Automotive Technology 6th Edition
Chapter 9 HAND TOOLS
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 the chapter learning objectives to the students as listed at the beginning of the chapter: 1. Compare the different types of wrenches. 2. Discuss the purpose of ratchets, sockets, and extensions, and screwdrivers. 3. Discuss the purpose of hammers, mallets, and pliers. 4. Explain the characteristics of cutters, punches, chisels, removers, and hacksaws. 5. Identify the different types of electrical hand tools. 6. Discuss the safety tips for using hand tools and hand tool maintenance.
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 the 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

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http://www.jameshalderman.com/automotive_principles.html NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Chapter 9 Hand Tools
	**1. SLIDE 1 CH9 HAND TOOLS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	http://www.youtube.com/watch?v=oHXjWvmWiyc http://www.youtube.com/watch?v=kvOyPwKhKRc
	**http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF**
	**2. SLIDE 2 EXPLAIN Figure 9-1** forged wrench after it has been forged but before the flashing, extra material around the wrench, has been removed. **3. SLIDE 3 EXPLAIN Figure 9-2** A typical open-end wrench. The size is different on each end and notice that the head is angled 15 degrees at each end. **4. SLIDE 4 EXPLAIN Figure 9-3** typical box-end wrench is able to grip the bolt or nut at points completely around the fastener. Each end is a different size. **5. SLIDE 5 EXPLAIN Figure 9-4** end of a box-end wrench is angled 15 degrees to allow clearance for nearby objects or other fasteners. **6. SLIDE 6 EXPLAIN Figure 9-5** combination wrench has an open end at one end and a box end at the other with the same size at each end.
	**DEMONSTRATION: open-end wrench is one of most basic tools. Show when and where open end wrenches are used in automotive service and repair**

ICONS	Chapter 9 Hand Tools
	**Open End & Gear Wrench Use Animation** **Open End Wrench (View) (Download)** **Gear Wrench (View) (Download)**
	**DEMONSTRATION: Show examples of box-end, adjustable, & line wrenches, and discuss where each is used in automotive applications. Remind students of safety procedures they should follow when using wrenches.**
	7. **SLIDE 7 EXPLAIN Figure 9-6** adjustable wrench. Adjustable wrenches are sized by the overall length of the wrench and not by how far the jaws open. Common sizes of adjustable wrenches include 8, 10, and 12 in. 8. **SLIDE 8 EXPLAIN Figure 9-7** end of a typical line wrench, which shows that it is capable of grasping most of the head of the fitting.
	9. **SLIDE 9 EXPLAIN Figure 9-8** typical ratchet used to rotate a socket. A ratchet makes a ratcheting noise when it is being rotated in the opposite direction from loosening or tightening. A knob or lever on the ratchet allows the user to switch directions. 10. **SLIDE 10 EXPLAIN Figure 9-9** typical flex handle used to rotate a socket, also called a breaker bar because it usually has a longer handle than a ratchet and, therefore, can be used to apply more torque to a fastener than a ratchet. 11. **SLIDE 11 EXPLAIN Figure 9-10** most commonly used socket drive sizes include 1/4, 3/8, and 1/2 in. drive.
	**DEMONSTRATION: Show students how to use a ratchet and socket set, and identify automotive applications where socket wrenches are best used. Explain relevance of drive size to application**
	**Show ANIMATION: Rounded bolts:** **www.jameshalderman.com** **6 and 12 Point**

ICONS	Chapter 9 Hand Tools
	**Student HANDS-ON Task:** have students practice using sockets and wrenches
	12. **SLIDE 12 EXPLAIN Figure 9-11 a** 6-point socket fits the head of the bolt or nut on all sides. A 12-point socket can round off the head of a bolt or nut if a lot of force is applied. 13. **SLIDE 13 EXPLAIN Figure 9-12** crowfoot socket is designed to reach fasteners using a ratchet or breaker bar with an extension. 14. **SLIDE 14 EXPLAIN Figure 9-13** Using a torque wench to tighten connecting rod nuts on an engine. 15. **SLIDE 15 EXPLAIN Figure 9-14** beam-type torque wrench that displays torque reading on face of dial. The beam display is read as beam deflects, which is in proportion to amount of torque applied to fastener.
	**EXPLAIN TECH TIP: Right to Tighten** **It is sometimes confusing which way to rotate a wrench or screwdriver, especially when the head of the fastener is pointing away from you. To help visualize while looking at fastener, say "righty tighty, lefty loosey."**
	**DEMONSTRATION: Show students clicker type and beam-type torque wrenches & demonstrate how to use them properly. Stress importance of resetting torque wrenches to lowest setting (lowest setting is not always "0")**
	**Show ANIMATION: Torque Wrench** **www.jameshalderman.com** **Torque to Angle (View) (Download)** **Torquing Cylinder Head Bolts - Step 1 (View) (Download)** **Torquing Cylinder Head Bolts - Step 2 (View) (Download)** **Torquing Cylinder Head Bolts - Step 3 (View) (Download)**

ICONS	Chapter 9 Hand Tools
	**HANDS-ON Task:** have students practice torquing a cylinder head.
	**EXPLAIN TECH TIP: Check Torque Wrench Calibration Regularly** Torque wrenches should be checked regularly. For example, Honda has a torque wrench calibration setup at each of their training centers. It is expected that a torque wrench be checked for accuracy before every use. Most experts recommend that torque wrenches be checked and adjusted as needed at least every year, and more often, if possible. • SEE FIGURE 9–15.
	**16. SLIDE 16 EXPLAIN Figure 9-15** Torque wrench calibration checker.
	**Advise students to check calibration of a torque wrench to ensure that fasteners are tightened to specifications and not beyond. Torque wrenches will stay in calibration longer if they are not used to loosen bolts.**
	**DEMONSTRATION: IF AVAILBLE: Show students HOW a torque wrench is calibrated**
	**DISCUSS FREQUENTLY ASKED QUESTION:** **Is It lb-ft or ft-lb of Torque?** The unit for torque is expressed as a force times the distance (leverage) from the object. Therefore, the official unit for torque is lb-ft (pound-feet) or newton-meters (a force times a distance). However, it is commonly expressed in ft-lb and even some torque wrenches are labeled with this unit.

ICONS	Chapter 9 Hand Tools
	**EXPLAIN TECH TIP: Double-Check the Specifications** **Misreading torque specifications is easy to do but can have serious damaging results. Specifications for fasteners are commonly expressed in pound-feet. Many smaller fasteners are tightened to specifications expressed in pound-inch** **1 lb-ft = 12 lb-in.** **So, if a fastener were to be accidentally tightened to 24 pound-feet instead of 24 pound-inch, the actual torque applied to the fastener will be 288 lb-inch instead of the specified 24 pound-inch. This extra torque will likely break the fastener, but it could also warp or distort the part being tightened. Always double-check the torque specifications.**
	17. **SLIDE 17 EXPLAIN Figure 9-16** Deep sockets allow access to the nut that has a stud plus other locations needing great depth, such as spark plugs.
	**EXPLAIN TECH TIP: Use Socket Adapters with Caution** **Socket adapters are available and can be used for different drive size sockets on a ratchet. Combinations include:** **• 1/4 inch drive—3/8 inch sockets** **• 3/8 inch drive—1/4 inch sockets** **• 3/8 inch drive—1/2 inch sockets** **• 1/2 inch drive—3/8 inch sockets** **Using a larger drive ratchet or breaker bar on a smaller size socket can cause the application of too much force to the socket, which could crack or shatter. Using a smaller size drive tool on a larger socket will usually not cause any harm, but would greatly reduce the amount of torque that can be applied to the bolt or nut.**

ICONS	Chapter 9 Hand Tools
	**EXPLAIN TECH TIP: Avoid Using "Cheater Bars" Whenever a fastener is difficult to remove, some technicians will insert the handle of a ratchet or a breaker bar into a length of steel pipe. The extra length of the pipe allows the technician to exert more torque than can be applied using the drive handle alone. However, the extra torque can easily overload the socket and ratchet, causing them to break or shatter, which could cause personal injury.**
	18. **SLIDE 18 EXPLAIN Figure 9-17** flat-tip (straight blade) screwdriver. Width of blade should match width of the slot in the fastener being loosened or tightened. 19. **SLIDE 19 EXPLAIN Figure 9-18** Two stubby screwdrivers that are used to access screws that have limited space above. A straight blade is on top and a #2 Phillips screwdriver is on the bottom.
	**Show ANIMATION: Screw Driver Selection** **www.jameshalderman.com** **Screwdriver Selection (View) (Download)**
	**DEMONSTRATION: Show students a variety of flat-tip and Phillips screwdrivers. Ask them which type is used more on automobiles and why. Show students how to use offset & impact Screwdrivers. For what type of application is each used?**
	20. **SLIDE 20 EXPLAIN Figure 9-19** offset screwdriver is used to install or remove fasteners that do not have enough space above to use a conventional screwdriver. 21. **SLIDE 21 EXPLAIN Figure 9-20** impact screwdriver used to remove slotted or Phillips head fasteners that cannot be broken loose using a standard screwdriver.
	**DEMONSTRATION: Show examples of hammers and mallets. Discuss the features of each hammer or mallet and describe where it is used.**

ICONS	Chapter 9 Hand Tools
	22. **SLIDE 22 EXPLAIN Figure 9-21** typical ball-peen hammer. 23. **SLIDE 23 EXPLAIN Figure 9-22** rubber mallet used to deliver a force to an object without harming the surface. 24. **SLIDE 24 EXPLAIN Figure 9-23** dead-blow hammer that was left outside in freezing weather. Plastic covering was damaged, which destroyed this hammer. The lead shot is encased in the metal housing and then covered.
	25. **SLIDE 25 EXPLAIN Figure 9-24** Typical slip-joint pliers, which are also common household pliers. Slip joint allows jaws to be opened to two different settings.
	**Show Animation: Diagonal Pliers** **www.jameshalderman.com** **Slip Joint Pliers (View) (Download)**
	26. **SLIDE 26 EXPLAIN Figure 9-25** Multigroove adjustable pliers are known by many names, including the trade name Channel Locks. 27. **SLIDE 27 EXPLAIN Figure 9-26** linesman's pliers are very useful because they can help perform many automotive service jobs.
	**ANIMATION: Channel Lock & Lineman's** **www.jameshalderman.com** **Channel Lock Pliers (View) (Download)** **Linemans Pliers (View) (Download)**
	**DEMONSTRATION: Show examples of slip-joint & multigroove adjustable pliers and discuss how each is used.**
	28. **SLIDE EXPLAIN Figure 9-27** Diagonal-cut pliers are another common tool that has many names.

ICONS	Chapter 9 Hand Tools
	**Show Animation: Diagonal Pliers** **www.jameshalderman.com** **Dikes (View) (Download)**
	**29. SLIDE 29 EXPLAIN Figure 9-28** Needle-nose pliers are used where there is limited access to a wire or pin that needs to be installed or removed.
	**EXPLAIN TECH TIP: Brand Name Versus Proper Term: Technicians often use slang or brand names of tools rather than the proper term. This results in some confusion for new technicians. Some examples are given in the following table.** **Brand Name Proper Term Slang Name** **Crescent wrench Adjustable wrench Monkey wrench** **Vise Grip Locking pliers-Channel Locks-Water pump pliers or multigroove adjustable pliers Pump pliers** **Diagonal cutting pliers Dikes or side cuts**
	30. SLIDE 30 EXPLAIN Figure 9-29 Locking pliers are best known by their trade name Vise-Grip®
	**EXPLAIN TECH TIP: Use Chalk** **Often soft metal particles can become stuck in a file, especially when using it to file aluminum or other soft metals. Rub some chalk into the file before using it to prevent this from happening.**
	**Show Animation: Diagonal Pliers** **www.jameshalderman.com** **Vise Grips (View) (Download)**
	**HANDS-ON TASK: Have students use a pair of snap-ring pliers to remove and replace internal and external snap rings.**

ICONS	Chapter 9 Hand Tools
	**31. SLIDE 31 EXPLAIN Figure 9-30** Snap-ring pliers are also called lock-ring pliers and are designed to remove internal and external snap rings (lock rings).
	**Show Animation: Diagonal Pliers** **www.jameshalderman.com** **Snap Ring Pliers (View) (Download)**
	**32. SLIDE 32 EXPLAIN Figure 9-31** Files come in many different shapes and sizes. Never use a file without a handle.
	**33. SLIDE 33 EXPLAIN Figure 9-32** Tin snips are used to cut thin sheets of metal or carpet. **34. SLIDE 34 EXPLAIN Figure 9-33** utility knife uses replaceable blades and is used to cut carpet and other materials.
	**DEMONSTRATION: Show examples of a variety of cutters, including tin snips and utility knives, and describe where each might be used in automotive**
	**35. SLIDE 35 EXPLAIN Figure 9-34** punch used to drive pins from assembled components. This type of punch is also called a pin punch. **36. SLIDE 36 EXPLAIN Figure 9-35** Warning stamped in the side of a punch warning that goggles should be worn when using this tool. Always follow safety warnings
	**SAFETY NOTE: Stress importance of wear safety glasses with side shields when using punches, chisels, or especially any type of rotary grinding device**
	

ICONS	Chapter 9 Hand Tools
	37. **SLIDE 37 EXPLAIN Figure 9-36** Use grinder or a file to remove mushroom material on end of punch or chisel.
	**DEMONSTRATION: Show examples of punches and chisels and describe intended purpose of each. Where are these tools be used in an automotive setting?**
	38. **SLIDE 38 EXPLAIN Figure 9-37** stud remover uses an offset serrated wheel to grasp stud so it will be rotated when a ratchet or breaker bar is used to rotate assembly. 39. **SLIDE 39 EXPLAIN Figure 9-38** nut splitter is used to split a nut that cannot be removed. After the nut has been split, a chisel is then used to remove the nut. 40. **SLIDE 106 EXPLAIN Figure 9-39** set of bolt extractors, commonly called easy outs.
	**DEMONSTRATION: Show students how to use an easy-out extractor to remove a broken bolt.**
	**EXPLAIN TECH TIP: The Wax Trick** **Many times, rusted fasteners can be removed by using heat to expand metal and break rust bond between fastener and nut or casting. Many technicians heat fastener using a torch and then apply paraffin wax or a candle to heated fastener. • SEE FIGURE 9–40. Wax will melt and as part cools, will draw the liquid wax down between threads. After allowing part to cool, attempt to remove the fastener. It will often be removed without any trouble.**
	41. **SLIDE 41 EXPLAIN Figure 9-40** Removing plugs or bolts is easier if the plug is first heated to cherry red color, using a torch, and then applying wax.

ICONS	Chapter 9 Hand Tools
	**DEMONSTRATION:** Show wax trick to help remove a rusted fastener. Make sure students understand paraffin wax is flammable: Figure 9-40
	**HANDS-ON TASK:** Have students perform wax trick to help remove a rusted fastener. Make sure students understand paraffin wax is flammable: Figure 9-40
	42. **SLIDE 42 EXPLAIN Figure 9-41** typical hacksaw that is used to cut metal. If cutting sheet metal or thin objects, a blade with more teeth should be used.
	**DISCUSS FREQUENTLY ASKED QUESTION:** **I Broke Off an Easy Out—Now What?** **An extractor (easy out) is hardened steel and removing this and the broken bolt is now a job for a professional machine shop. The part, which could be as large as an engine block, needs to be removed from the vehicle and taken to a machine shop that is equipped to handle this type of job. One method involves using an electrical discharge machine (EDM). An EDM uses a high-amperage electrical current to produce thousands of arcs between the electrode and the broken tool. The part is submerged in a non-conducting liquid and each tiny spark vaporizes a small piece of the broken tool.**

ICONS	Chapter 9 Hand Tools
	**EXPLAIN TECH TIP:** **Hide Those from the Boss** **An apprentice technician started working for a dealership and put his top tool box on a workbench.** **Another technician observed that, along with a complete set of good-quality tools, the box contained several adjustable wrenches. The more experienced technician said, "Hide those from the boss." If any adjustable wrench is used on a bolt or nut, the movable jaw often moves or loosens and starts to round the head of the fastener. If the head of the bolt or nut becomes rounded, it becomes that much more difficult to remove.**
	**EXPLAIN TECH TIP:** **Need to Borrow a Tool More Than Twice? Buy It!** **Most service technicians agree that it is okay for a beginning technician to borrow a tool occasionally. However, if a tool has to be borrowed more than twice, then be sure to purchase it as soon as possible. Also, whenever a tool is borrowed, be sure that you clean the tool and let the technician you borrowed the tool from know that you are returning the tool. These actions will help in any future dealings with other technicians.**
	43. **SLIDE 43 EXPLAIN Figure 9-42** A typical beginning technician tool set that includes the basic tools to get started. 44. **SLIDE 44 EXPLAIN Figure 9-43** A typical large tool box, showing just one of many drawers.
	**EXPLAIN TECH TIP:** **Valve Grinding Compound Trick:** **Apply a small amount of valve grinding compound to a Phillips or Torx screw or bolt head. The gritty valve grinding compound "grips" the screwdriver or tool bit and prevents the tool from slipping up and out of the screw head. Valve grinding compound is available in a tube from most automotive parts stores.**

ICONS	Chapter 9 Hand Tools
	45. **SLIDE 45 EXPLAIN Figure 9-44** seal puller being used to remove a seal from a rear axle. 46. **SLIDE 46 EXPLAIN Figure 9-45** seal driver or installer is usually plastic and is designed to seat the seal.
	**Show Animation: Diagonal Pliers** **www.jameshalderman.com** **Seal Driver (View) (Download)**
	**DEMONSTRATION: Show seal puller and a seal driver and where they are used on an automobile.**
	**HANDS-ON TASK: Have students use a pair of snap-ring pliers to remove and replace internal and external snap rings.**
	47. **SLIDE 47 EXPLAIN Figure 9-46** typical 12 volt test light. 48. **SLIDE 48 EXPLAIN Figure 9-47** An electric soldering gun used to make electrical repairs. Soldering guns are sold by the wattage rating. The higher the wattage, the greater amount of heat created. Most solder guns used for automotive electrical work usually fall within the 60 to 160 watt range.

ICONS	Chapter 9 Hand Tools
	**EXPLAIN TECH TIP:** It Just Takes a Second Whenever removing any automotive component, it is wise to screw the bolts back into the holes a couple of threads by hand. This ensures that the right bolt will be used in its original location when the component or part is put back on the vehicle. Often, the same diameter of fastener is used on a component, but the length of bolt may vary. Spending just a couple of seconds to put the bolts and nuts back where they belong when the part is removed can save a lot of time when the part is being reinstalled. Besides making certain that the right fastener is being installed in the right place, this method helps prevent bolts and nuts from getting lost or kicked away. How much time have you wasted looking for that lost bolt or nut?
	**There is a correct tool for every job. Tools are an expensive, life-long investment. If you are going to make a living with them, buy high-quality tools.**
	**EXPLAIN TECH TIP:** Use a Binder Clip A binder clip (size 1 1/4 inch wide) is used by wise technicians to help keep fender covers in place. • SEE FIGURE 9–48. Binder clips are found at office supply stores.?
	49. **SLIDE 49 EXPLAIN Figure 9-48** A binder clip being used to keep a fender cover from falling.
	**Stress importance of using fender covers to protect the vehicle's exterior finish from harm.**

ICONS	Chapter 9 Hand Tools
	**SAFETY** Warn students to be careful not to overtighten bolts and nuts by using a cheater bar. Explain that they might break the wrench or cause themselves harm.
	**HANDS-ON TASK** Hand Tool Identification Task sheet Page 12
	**DISCUSSION:** Talk with your students about the maintenance procedures for hand tools. What are the benefits of proper maintenance?