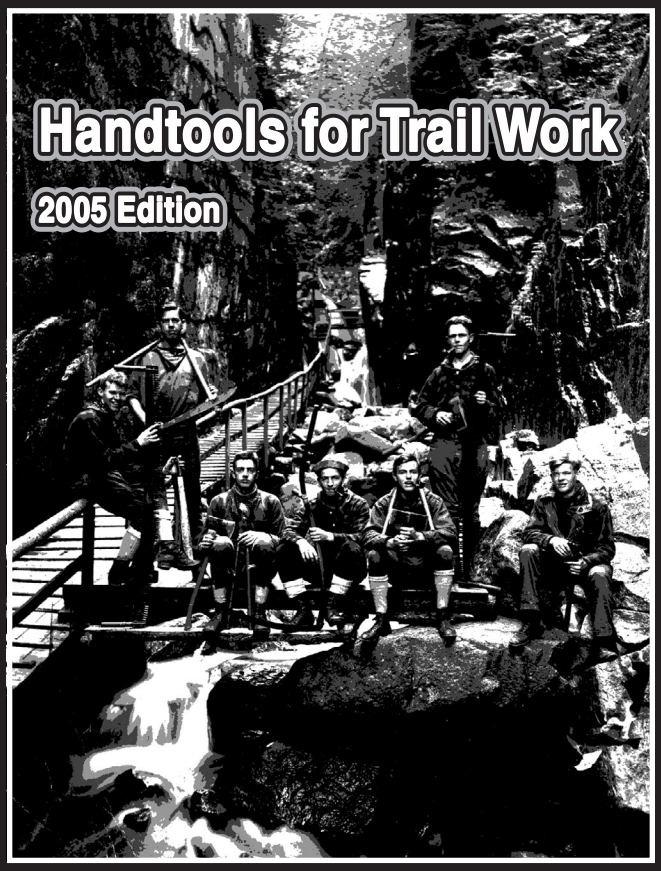

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Missoula, MT

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Abstract

The Missoula Technology and Development Center (MTDC), working with trail crews throughout the United States, has standardized a comprehensive document on the use and maintenance of handtools involved in trail work. Information collected from industry experts, from interviews with trail crew members, and from extensive literature and market research on the subject provides the text for this document. It stresses safe and efficient tool use. It describes each tool and presents nomenclature and maintenance procedures, including sharpening techniques and rehandling methods. The document is intended for both experienced and inexperienced trail crews.



cknowledgments

This document was prepared by William R. Hutcheson and Dale Mrkich, former forestry technicians at MTDC. The work was accomplished under the direction of Jerry Oltman, former MTDC forester and project leader.

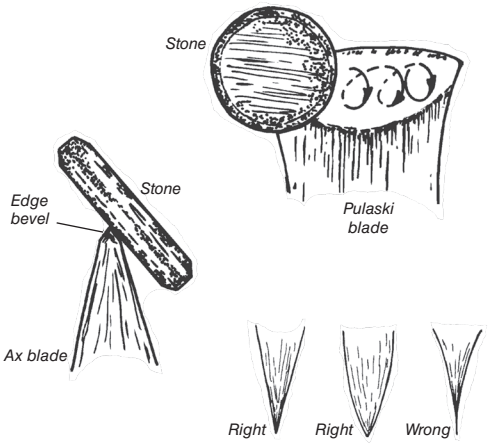
Special thanks to MTDC staff Bert Lindler, Sara Lustgraaf, Brian Vachowski, and Gary Hoshide for helping develop this revised edition.

Tools for Sharpening

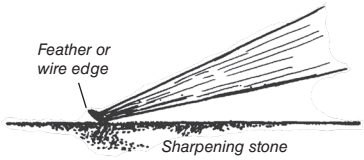


Dull tools are useless and dangerous.

very small bits of metal from the blade and causes the remaining metal to burr slightly on the cutting edge. This burr is called a feather, or wire edge. Remove this weak strip by honing the edge on the other side. The correctly honed edge is sharp, has no wire edge, and does not reflect light or show a sharpening line. Wear gloves when sharpening cutting edges.



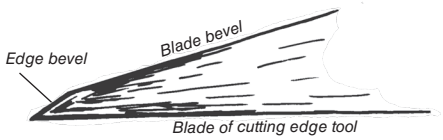
When sharpening an ax or Pulaski blade, for example, work the stone in small circles across and "into" the blade.



A wire edge is removed by honing the opposite edge.

About Sharpening

A tool need not be old and worn to need sharpening. Many tools arrive dull from the factory. They may leave in good condition but become damaged during shipping. Inspect all tools before use. Sharpening makes tools last longer—a small scratch that is ignored could lead to a serious crack or nick in the blade.

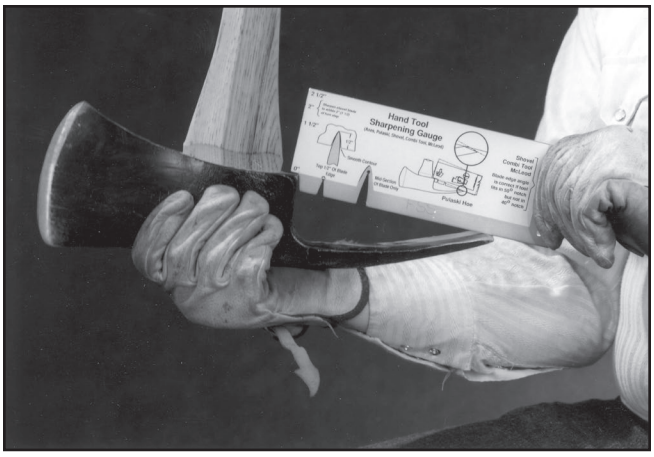


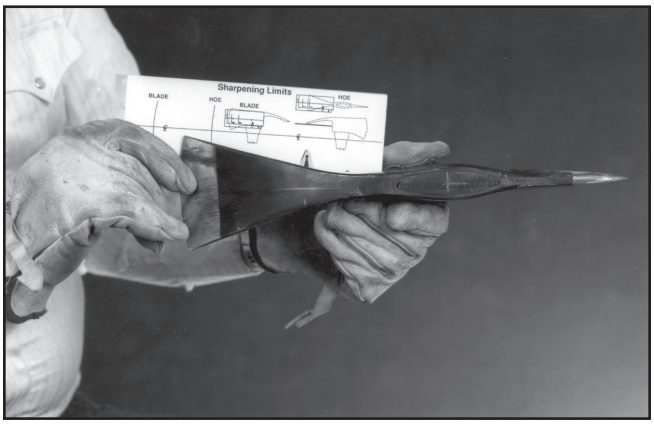
Use a material like a file or grindstone that is harder than tool steel to remove metal from the edge. If there are no visible nicks, a touch-up with a whetstone will restore a keen cutting edge. In these instances, you need only restore the edge bevel. Whetting the edge removes

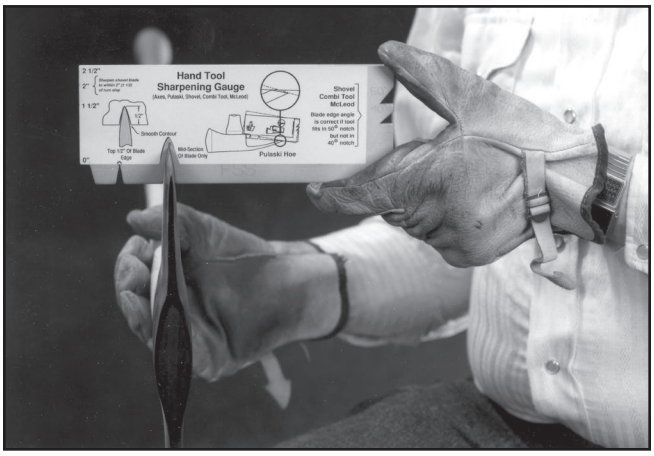
Restoring the blade bevel requires coarser grinding tools to affect the shape of worn cutting blades. Reshape blades with hand files, sandstone wheels, or electric grinders. Remove visible nicks by grinding the metal back on the blade. Remember, however, that the correct blade bevel must be maintained. Remove the metal necessary to make the blade smooth while retaining its proper shape. If the shape is too radically affected, either have a blacksmith recondition the tool head or discard the tool.

The Missoula Technology and Development Center has developed a handtool sharpening gauge that provides a quick guide to the proper cutting angle for a number of tools. The gauge takes the guesswork out of sharpening Pulaskis (both ends), axes, shovels, combination tools, and McLeods. It has a "no-go" line that shows when a Pulaski

head is too worn to refurbish. The handtool sharpening gauge is available from the General Services Administration, item number: NSN 5210-01-324-2776, NFES 0510.



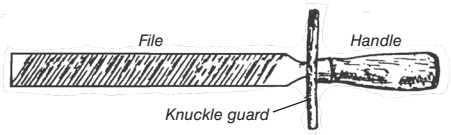




The handtool sharpening gauge is a handy aid for inspecting and sharpening a variety of fire handtools.

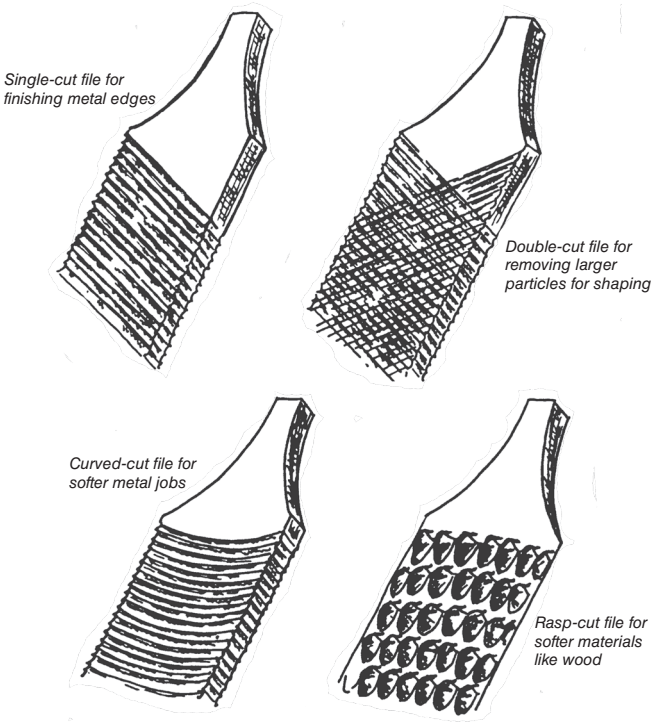
Files

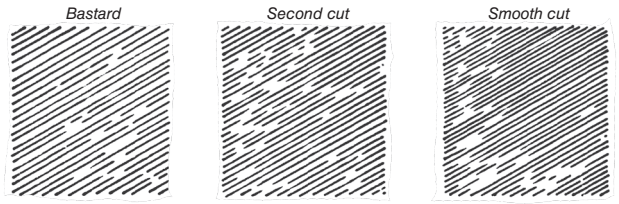
Files come in single, double, curved, or rasp cuts. Single-cut files have one series of parallel teeth angled 60° to 80° from the edge, and are used for finishing work. Double cuts have two series of parallel teeth set 45° to each other; they are used for restoring shape. Curved and rasp cuts are used for shaping soft metals and wood, respectively.



This file has a knuckle guard made from old linen hose.

Files vary in length and shape. Files are measured from the point to the heel, excluding the tang (the tip used to attach a handle). Length determines the coarseness of files. There are generally three degrees of file coarseness: *bastard, second cut,* and *smooth.* The bastard will be the coarsest file available, however, only when it is included among different cuts of files of the same length. Of the many shapes of files currently on the market, you will probably not often use mill and flat files. Mill files are single-cut, and flat files are double-cut. A 10-inch mill bastard file is good for all-around tool sharpening.





Comparative coarseness of files of uniform length.

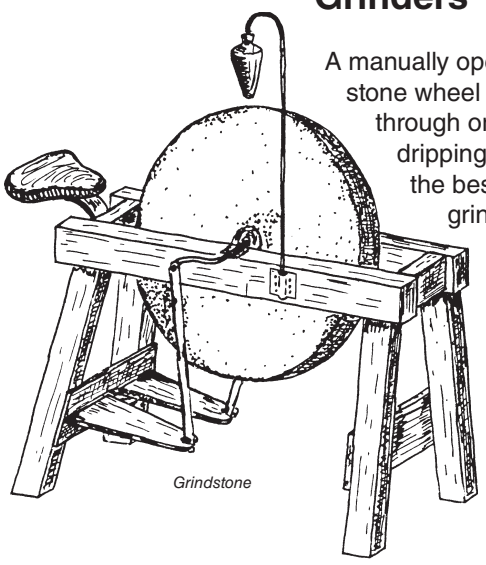
Before filing, fit the file with a handle and knuckle guard. Always wear gloves on both hands to prevent cuts from the sharpened edge. Secure the tool so both hands are free for filing. Use the largest file you can, depending on the size, nature, and workable stroke length of the job. Remember that files are designed to cut in one direction only. Apply even pressure on the push stroke, then lift the file up and off the tool while returning for another pass. Store or transport files so they are not thrown together and protect them from other tools.

Maintain files with a brush or file card. A file brush has coarse and fine bristles and a wire pick for extracting trapped filings. A card has a small brush and a wire scorer.



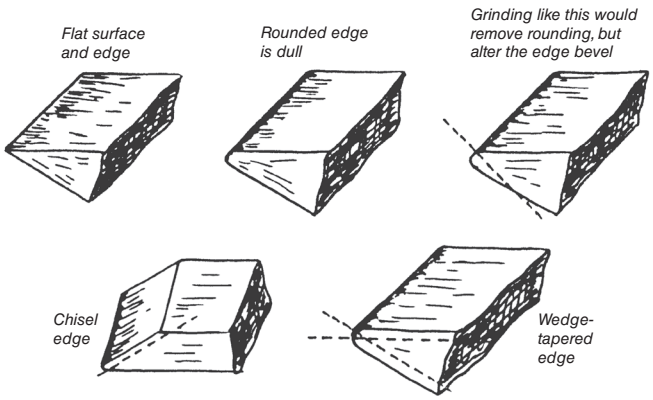
Always wear gloves and goggles while filing.

Grinders

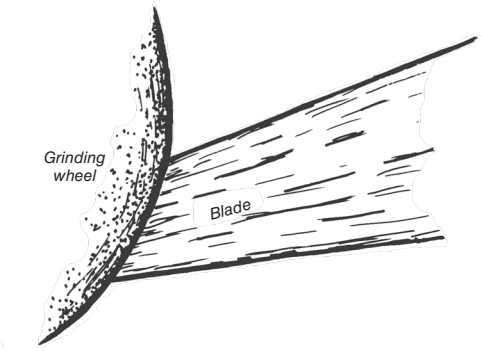


A manually operated sandstone wheel that runs through or receives dripping water is the best all-round grinding tool. The wheel turns slowly enough to allow monitoring of the amount of metal being removed and the water keeps the blade cool. For volume sharpening, a sandstone wheel may be provided with mechanical power, but only if it remains geared to the same maximum revolutions per minute that a hand operation would allow.

Electric bench grinders quickly reshape damaged tools, but extreme caution must accompany their use. Improper electric grinding can ruin both the bevel and temper of a tool. High speeds remove metal from the blade quickly, which can cause it to weaken and chip easily. High speeds also allow heat buildup in tool heads, which can destroy temper and make it impossible for the blade to hold an edge. Using electric grinders, grind slowly and keep the blade cool. Inspect blades frequently to prevent too much metal from being ground from the blade. Dip the tool in water or cool it in open air. Avoid grinding on flat sides of electric wheels because they will weaken and break.



Grinding parallel to bevels maintains the correct angle.



Sharpening a blade on a grinding wheel.

Finish the edge with a whetstone as if you were touching up. Blade and edge bevels may vary with individual preference and based on the task at hand. When sharpening an ax, for example, the blade bevel for use in softwoods might be thinner than one for hardwoods. Experience, observation, and experimentation will determine the appropriate bevels for each tool and cutting job.

Use adequate safety equipment when grinding tools. Always wear heavy leather gloves. Long-sleeved shirts and leather aprons will help prevent small burns from sparks or metal shavings. Proper eye protection is essential, including eye shields or safety goggles for operators and shields and hood guards on grinders. Hold portable grinders securely when using.

Whetstones

Use whetstones to finish sharpened cutting edges or when touching up edges in the field. Whetstones are natural or manmade. We recommend synthetic abrasives for sharpening tools because they are harder than natural stones, the uniform honing particles assure an even sharpening surface, and they cost less than natural stones. If you prefer finishing with a natural stone, use a synthetic stone first. This produces a very sharp edge and saves expensive natural stones from unnecessary wear on rough work.

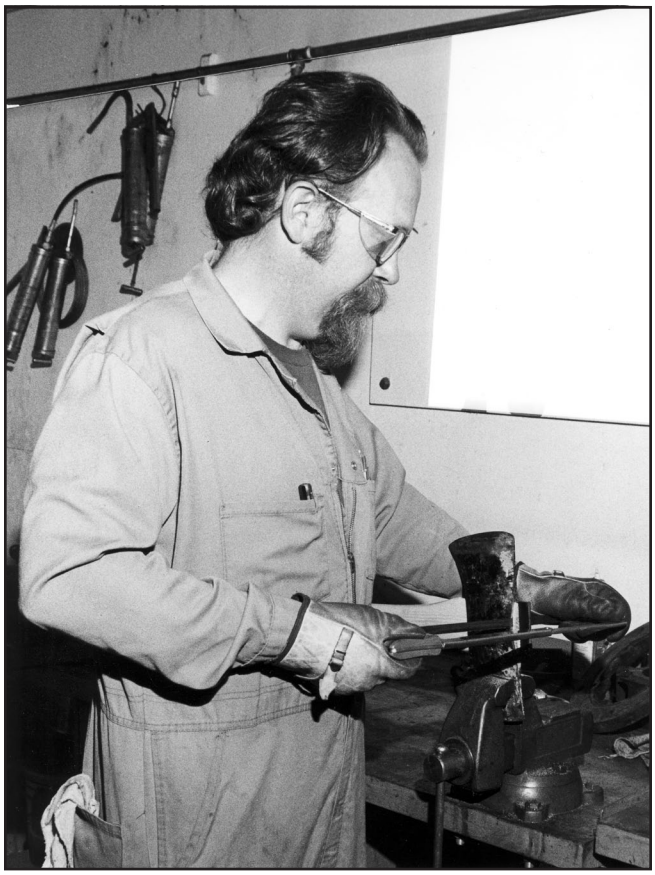
Most whetstone manufacturers soak new stones in light oil. You may also apply oil to the stone's surface before honing to float off pieces of metal and grit and prevent them from lodging in the stone's pores. If the stone glazes because the pores fill with shavings, clean it with citrus-based solvent and a stiff brush.

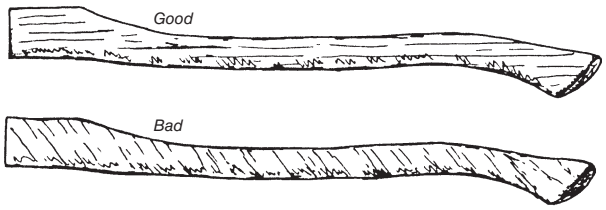
When whetting, use the entire stone surface to maintain its shape. Rotate the stone periodically to ensure even wear. If the surface becomes uneven, it may be reshaped by rubbing it over a sheet of glass sprinkled with carborundum powder or on a sheet of coarse sandpaper. Keep stone surfaces wet while reshaping them.

SHARPENING STONES

Stone	Natural	Synthetic	Size (inches)	Cost (dollars)	Use	Sharpening Speed
Black hard Arkansas	X		8x2x1	50 to 60	Edge polishing	Very slow
Hard white Arkansas	X		8x2x1	30 to 40	Edge finishing	Slow
Soft Arkansas	X		8x2x1	15 to 20	Sharpening	Medium
Washita	X		8x2xl	25 to 30	Shaping-roughing	Fast
Silicon carbide		X	8x2xl	8 to 10	Roughing to sharpening	Fast to medium
India		X	8x2xl	8 to 10	Roughing to sharpening	Fast to medium
Crystolon		X	8x2xl	8 to 10	Roughing to sharpening	Fast to medium
Diamond-nickel		X	6x2x$^{11}/_{16}$	25 to 30	Sharpening hard steels	Medium
Silicarbide-rubber		X	8x2xl	8 to 10	Deburring	Fast

Tools for Rehandling





The grain of ax handles should run parallel to the wedge slot.



Diagram of the wedge slot and end grain of ax handles.

About Rehandling

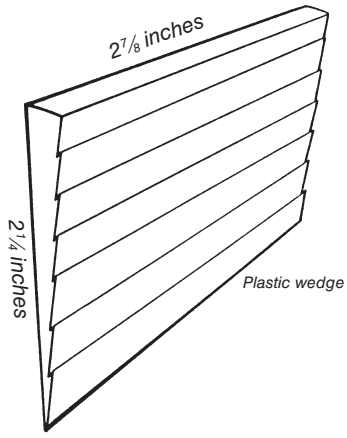
Wood handles are common to most trail tools and are the most common type of replacement handle. Hickory makes the best handles for impact tools because it combines hardness and stiffness with excellent resiliency. For bent handles or simple handholds, ash is usually used.

When choosing tool handles, remember that straight grains offer maximum flexibility and strength. If possible, the grain should also be tight and knot-free, and it should run parallel to the wedge slot. Avoid coated handles. Painting or staining can hide flaws in materials or construction.

Fastening Wedges

The best wedges for securing tool heads are hardwood or plastic. Traditionalists swear that wooden wedges are best, but many new tools are equipped with plastic wedges. Avoid metal wedges for fastening heads to handles; these crush and weaken handle wood and make broken handles difficult to remove by drilling.

Sometimes a handle may need only a new wedge because the handle was not broken but loosened. In this case, carefully drill out the old wedge; remove the handle; clean the slot; and replace the handle on the head.



Plastic wedges used for securing tool heads.
Wooden wedges are the choice of traditionalists.

Rehandling Procedures

Regularly inspect all tool handles and replace any cracked, rough, or badly weathered handles as soon as possible. When a tool needs a new handle, follow this step-by-step procedure. We have selected ax handles as the example for this discussion, but the technique is adaptable to other trail tools:

❏ Clear the eye of the tool. To remove worn or broken handles from the eye of a tool, place it upright in a vise and drill several holes into the wood from the top. These holes relieve pressure on the wood inside the eye so it can be driven out with a hammer and punch. If heads are epoxy-bonded to handles, soak the head in boiling water to soften the bond.

❏ Size up the tool and match an appropriate handle to the head. All handles will need some reshaping by hand to fit the head. Be sure that the top of the handle will fill the eye of the tool in both length and width.

❏ Saw the handle to an approximately correct length. If the handle was not factory sawed to accept a wedge, remove the head, secure the handle, and carefully saw down about two-thirds the depth of the head.

❏ Inscribe two perpendicular centering lines across the length and width of the handle end inside the eye. You will use them as a guide/check for centering the handle in the eye later. Make an additional mark below the head and just above where the handle broadens to denote the final seat for the head.

❏ Slowly remove excess material from the handle using a spoke shave, wood rasp, or grinder.

❏ Fit the eye of the tool to the handle. Light tapping on the tool head will allow repeated removal of the handle without damaging the wedge slot. Continue shaving and fitting until the head rests squarely $\frac{1}{4}$ to $\frac{3}{8}$ inch above the final seating mark. Make sure that the head is straight on the handle.

❏ With tool head aligned perpendicular with the handle, draw a line across both sides of the handle at the final seating mark. Saw a shallow cut along these lines to create a square shoulder. Fit the tool head to rest lightly on this shoulder.

❏ With rasp and sandpaper, uniformly backslope the handle from the perimeter of the handle to where the head finally seats. Carefully smoothing the handle just below the head prevents splintering.

❏ Use a long tapered wedge that extends the full width of the slot to attach the head to the handle. Drive the wedge into the slot, and tap alternately on the wedge and the end of the handle until the striking tool bounces off each with equal force. Use epoxy to fill remaining voids between the handle and the eye and seal out moisture.

❏ After the epoxy sets, trim excess wood flush with the top of the head. A hacksaw works best here because the blade will not be dulled by the metal, and because the saw blade can be turned 90° on the frame.

❏ Remove any varnish or paint from the handle. A light coating of raw linseed oil regularly applied will protect against drying and cracking. Some woods workers recommend drilling short holes in the base of the handle and periodically filling them with linseed oil. The oil penetrates the entire handle through natural pores in the wood.

A loose handle can be temporarily tightened in the field by soaking the head in water or linseed oil. The wood in the head swells to accommodate the fluid and fits tighter in the eye. Make permanent repairs as soon as possible.

Handles may also be shaved to fit individual grips more comfortably to reduce impact shock and hand and arm cramps. When shaving handles, proceed slowly and carefully; it is better to remove too little wood and have to trim again than to remove too much and have a weak or unusable handle.



A—Size up the tool head and match it to the handle. Note that the handle protrudes excessively long through the head. Scribe it to be cut off.



C—A line has been scribed below the roughly-fitted handle. The line denotes the final shoulder upon which the head sets.



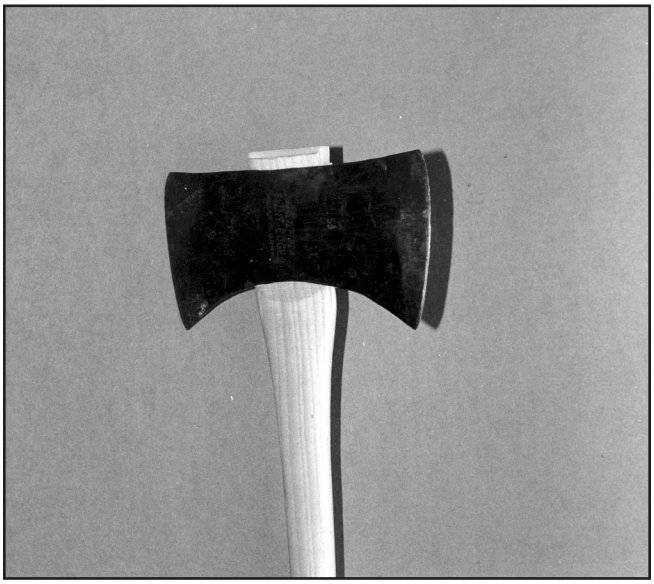
B—Saw the handle to about the correct length. The handle has been roughly fitted so the head slides to within about ½ inch of the final seating position.



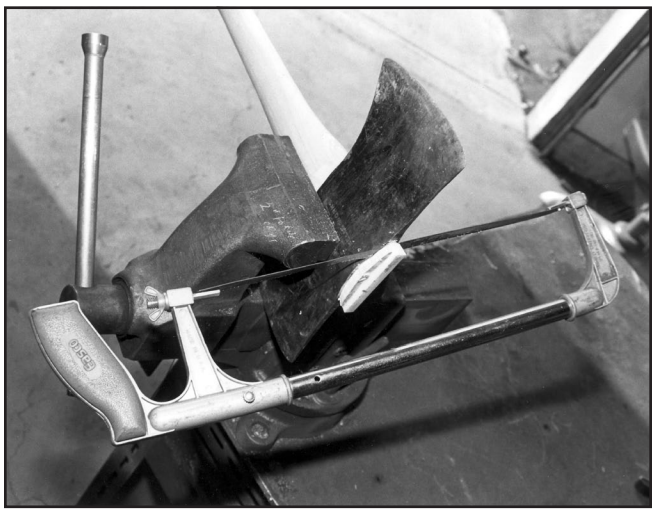
D—The tool head has been snug-fitted to the square seating shoulder. Note that there is about ½ inch excess handle above the head.



E—All surfaces just below the handle should be sanded smooth before the head is placed to insert the wedge. The wedge has been started in kerf.



F—The wedge has been driven home with the alternate driving of the wedge and the end of the tool handle.



G—Use a hacksaw to trim off the excess handle and wedge flush with the tool head. Turn the saw blade 90° on the frame to facilitate the flush cut.



H—The finished mounted tool. The handle can be finish-sanded and oiled with raw linseed oil to protect against moisture.