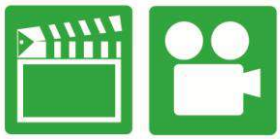
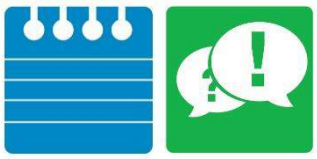
Automotive Electrical & Engine Performance 7/E

Chapter 17 Cranking System

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	**This course or class covers Automotive Electrical & Engine Performance. 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. 1. Describe the parts and operation of a cranking circuit. 2. Discuss how a starter motor converts electrical power into mechanical power. 3. List the different types of starters. 4. Describe the purpose and function of starter drives. 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.

NOTE: This lesson plan is based on Automotive Electrical & Engine Performance 7/E Chapter Images found on Jim's web site @ www.jameshalderman.com
LINK CHP 17: Chapter Images

ICONS	Ch17 Cranking System
	**1. SLIDE 1 CH17 Cranking System**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**NO VIDEOS IN THIS CHAPTER GOTO WWW.YOUTUBE.COM**
	**At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them**
	**Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**
	2. **SLIDE 2 EXPLAIN Figure 17-1** typical solenoid-operated starter. 3. **SLIDE 35 EXPLAIN Figure 17-2** 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. 4. **SLIDE 4 EXPLAIN Figure 17-3** To prevent engine from cranking, an electrical switch is usually installed to open circuit between ignition switch & starter solenoid.
	**Starter Circuit Neutral Safety Switch**
	**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.**

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	5. **SLIDE 5 EXPLAIN Figure 17-4** 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. 6. **SLIDE 6 EXPLAIN Figure 17-5** top button on this key fob is the remote start button.
	**Starter Circuit**
	7. **SLIDE 7 EXPLAIN Figure 17-6** series-wound electric motor shows the basic operation with only two brushes: one hot brush and one ground brush. The current flows through both field coils, then through the hot brush and the loop winding of the armature, before reaching ground through the ground brush. 8. **SLIDE 8 EXPLAIN Figure 17-7** interaction of the magnetic fields of armature loops and field coils creates a stronger magnetic field on right side of conductor, causing the armature loop to move toward left.
	**DEMONSTRATION: USE TWO BAR MAGNETS TO SHOW THE STUDENTS HOW LIKE MAGNETIC CHARGES REPEL WHILE OPPOSITE CHARGES ATTRACT. FIGURE 17-7**
	**DISCUSSION: HAVE STUDENTS DISCUSS THE PRINCIPLES OF MAGNETISM. WHAT CAUSES A STRONGER MAGNETIC FIELD?**
	9. **SLIDE 9 EXPLAIN Figure 17-8** armature loops rotate due to the difference in the strength of the magnetic field. The loops move from a strong magnetic field strength toward a weaker magnetic field strength. 10. **SLIDE 10 EXPLAIN Figure 17-9** Magnetic lines of force in a four-pole motor. 11. **SLIDE 11 EXPLAIN Figure 17-10** pole shoe/field winding 12. **SLIDE 12 EXPLAIN Figure 17-11** wiring diagram illustrates construction of a series-wound electric motor. Notice that all current flows through field coils, then through armature (in series) before reaching ground 13. **SLIDE 13 EXPLAIN Figure 17-12** This wiring diagram illustrates construction of shunt-type electric motor, & shows field coils in parallel (or shunt) across armature.

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	**DISCUSSION: DISCUSS PRINCIPLE OF CEMF (COUNTERELECTROMOTIVE FORCE). HOW IS TORQUE OF A SHUNT MOTOR AFFECTED BY CEMF?**
	**DISCUSSION: HAVE STUDENTS DISCUSS CHARACTERISTICS OF A SERIES MOTOR. WHAT IS RELATIONSHIP BETWEEN THE STRENGTH OF MAGNETIC FIELDS AND STARTER TORQUE?**
	14. **SLIDE 14 EXPLAIN Figure 17-13** A compound motor is a combination of series and shunt types, using part of the field coils connected electrically in series with the armature and some in parallel (shunt). 15. **SLIDE 15 EXPLAIN**: HOW STARTER MOTOR WORKS & **EXPLAIN Figure 17-14** A typical starter motor showing the drive-end housing. 16. **SLIDE 16 EXPLAIN Figure 17-15** Pole shoes and field windings installed in the housing. 17. **SLIDE 17 EXPLAIN Figure 17-16** A typical starter motor armature. The armature core is made from thin sheet metal sections assembled on the armature shaft, which is used to increase the magnetic field strength.
	18. **SLIDE 18 EXPLAIN Figure 17-17** armature showing how its copper wire loops are connected to the commutator. 19. **SLIDE 19 EXPLAIN Figure 17-18** typical starter motor showing commutator, brushes, & brush spring
	**EXPLAIN TECH TIP** 20. **SLIDE 20 EXPLAIN FIGURE 17–19** This starter permanent magnet field housing was ruined when someone used a hammer on the field housing in an attempt to "fix" a starter that would not work. A total replacement is the only solution in this case
	**HANDS-ON TASK: HAVE THE STUDENTS DISASSEMBLE A STARTER MOTOR TO INSPECT ITS COMPONENTS**
	**Starter Drive Gear**
	21. **SLIDE 21 EXPLAIN**: **GEAR-REDUCTION STARTERS & EXPLAIN FIGURE 17-20** typical gear-reduction starter.

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      	22. **SLIDE 22 EXPLAIN Figure 17-21** cutaway of a typical starter drive showing all of the internal parts. **Starter Drive Gear** **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.** 23. **SLIDE 23 EXPLAIN Figure 17-22** ring gear to pinion gear ratio is usually 15:1 to 20:1 24. **SLIDE 24 EXPLAIN Figure 17-23** Operation of the overrunning clutch. (a) Starter motor is driving the starter pinion and cranking the engine. The rollers are wedged against spring force into their slots. (b) The engine has started and is rotating faster than the starter armature. Spring force pushes the rollers so they can rotate freely **DISCUSS FREQUENTLY ASKED QUESTION** **DEMONSTRATION: SHOW STUDENTS HOW TO BENCH TEST A STARTER MOTOR TO CHECK FOR PROPER OPERATION.** 33. **SLIDE 33: EXPLAIN** POSITIVE ENGAGEMENT STARTERS & **EXPLAIN Figure 17-24** Ford movable pole shoe starter 34. **SLIDE 34 EXPLAIN FIGURE 17–25** Wiring diagram of a typical starter solenoid. Notice that both the pull-in winding and the hold-in winding are energized when the ignition switch is first turned to the “start” position. As soon as the solenoid contact disk makes electrical contact with both the B and M terminals, the battery current is conducted to the starter motor and electrically neutralizes the pull-in winding. **DISCUSS FREQUENTLY ASKED QUESTION**

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  	27. **SLIDE 27 EXPLAIN Figure 17-26** Palm-size starter armature **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.**