Automotive Maintenance and Light Repair, 1ST Edition

Chapter 30 CRANKING SYSTEM

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers **Automotive Maintenance and Light Repair.** It correlates material to task lists specified by ASE and NATEF.
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 the chapter learning objectives to the students. ⌒ Discuss how to perform a voltage drop test on the cranking circuit. ⌒ Perform control circuit testing and starter amperage test, and determine necessary action. ⌒ Explain starter motor service and bench testing ⌒ This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "C" (Starting 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.

ICONS	Ch30 CRANKING SYSTEM
	1. SLIDE 1 CH30 CRANKING SYSTEM **2. SLIDES 2-3 EXPLAIN OBJECTIVES**
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ **WEB SITE REGULARLY UPDATED**
	4. SLIDE 4 EXPLAIN Cranking Circuit **5. SLIDE 5 EXPLAIN Figure 30-1** typical solenoid-operated starter. **6. SLIDE 6 EXPLAIN Figure 30-2** Some column-mounted ignition switches act directly on the electrical ignition switch itself, whereas others use a link from the lock cylinder to the ignition switch. **7. SLIDE 7 EXPLAIN Figure 30-3** To prevent engine from cranking, an electrical switch is usually installed to open circuit between ignition switch & starter solenoid.
	Starter Circuit Neutral Safety Switch
QUESTION	**DISCUSSION: HAVE THE STUDENTS DISCUSS DIFFERENCE BETWEEN ENGINE CRANKING AND ENGINE STARTING.** **WHAT IS REQUIRED FOR AN ENGINE TO START?**
	HANDS-ON TASK: HAVE HALF THE STUDENTS LOCATE AND LABEL SYSTEM COMPONENTS WITH NUMBERS. HAVE OTHER HALF IDENTIFY THE COMPONENTS BY NUMBER.
	8. SLIDE 8 EXPLAIN Figure 30-4 Instead of using an ignition key to start the engine, some vehicles are using a start button which is also used to stop the engine, as shown on this Jaguar
	Starter Circuit
DEMO	**DEMONSTRATION: USE TWO BAR MAGNETS TO SHOW THE STUDENTS HOW LIKE MAGNETIC CHARGES REPEL WHILE OPPOSITE CHARGES ATTRACT.**

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QUESTION	**DISCUSSION:** HAVE STUDENTS DISCUSS THE PRINCIPLES OF MAGNETISM. WHAT CAUSES A STRONGER MAGNETIC FIELD?
QUESTION	**DISCUSSION**: DISCUSS PRINCIPLE OF CEMF (COUNTERELECTROMOTIVE FORCE). HOW IS TORQUE OF A SHUNT MOTOR AFFECTED BY CEMF?
QUESTION	**DISCUSSION**: HAVE STUDENTS DISCUSS CHARACTERISTICS OF A SERIES MOTOR. WHAT IS RELATIONSHIP BETWEEN THE STRENGTH OF MAGNETIC FIELDS AND STARTER TORQUE?
	HANDS-ON TASK: HAVE THE STUDENTS DISASSEMBLE A STARTER MOTOR TO INSPECT ITS COMPONENTS
	Starter Drive Gear
QUESTION	**DISCUSSION**: DISCUSS GEAR-REDUCTION STARTERS. WHAT IS THE PURPOSE OF A GEAR REDUCTION STARTER? HAVE THE STUDENTS DISCUSS HOW GEAR REDUCTION STARTER CONSTRUCTION DIFFERS FROM THAT OF TRADITIONAL STARTER MOTORS.
DEMO	**DEMONSTRATION:** SHOW STUDENTS HOW TO BENCH TEST A STARTER MOTOR TO CHECK FOR PROPER OPERATION.
We Support NATEF	**NATEF TASK SHEET:** RESEARCH APPLICABLE VEHICLE AND SERVICE INFORMATION, SUCH AS ELECTRICAL OR ELECTRONIC SYSTEM OPERATION, VEHICLE SERVICE HISTORY, SERVICE PRECAUTIONS, & TECHNICAL SERVICE BULLETINS
	HOMEWORK: SEARCH INTERNET: ASK STUDENTS TO RESEARCH HISTORY OF STARTER MOTOR ON THE INTERNET. ASK THEM TO IDENTIFY THE FIRST CAR COMPANY TO OFFER ELECTRIC START, AND WHEN IT WAS OFFERED. ASK STUDENTS TO PRESENT THEIR FINDINGS TO THE CLASS.
	Starter Circuit Voltage Drop Tests **Starter Circuit Voltage Drop Tests 2**

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	9. **SLIDES 9-10 EXPLAIN**: STARTING SYSTEM TROUBLESHOOTING PROCEDURE 11. **SLIDE 11 EXPLAIN FIGURE 30–5** A theft deterrent indicator lamp of the dash. A flashing lamp usually indicates a fault in system, and the engine may not start
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?**
DEMO	**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 STUDENTS PRINT OUT A SCHEMATIC OF STARTER CIRCUIT FOR VEHICLE THEY WILL BE WORKING ON AND POINT OUT TEST POINTS. DISCUSS WITH THEM THAT STARTER CIRCUITS & COMPONENTS CAN VARY GREATLY FROM VEHICLE TO VEHICLE, & FROM OEM TO OEM.
	12. **SLIDE 12 EXPLAIN**: VOLTAGE DROP TESTING 13. **SLIDE 13 EXPLAIN Figure 30-6** Voltmeter hookups for voltage drop testing of a solenoid-type cranking circuit. 14. **SLIDE 14 EXPLAIN Figure 30-7** Voltmeter hookups for voltage drop testing of a Ford cranking circuit. 15. **SLIDE 15 EXPLAIN Figure 30-8** 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).
DEMO	**DEMONSTRATION: SHOW HOW TO PERFORM A VOLTAGE DROP TEST ON STARTER MOTOR CIRCUIT OF LIVE VEHICLE. EMPHASIZE DISABLING THE VEHICLE. ALSO, EMPHASIZE HOW NOT TO ACCIDENTALLY TURN WRENCHES, JEWELRY, & OTHER METAL OBJECTS INTO ARC WELDERS.**

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DEMO	**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 SIGNAL SIDE OF CIRCUIT CAN DO TO OVERALL CIRCUIT FUNCTION.**
	16. **SLIDE 16 EXPLAIN:** CONTROL CIRCUIT TESTING
	17. **SLIDE 17 EXPLAIN**: STARTER AMPERAGE TEST 18. **SLIDE 18 EXPLAIN Figure 30-9** A starter amperage tester uses an amp probe around positive or negative battery cables
QUESTION	**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?**
DEMO	**DEMONSTRATION: SHOW SCAN TOOL DIAGNOSIS PROCESS FROM THE ABOVE DISCUSSION.**
QUESTION	**DISCUSSION: DISCUSS THE 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 INDUCTIVE PICKUP. WHEN SHOULD EACH TYPE OF MEASUREMENT BE USED?**
	SHOW VIDEO: CHECKING STARTER CURRENT DRAW VIDEO HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=CHECKING%20STARTER%20CURRENT%20DRAW&CLIP=PANDC/CHET/2012/AUTOMOTIVE/STARTING_CHARGING_ELECT/A6T4.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/STARTING_CHARGING_ELECT/XML/A6T4.XML

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	19. **SLIDE 19 EXPLAIN**: STARTER REMOVAL 20. **SLIDE 20 EXPLAIN Figure 30-10** starter is located under intake manifold on this Cadillac Northstar engine
DEMO	**DEMONSTRATION: SHOW HOW TO BENCH-TEST A STARTER. EMPHASIZE THAT THE REMOTE STARTER CABLES SHOULD NOT SMOKE DURING THIS TEST.**
	21. **SLIDE 21 EXPLAIN**: STARTER INSTALLATION
	22. **SLIDE 22 EXPLAIN**: STARTER DRIVE-TO-FLYWHEEL CLEARANCE 23. **SLIDE 23 EXPLAIN Figure 30-11** A shim (or half shim) may be needed to provide the proper clearance between the flywheel teeth of the engine & pinion teeth
	SHOW VIDEO: MEASURING STARTER CIRCUIT VOLTAGE DROP HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=MEASURING%20STARTER%20CIRCUIT%20VOLTAGE%20DROP&CLIP=PANDC/CHET/2012/AUTOMOTIVE/STARTING_CHARGING_ELECT/A6T5.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/STARTING_CHARGING_ELECT/XML/A6T5.XML
DEMO	**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.**
We Support NATEF	**NATEF MLR TASK A6C1. PERFORM STARTER CURRENT DRAW TEST; DETERMINE NECESSARY ACTION.**
We Support NATEF	**NATEF MLR TASK A6C2. PERFORM STARTER CIRCUIT VOLTAGE DROP TESTS; DETERMINE NECESSARY ACTION.**
We Support NATEF	**NATEF MLR TASK A6C3 INSPECT AND TEST STARTER RELAYS AND SOLENOIDS; DETERMINE NECESSARY ACTION.**
We Support NATEF	**NATEF MLR TASK A6C4 REMOVE AND INSTALL STARTER IN A VEHICLE.**

ICONS	Ch30 CRANKING SYSTEM
	NATEF MLR TASK A6C5 INSPECT AND TEST SWITCHES, CONNECTORS, AND WIRES OF STARTER CONTROL CIRCUITS; DETERMINE NECESSARY ACTION.