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Saws That Sing

A Guide To Using Crosscut Saws

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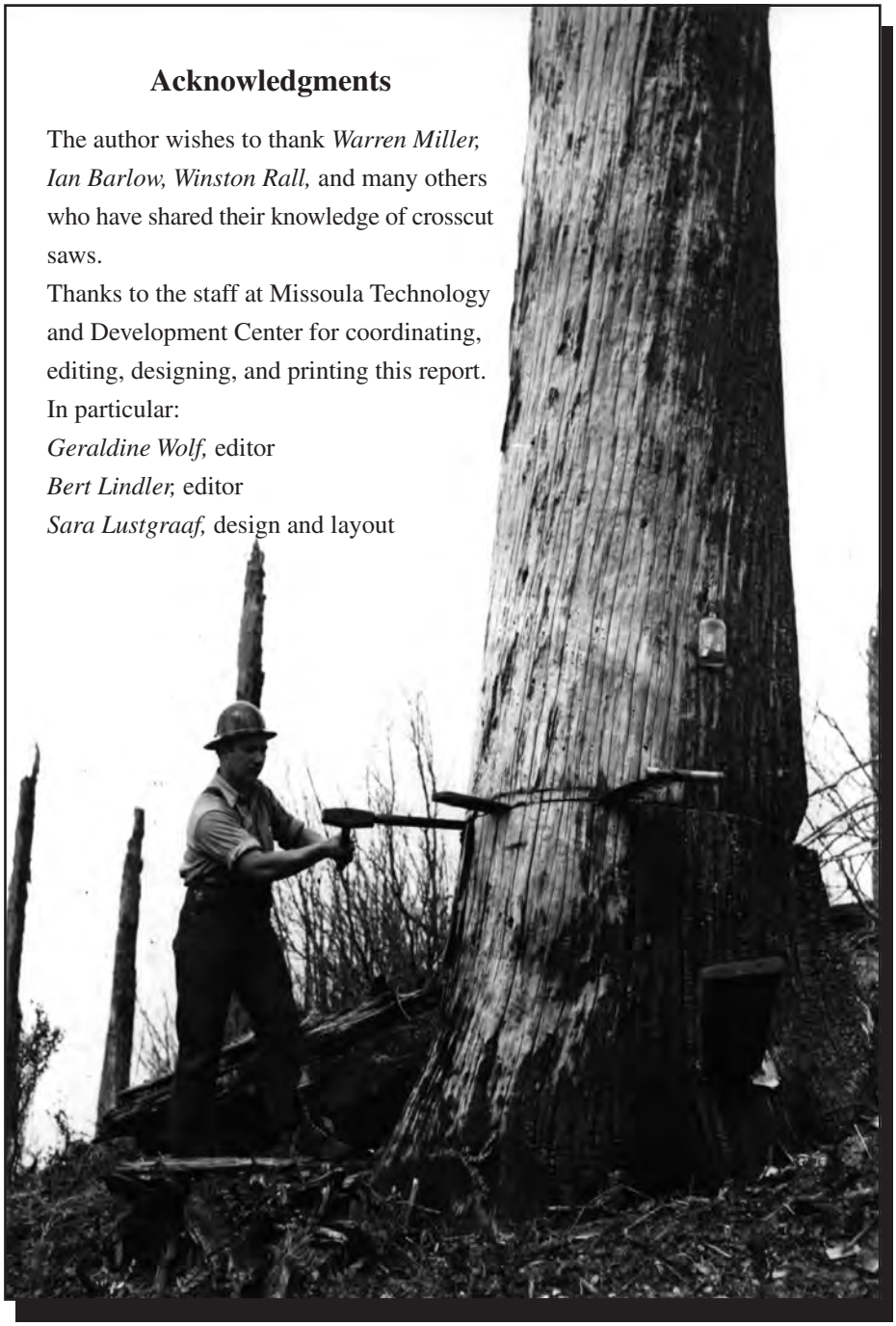
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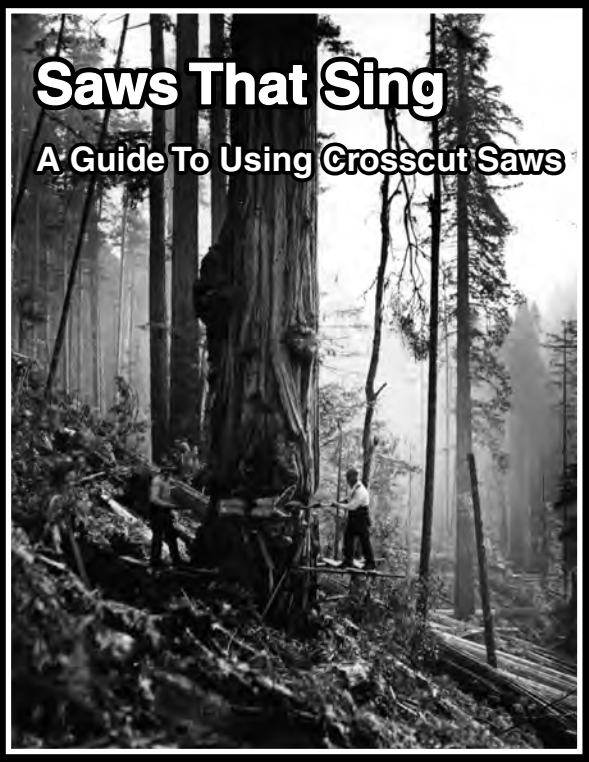
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Wedging to relieve pressure on the saw, Mt. Hood National Forest, 1943.—*USDA Forest Service photo by George E. Griffith*

Cover photo: California redwood region, upper Bridge Creek, Humboldt County.
—*USDA Forest Service photo, H.L. Person, October 1935*



Saws That Sing

A Guide To Using Crosscut Saws

David E. Michael, *Author*
Tahoe National Forest

Brian Vachowski
Program Leader

USDA Forest Service
Technology and Development Program
Missoula, MT

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Contents

Introduction ____ **1**
Historical Origin of Crosscut Saws ____ 1

Types of Crosscut Saws ____ **3**
One-Person Crosscut Saws ____ 3
Two-Person Crosscut Saws ____ 3
Felling Saws ____ 4
Bucking Saws ____ 4

Saw Grinds ____ **6**
Flat Ground ____ 6
Straight Taper Ground ____ 7
Crescent Taper Ground ____ 7

How a Saw Cuts ____ **8**
Cutter Teeth ____ 8
Rakers ____ 8
Teeth That Both Cut and Rake ____ 8
Gullets ____ 9
Tooth Spacing ____ 9
Tooth Patterns ____ 10
Plain Tooth (Peg Tooth) Pattern ____ 10
M Tooth Pattern ____ 10
Great American Tooth Pattern ____ 10
Champion Tooth Pattern ____ 10
Perforated Lance Tooth Pattern ____ 10
Lance Tooth Pattern ____ 10

Saw Handles ____ **11**
Types of Handles ____ 11
Loop-Style Handles ____ 11
Pin-Style Handles ____ 12
Handle Installation and Maintenance ____ 13

Saw Maintenance ____ **14**
Cleaning the Saw ____ 14
Cleaning Solutions ____ 15
Field Cleaning ____ 15
Shop Cleaning ____ 15
Checking for Straightness ____ 15
Using Straightedges ____ 15
Testing the Saw ____ 16

Saw Filing ____ **18**
Saw Vises and Tools ____ 18
Straightening ____ 18
Jointing ____ 18
Fitting Rakers ____ 19
Tooth Pointing ____ 19
Setting Teeth ____ 19

Storage 21
Long-Term Storage 21
Storage in the Field 21
Saw Sheaths 21

Transporting Saws 23
Boats 23
Aircraft 23
Vehicles 24
Packstock 24
Hikers 25

Axes 27
Safety Considerations 27
Single-Bit Axes 27

Wedges 28
Felling Wedges 29
Bucking Wedges 29

Underbucks 31
Axes for Underbucking 31
Mechanical Underbucks 31

Lubricants 33
Applying Lubricants 33

Preparation for Bucking and Felling 34
Safety Considerations 34
Personal Protective Equipment 34
Determining the Forces on the Log 34
Situational Awareness 35
Bucking Sizeup 35
Overhead Hazards 35
Side Slopes 35
Spring Poles 35
Suspended Logs 36
Pivot Points 37
Side Binds 37
Rootwad Movement 37
Unsound Wood 37
Log Movement 37
Planning the Cut 38
Types of Cuts 38
Determining the Safe Working Side of the Log 39
Planning and Clearing Escape Routes 39
Establishing a Work Platform 39
Providing Adequate Saw Clearance 39
Bark Removal 39
Tool Placement 39

Crew Communication 39
Determining Binds 40
Determining Bucking Locations 40
Points to Remember When Planning the Cut 40
Single-Bucking Techniques 41
Single Bucking With No Bind: Top Cutting 41
Single Bucking With Top Bind: Underbucking Required 42
Single Bucking With Top Bind: Top Cutting 43
Single Bucking With Bottom Bind: Top Cutting 43
Single Bucking With Bottom Bind: Underbucking 44
Single Bucking With End Bind 44
Single Bucking With Side Bind 44
Double-Bucking Techniques 44

Felling 46
Safety Considerations 46
Direction of Fall 47
Situational Awareness 47
Felling Sizeup 48
Establishing Escape Routes 48
Placing the Undercut 49
Chopping Out the Undercut With an Ax 50
Using a Crosscut Saw and an Ax 50
Making the Undercut With a Saw 50
Making the Back Cut 52

Concluding Principles 55

References Cited 56

Additional References 57

Sources for Crosscut Saws and Accessories 60
Vintage Saws 60
New Crosscut Saws and Accessories 60
Subscribe to Crosscut Saw Bulletin 61

Introduction

After working in the woods from Alaska to Arizona for more than 35 years, I've developed a profound appreciation for the precision and usefulness of the crosscut saw. There is an unfilled demand today for skilled crosscut saw users, particularly in the nearly 35 million acres of wilderness managed by the United States Department of Agriculture, Forest Service. My goal is to present tried-and-true techniques for using, appreciating, and caring for vintage crosscut saws.

I do not cover everything. Sharpening, a complex and exacting art, is left for the reader to discover in Warren Miller's excellent publication, *Crosscut Saw Manual* (1977, rev. 2003). I also will not cover complex felling techniques. I will focus on several topics:

- The saws themselves, with particular emphasis on good handles.
- The selection, function, and use of wedges. Wedges are used differently with a crosscut saw than with a chain saw.
- Bucking logs. Bucking comprises 90 percent of the trail work done with crosscut saws.

A condensed version of this text is included in the USDA Forest Service's Chain Saw and Crosscut Saw Training Course (Wolf and Whitlock 2006). Space and training time did not allow for its full inclusion there, so this book provides a more detailed reference. This 2007 revision includes updated safety information.



The USDA Forest Service requires crosscut saw users working for or on behalf of the agency to receive the required training and to be certified to perform the specific crosscut saw work they plan to do. Reading this book is not enough to provide the required training or to receive certification.

Most of what has been written about how trees and logs react to being cut with a chain saw was adapted from knowledge obtained from crosscut sawyers. Whether a tree or log is cut with a chain saw or crosscut saw, its reaction to the laws of physics will be the same. While the principles of bind and gravity are the same regardless of the tool, how you deal with them is often quite different, depending on whether you are using a chain saw or a crosscut saw. I'll go into some detail about the correct crosscut saw techniques to help you understand these differences.

Historical Origin of Crosscut Saws

The crosscut saw did not come into common use in Europe until the mid-15th century. These early saws were rectangular with handles that fitted into sockets forged into each end of the blade. Early saws had a plain tooth (also called peg tooth) design. Over the next 400 years, numerous saw patterns developed. Many countries and regions had their own "national" patterns. Saws started to appear with a curve both on the back as well as on the toothed edge. But as late as 1900 in Europe, the plain and the "M tooth" pattern were the most common.

Imported saws were used in Colonial America, and by the mid-1800s they were being manufactured in this country. However, it wasn't until about the 1880s that saws were used for fell ing timber. During the golden age of crosscut saws, from 1880 to 1930, numerous saw and handle styles, tooth patterns, types of steel, and methods of grinding were developed (figure 1).



Figure 1—Crosscut saws ruled the woods from 1880 through the 1930s. A lot of effort was invested to improve and perfect this versatile tool.—*USDA Forest Service photo, K.D. Swan, 1924, Flathead National Forest*

The machinery to make these vintage saws began to disappear by the 1950s, as crosscuts were replaced by power saws. Today, no taper ground crosscut saws are manufactured.



Crosscut saws manufactured today, except possibly some of the custom competition saws, generally do not have the same high quality of materials or workmanship as earlier saws. This is reason in itself to value our vintage saws.

Nostalgia may be one reason to learn how to use crosscut saws safely, but an even better reason is for management in designated wilderness, where mechanized or motorized equipment is prohibited by law. Here, traditional tools like crosscut saws and axes are needed to clear trails, cut firewood, manage wildland fires, and maintain or restore administrative buildings. In wilderness, a well-tuned crosscut saw is usually the tool of choice for felling trees and bucking logs.

Outside of wilderness, crosscut saws are the tools of choice:

- In areas of seasonal closures, such as wildlife nesting areas, because crosscut saws are quiet.
- When chain saws and internal combustion engines are prohibited because of fire restrictions.
- In situations involving miles of hiking and little cutting (minor trail clearing and smokejumping, for example) where the light weight of a crosscut saw makes it much easier to carry than a chain saw.

More and more, I see trail managers and others discovering that it's cheaper and more efficient to switch off the chain saw and pick up the crosscut. Some trail contractors have found that they pay lower worker's compensation insurance premiums when they use crosscut saws rather than chain saws.

With the right training and a sharp saw, it is amazing to see the esprit de corps and crew cohesion that develop among younger fire and trail crew members as they learn, master, and apply their crosscut saw skills.

Types of Crosscut Saws

One-Person Crosscut Saws

A one-person crosscut saw's blade is asymmetrical. The saw has a D-shaped handle. The saw also has holes for a supplemental handle at the point (tip) and the butt (near the handle). The saws are usually 3 to 4½ feet long (figure 2).

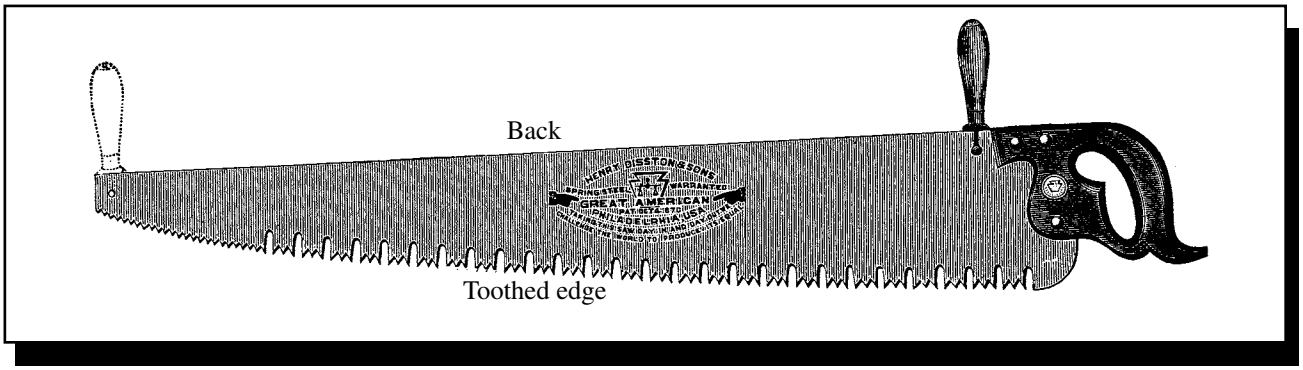


Figure 2—One-person crosscut saw. The handle can be placed in either of two locations on this vintage Disston saw.—*Henry Disston & Sons catalog (1902), with permission of Astragal Press, Mendham, NJ*

Two-Person Crosscut Saws

Two-person crosscut saws are symmetrical (figure 3). They cut in either direction. Two-person saws were 4 to 12 feet long for general sawing and up to 16 feet long for working in the California redwoods. If a longer saw was needed, two shorter saws were sometimes brazed together. Saws from 4 to 7 feet were made in ½-foot increments. Saws longer than 7 feet were made in 1-foot increments.



For felling, I try to select a saw that is twice the average diameter of the material I'll be sawing consistently. For bucking, I have found that it is easier and more efficient to use a shorter saw for an occasional large log than to carry a saw that is longer than I typically need.

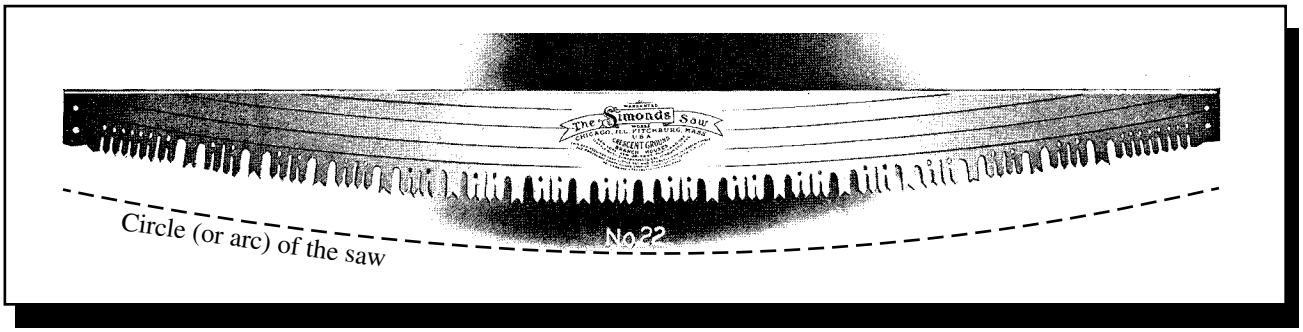


Figure 3—Two-person crosscut saw.—*Simonds, Inc., saws and knives catalog (1919), with permission of Roger K. Smith, Athol, MA*

Many vintage saws have teeth all the way to the ends, but saws manufactured today do not. I recommend using saws with teeth all the way to the end of the saw. This allows the greatest versatility for starting or ending a cut, for under-bucking, and for using a shorter saw.

Historically, two-person saws were manufactured with 15-gauge steel for the shorter 4- to 5-foot saws and a thicker 14-gauge for saws between 5 and 7 feet. Longer saws were typically 13-gauge. These thicknesses are measured at the tooth and represent the thickest metal in the saw. Straight taper and crescent taper saws were often a full 5 gauges thinner at the center back of the saw.

Felling Saws

Felling saws (figure 4) are best suited for felling standing timber. They cut best in a horizontal position. Felling saws have a concave back and are narrower than bucking saws. The combination of a concave back and narrower width give felling saws the following characteristics:

- The saw is more flexible.
- The saw is lighter, so less effort is needed to hold it horizontally.
- The saw has only one handle hole on each end.
- The sawyer can insert a wedge sooner.

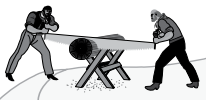
The flexibility of the felling saw allows it to conform to the arc of the faller's arm. As the saw is pulled towards the sawyer, the saw rises, keeping it from binding. Historically, fallers standing on spring-boards (small platforms used to cut the tree) were able to transmit some of the energy from their legs into the saw much as you would if you rock forward on your toes when using a maul to split wood.

Because felling saws are limber and require two people to use them, they do not make good bucking or general all-around utility saws. I recommend instead that the bucking saw be the standard saw used for most trail and construction applications today.

Bucking Saws

Bucking saws (figure 4) have a straight back. They are thicker than felling saws, so they are heavier and stiffer. For example, my 6-foot Simonds 513 felling saw weighs 6¼ pounds, and my 6-foot Simonds 503 bucking saw weighs 8½ pounds.

Bucking saws can be used for occasional felling. Some saws were manufactured to incorporate the best characteristics of both felling and bucking saws.



I recommend the 5½-foot vintage bucking saw with teeth extending to the ends of the saw as the standard saw for most trail and construction applications today. This saw is used by a single sawyer.

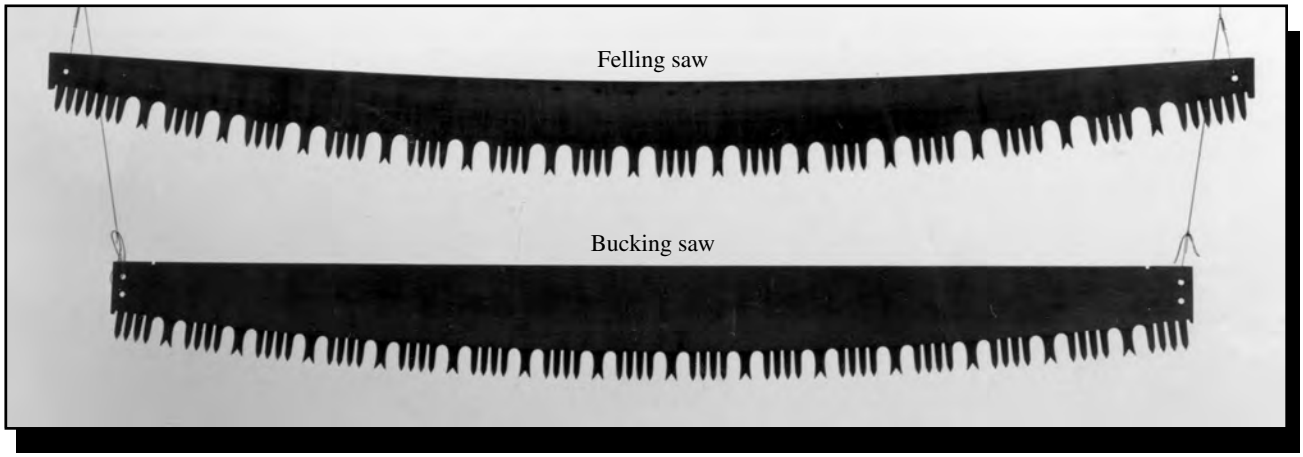


Figure 4—Felling saws have a curved back and often have just one handle hole per side. Straight-backed bucking saws often have two holes per side.

Sawyers need to master the skill of operating a two-person bucking saw solo before working with a partner as a bucking team. Because the bucking saw is usually operated by one person, it cuts on both the push and pull strokes. The saw's additional stiffness helps prevent the saw from buckling on the push stroke.



Appalachian family wedging a chestnut log, Tallulah Ranger District, Chattahoochee National Forest, Georgia.—*USDA Forest Service photo, date unknown*

Saw Grinds

The sides of vintage saws were finished, or ground, in three different ways. Each method affected the thickness of the saw in a particular way, and has major implications for the overall quality of the saw. These grinding methods are flat, straight taper, and crescent taper (figure 5).

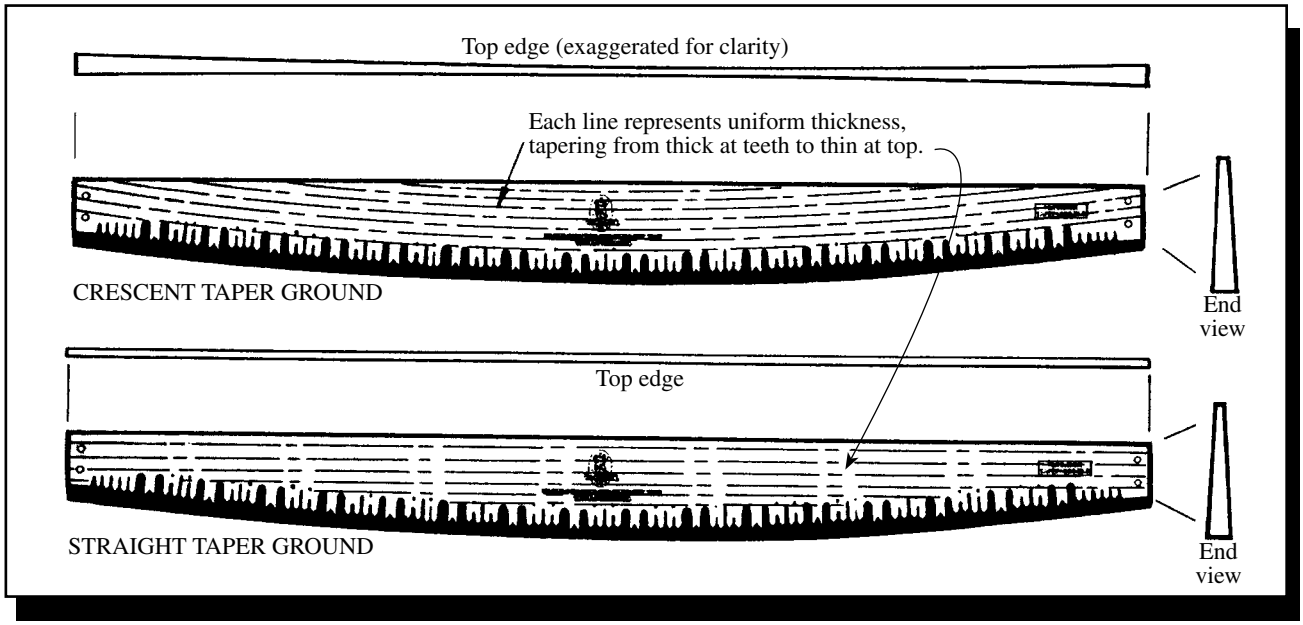


Figure 5—A comparison of straight-taper-ground and crescent-taper-ground saws. Neither is manufactured today. Today's saws are flat ground, a design that is inferior to tapered saws.

Flat Ground

On a flat-ground saw, the metal's thickness is the same throughout. Saws manufactured today are flat ground.

Flat-ground saws are considered the least desirable. The main disadvantage is that it takes more set to enable the saw to clear the kerf (the slot the saw cuts in the wood). Set is the cutter tooth's offset from the plane of the saw. The kerf has to be wider for flat-ground saws, and more energy is required to use the saw (figure 6).

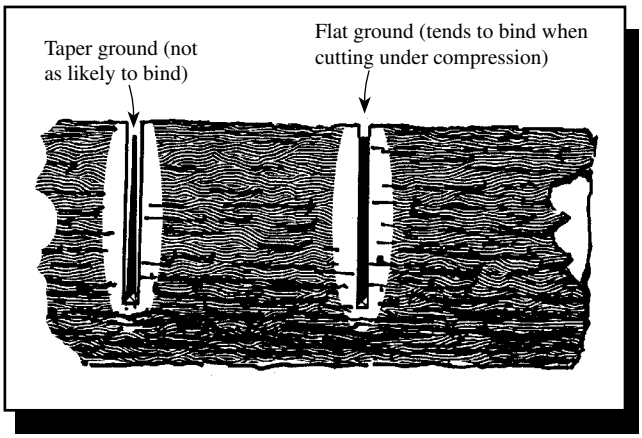


Figure 6—A comparison between taper-ground and flat-ground saws. Taper-ground saws are less likely to bind.

Straight Taper Ground

Straight-taper-ground saws have an advantage over flat-ground saws because the saw is thinner at the back than at the teeth. The back of the saw has more clearance, reducing binding.

The teeth of straight-taper-ground saws are thicker near the center of the saw than along either end. Straight-taper-ground saws require less set than flat-ground saws.

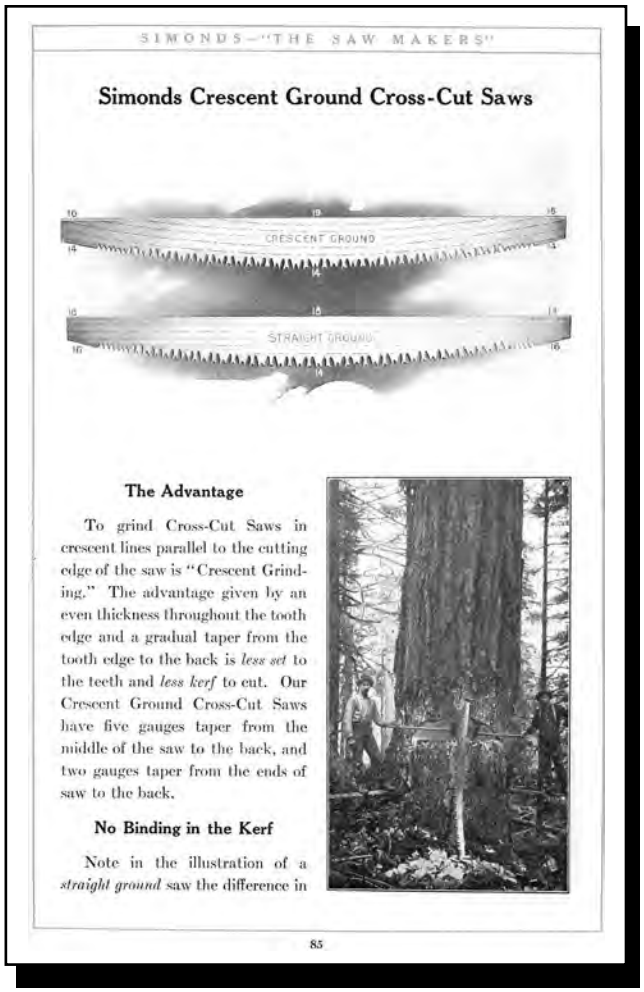
Crescent Taper Ground

The best vintage saws were crescent taper ground. Warren Miller explains the difference between straight taper and crescent taper saws in the *Crosscut Saw Manual* (1977, rev. 2003): "The difference between the straight taper and crescent taper is that the lines of equithickness for the straight-taper-ground saw are straight and those for the crescent-taper-ground saw are concentric to the circle of the saw. This means that the teeth of the crescent-taper-ground saw are all the same thickness; whereas the teeth of the straight-taper-ground saw are thicker toward the center of the saw."



Crescent-taper-ground saws are no longer manufactured. They provide the maximum cutting efficiency with the least amount of human effort—the pinnacle of ergonomic design. They should be the best cared-for tool in the cache.

Saw manufacturing companies called crescent-taper-ground saws by different trade names: Crescent Ground (Simonds), Improved Ground (Disston), and Segment Ground (Atkins). Other names included Precision Ground and Arc Ground (figure 7).



SIMONDS—"THE SAW MAKERS"

Simonds Crescent Ground Cross-Cut Saws

CRESCENT GROUND

STRAIGHT GROUND

The Advantage

To grind Cross-Cut Saws in crescent lines parallel to the cutting edge of the saw is "Crescent Grinding." The advantage given by an even thickness throughout the tooth edge and a gradual taper from the tooth edge to the back is *less set* to the teeth and *less kerf* to cut. Our Crescent Ground Cross-Cut Saws have five gauges taper from the middle of the saw to the back, and two gauges taper from the ends of saw to the back.

No Binding in the Kerf

Note in the illustration of a *straight ground* saw the difference in

85

Figure 7—Companies like Simonds heavily promoted their Crescent Ground crosscut saws as the best ever made. The numbers refer to the gauge, or thickness, of the steel.—*Simonds saws and knives catalog (1919), with permission of Roger K. Smith, Athol, MA*

The thinnest part of a crescent ground saw is at the back center, which is often 4 or 5 gauges thinner than the teeth. If you hold one of these saws and sight down its back you can *see* the taper. You can *feel* the change in thickness (figure 5).

Crescent-taper-ground saws offer the saw the most clearance in the kerf of any of the grinds. These saws require the least amount of set, allowing the narrowest kerf.

How a Saw Cuts

The teeth of a saw function like a series of knives, making progressive simultaneous parallel cuts and releasing the wood between them (figure 8). These teeth perform three functions. They:

- Cut the wood fibers
- Break the cut fibers loose
- Remove the fibers from the kerf

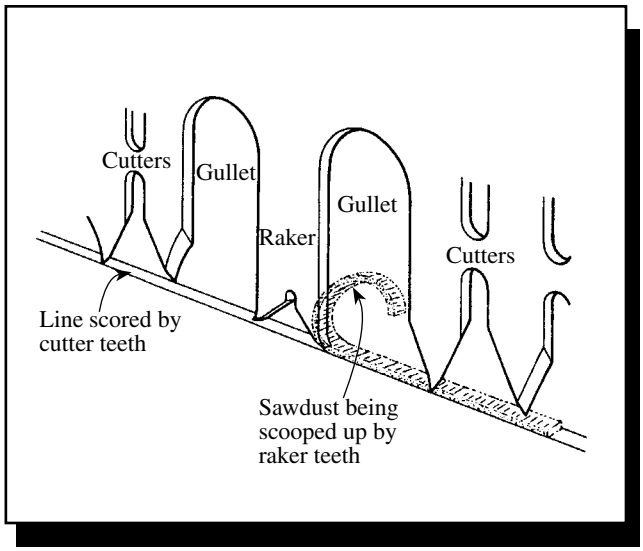


Figure 8—The way that the teeth of a crosscut saw work.—*Saws and Sawmills for Planters and Growers, with permission of John M. Morris*

Cutter Teeth

All saws, regardless of the tooth pattern, are made up of two rows of cutting edges. The saw releases wood fibers on each side of the kerf as it passes through a log. Cutters (figure 9) work best in brittle, seasoned wood. The weakened fiber is easily removed.

Rakers

Wet or green wood is hard to remove from the kerf because it is resilient. Even when the fiber is dislodged, it clogs a saw's cutter teeth.

A special kind of tooth, the raker, allows the cutter teeth to work more effectively with less effort. I prefer saws with rakers for general work in the woods.

Even though the rakers don't sever fiber, they perform the other two functions of saw teeth: breaking loose the cut fiber and removing it from the log. Rakers remove material whether the saw is being pushed or pulled.

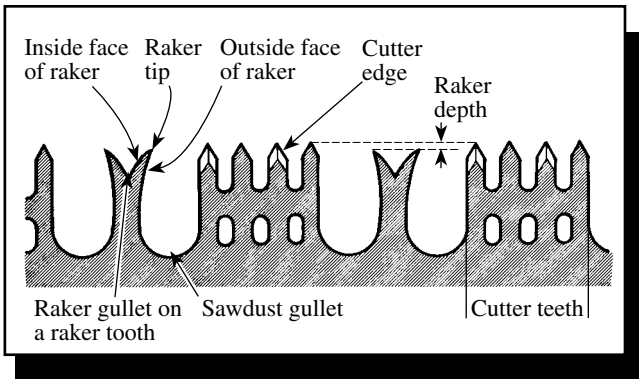


Figure 9—The configuration of the teeth of a crosscut saw. This is the perforated-lance tooth pattern.

When rakers are shaped properly and their depth has been set accurately, they pull out long shavings of wood rather than sawdust (figure 10).



Figure 10—Long, clean shavings like these indicate a well-sharpened saw. In some parts of the country these shavings are called *noodles*.

Teeth That Both Cut and Rake

Some saws have teeth that both cut and rake. These teeth are asymmetrical (not uniform). One face is bevel filed to be the cutter while another face is filed almost flat to be the raker. The M tooth and Great American patterns are examples (figure 11). Teeth that are filed to both cut and rake are an improvement over the plain tooth in severing and removing wood fiber. However, these combination cutter-raker teeth

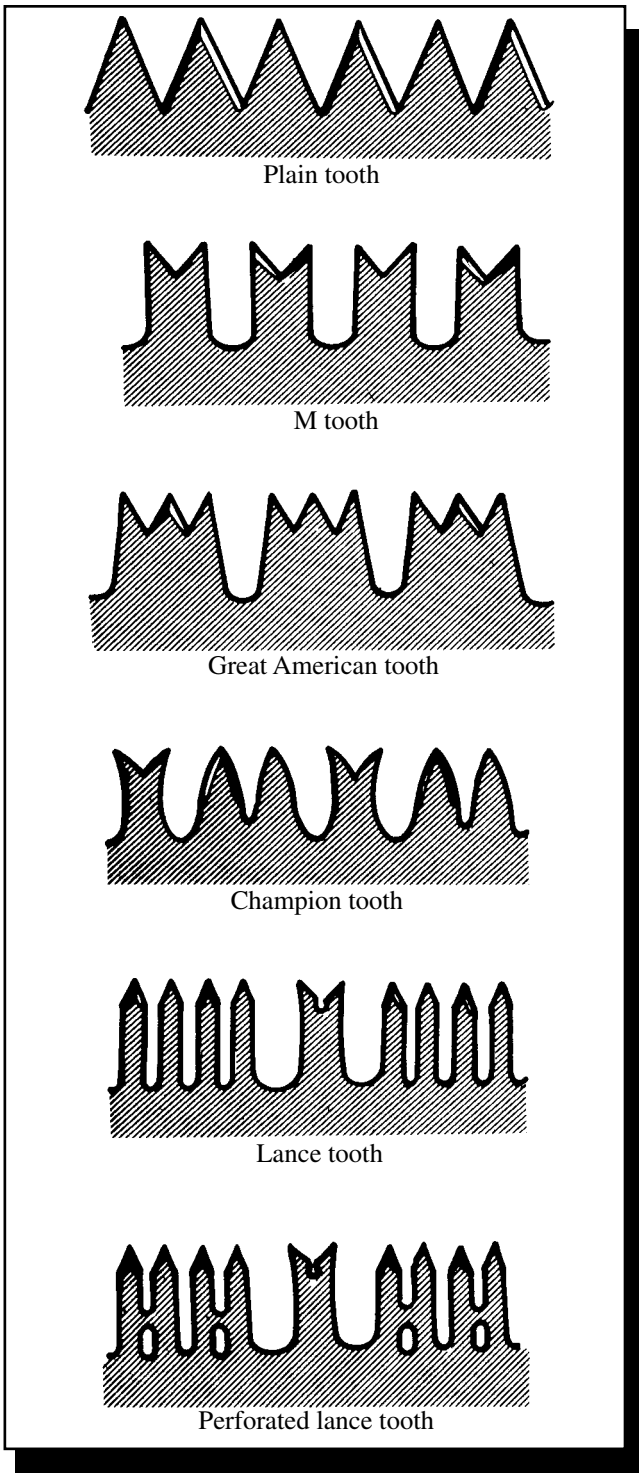


Figure 11—Common crosscut saw tooth patterns.

are a compromise. Without a raker to determine how far the tooth may penetrate, M tooth saws can cut very deeply and require a lot of strength to operate. While such an aggressive cutting action is appropriate for competition sawing, using such saws all day long for trail work is very fatiguing.

Gullets

Wood fiber that has been severed must be stored within the saw while the fiber is moved through the kerf. This storage area (the largest space between groups of cutters, or cutters and rakers) is called a gullet.

Gullets have a rounded shape so shavings will bend rather than break (figure 8). The gullet must be large enough to store all the shavings until the gullet clears the log and the shavings fall free. Saws that become worn out after repeated filings reduce the amount of shavings the gullet can hold.

The gullets determine the length of saw to use for a given application. For example, a gullet in the middle of a log 3 feet in diameter must travel $1\frac{1}{2}$ feet to allow its shavings to clear the log. At least a $6\frac{1}{2}$- or 7-foot saw would be needed to allow the shavings to clear a log 3 feet in diameter if the saw is being used by two persons. A shorter saw can be used by a single sawyer.

Tooth Spacing

The teeth of most crosscut saws lie on an arc of a circle (figure 3). This is sometimes called the circle of the saw, or the arc of the saw. This arc makes cutting faster, easier, and smoother. Especially on larger trees, when more teeth are being used, the arc causes the teeth to share the workload progressively instead of all at once. The circle of the saw works in conjunction with the arc of the sawyer's arm to effectively deliver power to the saw teeth as the saw feeds itself into the log.

The spacing of the saw's teeth ranks in importance with tooth pattern. Saw designers had to consider questions such as:

- Is the tooth strong enough for the intended work?
- Are the gullets far enough apart to effectively pick up all the fibers severed by the cutters?

- Is there enough room for the teeth and rakers to be sharpened and maintained?
- What's the best way to reduce vibration and chatter so the saw cuts smoothly?

The answer to these questions centers on tooth spacing. Generally, the longer the saw, the larger the teeth and the wider the space between teeth. Knowing tooth spacing helps the sawyer select the proper length of saw. Larger crosscut saws, with more space between the teeth, work poorly on small branches. Likewise, a small saw with small, closely spaced teeth doesn't work well on large trees or logs.

Tooth Patterns

For centuries, only the plain tooth (or peg tooth) pattern was used. Modifications to the plain tooth pattern were developed to make the saw easier to use. We will discuss six patterns: the plain tooth, the M tooth, the Great American tooth, the champion tooth, the perforated lance tooth, and the lance tooth.

Plain Tooth (Peg Tooth) Pattern

This pattern just includes cutter teeth. It is best used for cutting dry, very hard, or brittle small-diameter wood. Examples include many bow saws and pruning saws. These saws do not have special large gullets for sawdust. The sawdust is carried out in the small spaces between the teeth. Wet or resinous sawdust can bind up this tooth pattern.

M Tooth Pattern

The M tooth, still manufactured today in a modified form for competition saws, dates back to the 1400s in southern Germany. This tooth is designed to cut the fiber, break the severed fiber, and clean out the shavings. The tooth pattern consists of pairs of teeth set alternately and separated by a gullet. The outer edges of the teeth (the legs of the M) are vertical and act like rakers. The inside edges of the M are filed to a bevel, making a point. This tooth pattern is best suited for cutting dry, medium-to-hard woods.

Great American Tooth Pattern

This pattern consists of a group of three teeth, each set alternately, separated by a gullet. It is sometimes called a crown tooth because of its shape. The Great American tooth pattern is designed to cut dry, medium-to-hard woods. A special file is used for these saws. The file can be purchased today and is called a crosscut file or a Great American file. The file is shaped somewhat like a teardrop. The thicker rounded edge is for filing out the gullets. The sides of the file are used to file the rakers and cutters. This file also can be used to sharpen other tooth patterns.

Champion Tooth Pattern

This pattern is especially popular in the hardwood regions of North America. It consists of two cutter teeth set alternately and an unset raker with a gullet between them. The cutters are wider and more massive than the lance tooth pattern, allowing heavy sawing in extra hard, dry, or frozen wood. The larger teeth are sharpened in more of an almond shape rather than in the pointed shape of a lance tooth.

Lance Tooth Pattern

The lance tooth pattern also may be called the racer or four-tooth pattern. For many years the lance tooth pattern was the standard for felling and bucking timber in the American West. It consists of groups of four cutters set alternately, separated by an unset raker with gullets on each side. The lance tooth pattern is best suited for cutting soft green timber, especially fir, spruce, and redwood.

Perforated-Lance Tooth Pattern

This tooth pattern is considered a general utility pattern that can cut all but hard and frozen wood. It consists of groups of four cutters set alternately separated by an unset raker with gullets on each side. The "bridges" between the teeth form the perforations that give the pattern its name. These bridges strengthen the teeth and reduce chatter when the saw is used to cut harder wood. The perforated-lance tooth pattern is sometimes called the racer pattern and old-timers called it the four-tooth pattern. It was popular historically in the pine country of the American West, and is still popular there.

Saw Handles

The style, quality, and position of the handle on the saw greatly affect the saw's performance.

Types of Handles

Numerous designs have been used for saw handles. Many of these designs developed along regional preferences. Some were based on a particular saw's application. Many simply reflected the sawyer's preference as the most efficient way to transfer power from the sawyer's arms to the wood being cut.

Quality saw handles often are difficult to find. Handles must be strong and must not allow movement between the handle and the blade.

Handles may be fastened permanently to the blade with rivets (figure 12). These are rarely found and are usually removed so the saw can use pin-style handles. Removable handles may be fastened to the blade with a steel loop or with a pinned bolt and wing nut assembly. I prefer handles that are fastened with a pinned bolt and wing nut.

The handle's position on the saw affects the saw's efficiency. Changing either the arm and hand position, or the handle position, changes the delivery of force to the saw.



Figure 12—This vintage, but unused, Peugeot saw has its handles permanently fastened with rivets. The saw still has its original protective coating.

Loop-Style Handles

The loop-style handle is a common design (figure 13). Most of these models have a metal loop running up through a hardwood handle to a nut, which is either inside the handle (plug nut) or part of a cap at the end of the handle. The loop design allows the loop to be slipped over the saw blade. When the wooden handle is turned, the loop tightens around the saw. These models do not use the saw handle holes.

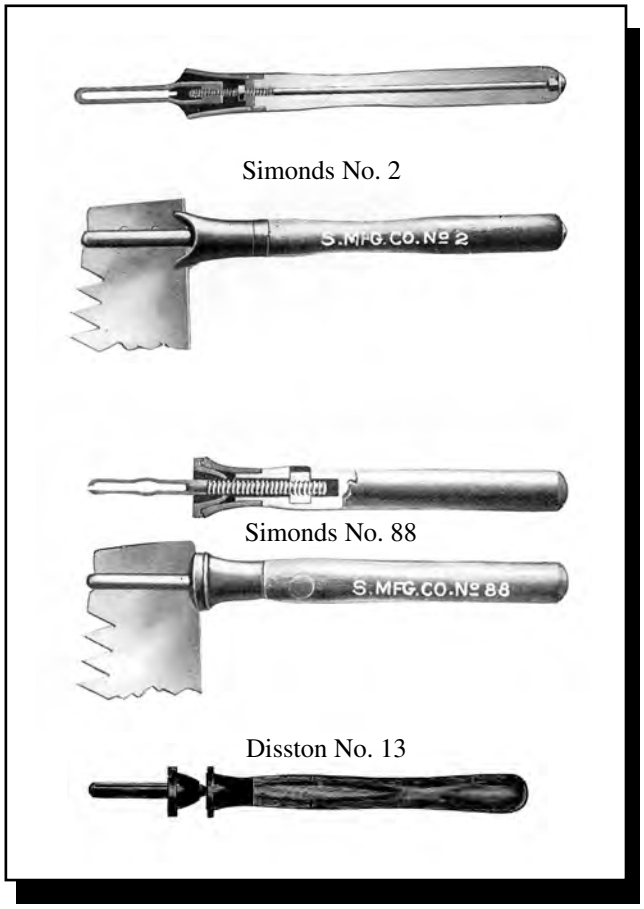


Figure 13—Examples of vintage loop-style handles.—*Henry Disston & Sons, Inc., catalog (1902), with permission of Astragal Press, Mendham, NJ; Simonds, Inc., saws and knives catalog (1919), with permission of Roger K. Smith, Athol, MA*

Many saws have a notch or a valley where the bottom of the loop rests. Because such saw blades must have a notch for the loop, they do not have teeth all the way to the end of the blade.

This saw and handle style is a disadvantage when I want to use just the end teeth to finish a cut. On the

other hand, some sawyers like these models because the handle can be loosened and removed quickly with a twist of the wrist, an important safety factor in felling operations.

Another reason I dislike a loop handle is because most standard loop handles only allow the hands to be placed above the saw teeth. Occasionally you can find a vintage loop-style handle with a threaded bolt and wing nut. These handles offer both the quick removal of a loop-style handle and the good handle placement option of the pin-style handle. They have a long handle extending above and below the bracket, allowing the hands to be placed above or below the saw teeth.

Pin-Style Handles

The pin-style handle design—the most common—uses handle holes in the saw blade.

Climax-style handles were an inexpensive pin-style design. Even today, they appear on some modern two-person crosscut saws (figure 14). Logging companies bought climax-style handles because they were inexpensive, but sawyers did not like them. Often I see pins damaged to the point that these handles cannot be removed from the saw blade. The damage results from sawyers tightening down too hard on the wing nut (often with a pair of pliers), as they try to reduce movement between the handle and the blade.

A pin that is too small in diameter, or made of a metal that is too soft also may cause damage. These handles do not allow the hands to be placed above or below the attachment, so I do not use them.

Perhaps the most common vintage saw handle used today is the Pacific Coast model of the pin-style design (figure 15). It has a finger guard with a groove to accept the saw blade and two cast flanges that saddle the wooden handle. The $\frac{1}{2}$-inch-diameter bolt passes through a hole in the wooden handle. It is secured with a heavy wing nut. This allows the long end of the handle to be placed above or below the pin.

Some sawyers today do not like this style of handle because they prefer to place their hand where the bolt end and wing nuts are located. I find there is no real need to have my hands over the bolt. These pin-style handles are my preference for general trail-clearing and felling operations.

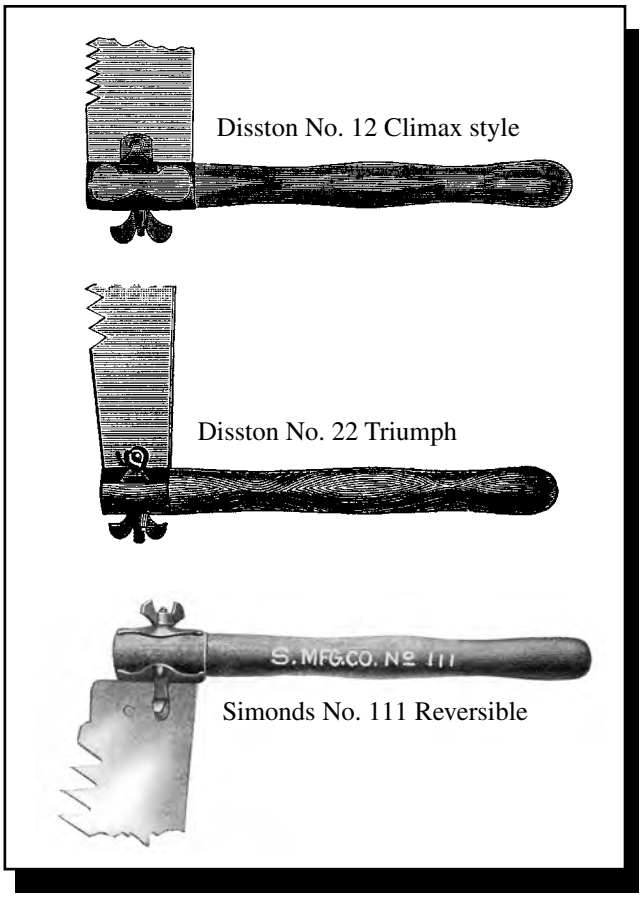


Figure 14—Pin-style handle designs.—*Henry Disston & Sons, Inc., catalog (1902), with permission of Astragal Press, Mendham, NJ; Simonds saws and knives catalog (1919), with permission of Roger K. Smith, Athol, MA*

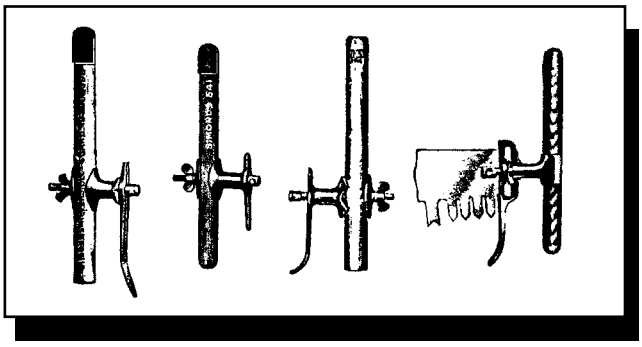


Figure 15—Pacific Coast model of the pin-style handle. This type is my personal favorite for general trail clearing and felling.

Standard 14-inch bucking handles had the bolt hole $5\frac{1}{2}$ inches from the end of the handle. This allowed the sawyer to choose to mount the handle with either the short or long portion up.

Some pin-style saw handles are called *reversible* or *universal* (figure 14). They were designed to allow the sawyer to rotate the handle, to keep the handle vertical whether felling, top cutting, or undercutting.

Supplementary handles (figure 16) are used on one-person crosscut saws. The handle can be placed on the end of the saw for an additional sawyer or directly in front of the D-shaped handle when a single sawyer wants to use both hands. I recommend having one of these available.

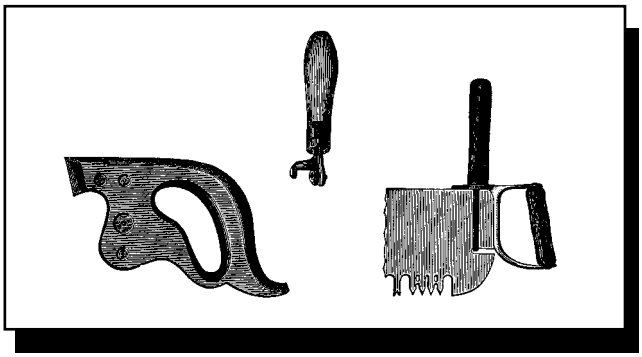


Figure 16—One-person saw "D" handle and supplemental handles from a vintage Disston catalog.—*Henry Disston & Sons, Inc., catalog (1902), with permission of Astragal Press, Mendham, NJ*



Because the handle is so important to a saw's efficiency, I use only vintage handles, or their reproductions. Until recently, no one was making any of the original saw handle designs. In 1990, a foundry started producing a replica of a popular West Coast design similar to an Atkins No. 140 handle (see the Sources section). Vintage handles are still preferred by crosscut saw users.

Handle Installation and Maintenance

A one-person saw has a fixed D-shaped handle with additional holes on the top of the saw where a supplemental handle can be attached. Many two-person crosscut saws (usually bucking saws) have two holes on each end for handles. Moving the handle from the lower hole has the same effect as moving the hands several inches up the saw handle. With the handle in the upper hole, a push stroke applies more downward force on the saw, causing the teeth to sink deeper into the wood. The deeper cut requires more force on the push stroke, but applies a slight upward force on the pull stroke.

The wooden handles on crosscut saws are usually select-grade hardwoods $1\frac{1}{4}$ inches in diameter and about 14 inches long. Felling saws often had shorter handles with the mounting bolt hole drilled in the center of the handle. When the handle is not on the saw, it needs to be kept away from sharp edges that could nick or cut it.

It's important to keep the wooden handle sanded smooth and to keep it well oiled with boiled linseed oil. Sand off any lacquered finish before applying the oil.

Keep metal parts of handles free of rust. To recondition old handles, I soak the metal parts in penetrating oil and brush them with a wire brush. If rusted wing nuts cannot be removed, sacrifice the wing nut rather than the machined threaded bolt. I use a torch to heat just the nut, expanding it so I can remove it. If that doesn't work, cut the nut off with a hacksaw. Use a thread chaser to touch up the threads and purchase a new malleable iron wing nut. Thin, cheap wing nuts are not suitable.

If I need replacement pins, I use a quality steel rivet of similar diameter. These rivets can be obtained from a good industrial supply house. The slotted mounting bolt is designed to hold the rivet when the saw is not attached. One side of the bolt has a smaller diameter hole than the other. I place the new rivet through the entire bolt. Then I slightly peen the end of the rivet to enlarge it. The rivet now should pass through the large end of the slotted bolt but not be able to fall completely out.

Saw Maintenance

These maintenance topics are intended for the crosscut sawyer. Some topics, such as saw filing, are included just to provide an overview. An experienced saw filer should actually do the filing. The *Crosscut Saw Manual* by Warren Miller (1977, rev. 2003) is a resource for more information on saw maintenance and filing.



I cannot overemphasize the need to have saws professionally sharpened. I continue to see quality vintage saws being used as "misery whips" because they were not properly sharpened.

Cleaning the Saw

Saws need to be clean to function effectively. Clean saws at the end of the day before storing them.

The goal is to remove all deposits on the surface of the saw without causing any damage. When saws have not been properly cared for over a long time, permanent damage can occur.

To clean the saw, remove the handles and place the saw on a flat wooden surface that you don't mind getting oily. I made a special beam table for cleaning saws. I took a smooth 8-by-8 timber 8 feet long and countersunk a number of magnets below the surface to hold the saw in place. These thin round magnets are sold as *pot magnets* at industrial supply houses. They have a hole in the center so they can be mounted with a screw. Place the beam on top of a couple of sawhorses that are about 30 to 36 inches high. Place the saw on the beam.

Rust causes more damage to saws than anything else. A wire brush can be used to remove loose rust and scale. Never use a power sanding disk on a saw blade. Remove light rust using steel wool. Normally, I use fine grade (No. 0) steel wool for saw work, although coarser grades are sometimes needed.

Use a pumice grill block to remove rust that is too heavy to be removed with steel wool. Pumice grill blocks are brick shaped (about 4 by 4 by 8 inches) and are used to clean grill tops. They can be bought at a restaurant supply house. Take long sweeping strokes with the stone back and forth along the length of the blade while you are standing over the saw. A liberal amount of cleaning solution or water will keep the block's pores open.

Don't apply too much pressure on the cutter teeth because you can remove metal from the set and shorten the teeth.

To remove heavier rust, use an ax stone. Always use a liberal amount of cleaning solution, either oil or water, depending on the stone. Never use a dry stone on the saw blade.

As rust is removed, the saw begins to tell a story. Sometimes you can see the original acid etching revealing the saw manufacturer and the name and model of the saw.



The manufacturer's etching may be destroyed over time, so you should be careful not to rub it out during cleaning. As a safeguard, I use an electric etcher to record the manufacturer and model number near the handle. I also assign the saw a number and etch the number and the name of the USDA Forest Service administrative unit on the blade. Keep a paper record describing the general amount of use and the sharpening record, such as the date of sharpening, raker depth, and tooth set.

As rust and other deposits are removed, you will see imperfections in the saw blade. Shiny spots indicate high spots. Spots that are duller than the normal saw surface indicate low spots. A high spot on one side of the blade usually produces a low spot on the other side. These kinks or bends need to be hammered out by an experienced saw filer.

Cleaning Solutions

Field Cleaning

A saw that is well cared for will not rust, but it will develop pitch deposits during normal use. Some pitch can be removed with a citrus-based solvent as the saw is being used. The saw's motion scrubs away the buildup. Traditionally, kerosene was used to clean the saw, but it is not recommended today because of environmental concerns and potentially harmful health effects.

Even when the saw is being lubricated, pitch can be deposited on the saw. Pitch buildups can be removed at the end of the day with steel wool and a cleaning solution.

Limit the use of harsh chemicals in remote settings where it may be difficult to handle such products properly.

Shop Cleaning

Harsher chemical products may be used in a shop, but only if you have access to proper disposal and handling methods.

Wear the proper personal protective equipment and know how to use the cleaning solutions safely. Check the Material Safety Data Sheet (MSDS) if you are unfamiliar with the hazards of using and storing a particular product. A number of citrus-based cleaners on the market are effective and are safer than petroleum-based solvents. Citrus-based cleaners are recommended rather than the traditional cleaners because they are safer to use and less harmful to the environment. The cleaning agents should not be left on the saw for long periods.

Generally speaking, rust and pitch can be removed by dissolving the deposits and wiping the saw clean or by abrasion.

Diesel fuel is both a solvent and an oil, so it was traditionally used with a stone or pumice block to clean saws. Another product often used for cleaning was kerosene or Jet-A fuel. Kerosene worked better for dissolving pitchy surfaces and was historically the solvent of choice.

A solution of muriatic acid (a commercial grade of hydrochloric acid) worked well on heavily pitted saws. Soap and hot water with a degreaser like TSP (trisodium phosphate) or Spic-n-Span also removes pitch.

A plastic squeeze bottle is a good container for applying cleaners in the shop. The squeeze bottle is just for applying the solution, not for storage. These products must be stored in an approved container.

Naval gel can be applied to remove heavy rust and scale. Use only as directed, with adequate ventilation. This product stops the chemical reaction of the rust.

Checking for Straightness

A saw should be checked for straightness if it receives any harsh treatment during transportation or use. A saw that is not straight can buckle on the push stroke. Additionally, a saw that is not straight will not cut efficiently. The narrower, lighter felling saws are most prone to buckling.

Using Straightedges

Remove the saw's handles and hang the saw from one of its handle holes. You will need a pair of straightedges. Saw filers usually have straightedges made especially for this work, available from sawmill supply companies (figure 17). Two combination square rules can be used. Two 12- or 18-inch metal drafting straightedges also work well. Before using the straightedges on the saw, hold them together and make sure they maintain contact along their entire length. You should not see light between them when you put them together and hold them up to a light source.

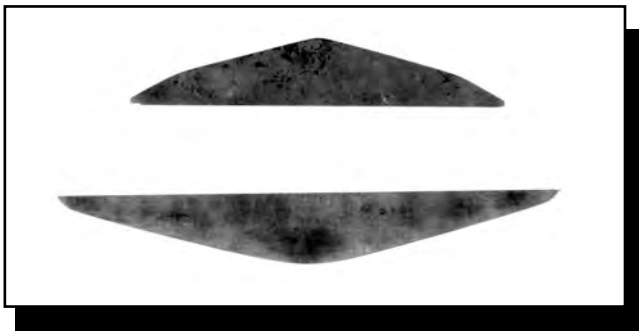


Figure 17—Examples of sawmaker's straightedges.

Straightedges work by allowing you to feel the difference in resistance between the saw and the straightedge as they are twisted back and forth over the saw's surface. Holding one straightedge in each hand, move the straightedges as a pair with the saw between them. You will feel increased drag on the ends of the straightedge on the side of a saw with a

depression. On the other side of the saw, the straightedge will pivot easily on the corresponding bump. Even resistance on both straightedges indicates a straight saw that does not have any kinks, bends, or bumps (figure 18).

If you find any major irregularities, mark them and tell the person who files your saws.



Figure 18—Locating kinks with two straightedges.

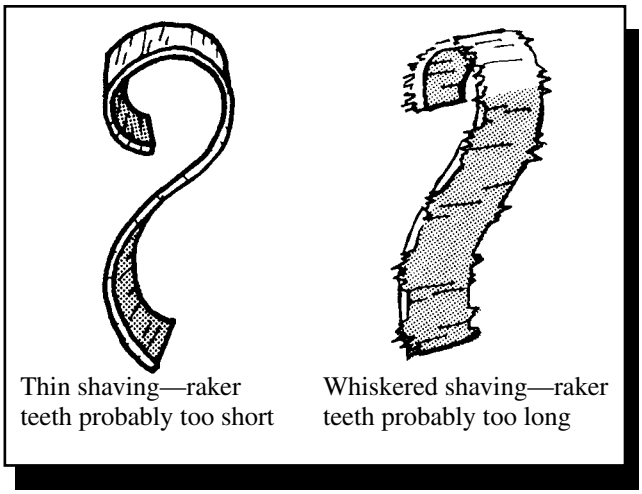
Often, a saw that needs straightening may be used until the next sharpening. However, the saw is more susceptible to buckling and will not cut as effectively. I don't recommend bending a saw that has a known irregularity so it can be transported. Such bending can compound the problem.

Testing the Saw

Testing determines whether a saw cuts straight, runs smooth, and produces long, thick shavings. The saw should produce shavings, not sawdust. The longer and more abundant the shavings, the better the saw is performing. Green logs produce longer shavings than dry logs. The shavings should be long and thick with smooth edges. If the edges of the shavings have "whiskers" or irregularities, the rakers are probably too long. If the shavings are paper thin, the rakers are too short (figure 19).

Tooth patterns without separate rakers (plain, M tooth, and Great American) usually do not produce long shavings, but produce chunky shavings with some sawdust.

Does the saw cut straight? Cut far enough into the test log to determine whether the cut is perfectly straight. Sometimes a sawyer standing in an awkward position can put a twist or bend on the saw that causes it to cut crooked.



Thin shaving—raker teeth probably too short

Whiskered shaving—raker teeth probably too long

Figure 19—Examining shavings to identify sharpening problems.

However, if the saw consistently pulls to one side through no fault of the sawyer, the saw needs additional maintenance.

A saw will not cut straight if it is kinked or bent. Too much set on one side of the cutters can cause the saw to pull to that side. If a saw has been sharpened improperly, the teeth may be longer on one side than the other. The saw will pull to the side with the longer teeth.

Never field sharpen or touch up dull cutters. Doing so shortens the teeth, compounding the problem.

Does the saw run smooth? The saw may feel like it is alternately catching and releasing. A smooth-running saw, on the other hand, seems to cut effortlessly. Look for a saw that doesn't chatter or seem like it is jumping as it cuts through the log.



A sharp vintage saw runs so smoothly that it is said to "sing." Such a saw is well tuned. Sadly, many crosscut sawyers have neither heard nor experienced the joy of working with a well-tuned saw.

Smoothness is most associated with the rakers. If a saw feels like it is snagging the wood, it is probably because one or more rakers have been filed incorrectly.

Inconsistent set in the teeth also can produce a jumpy saw. Look at the walls of the cut. A well-tuned crosscut saw leaves a smooth cut surface.

A cutter that has too much set may cause a saw to run rough. The saw may feel like there is a slight check or pause followed by a little jump.

A sawyer cannot do anything to fix a saw that is running rough. A qualified saw filer needs to make the necessary adjustments. Describe the problems to the filer.

Saw Filing

Good filers are few and far between. The filer's work is exacting and requires a lot of stamina and patience. Back in 1939, George C. Parker wrote in the *West Coast Lumberman*: "*There is today a scarcity of crosscut saw filers. This dearth of filers has gradually made itself manifest during the past 10 years. Filers are not made overnight. Years of practical experience are necessary before they become skilled and efficient.*"

Today, crosscut saw filers are much scarcer than they were in 1939. Treat any you know with respect, but insist on excellence in the work they perform. Ask them the number of saws they sharpen each year—more is better. Avoid filers who recommend only one setting for all types of cutting conditions. Our traditional crosscut saws cut well only when they are sharpened properly. The sawyer needs to tell the filer the expected cutting conditions. For example, cutting green blowdown in winter requires different raker and teeth set than cutting dry, beetle-killed snags. It is important to communicate this information to the filer.



The lack of qualified filers is as important as the shortage of good saws in eventually relegating crosscut saws to curio shops and collectors' shelves instead of their rightful role as working tools in the woods.

A few others and I are working with saw designers to create a saw that not only meets our trail clearing needs, but also can be sharpened by using a simple jig. Such a design is technically possible, though it is unlikely this type of saw would cut as well as a well-tuned vintage crosscut saw.

The *Crosscut Saw Manual* by Warren Miller (1977, rev. 2003) is a source of information on filing. Another publication is *Saws and Sawmills for Planters and Growers* by John Morris (1991).



It is important for the crosscut saw user to understand the skill and labor required to sharpen and recondition a saw. You will be more inclined to take care of your saws and to keep them from getting dull if you know how much work it takes to sharpen them.

Saw Vises and Tools

A filer needs to work in a well-lit location with a wooden vise that sandwiches the saw to hold it firm. I prefer vises that are heavy and massive rather than those that are lightweight and flimsy.

Specialized saw tools that every filer used to have are no longer being manufactured. Some replicas are being made, but vintage saw tools are superior. Anderson Tools are truly antiques and would be difficult to replace if lost or damaged. Files and sharpening stones are readily available, but tools like jointers, raker and pin gauges, anvils, and swaging hammers are scarce.

Straightening

Straightening is an art in itself. The filer must move the metal carefully by hammering the blade on an anvil. A special saw filer's hammer has slightly curved surfaces to work the metal back into place. I have sometimes spent more time trying to get a saw straight than I have spent sharpening it (figure 20).

Jointing

After the saw has been cleaned and straightened, jointing is the first step in sharpening. A tool called a jointer holds the file. The points are filed off the cutter tips so that each of them lies on the circle of the saw (figure 21). With each of the teeth lightly touched, this arc will become the reference plane for fitting rakers and sharpening teeth.

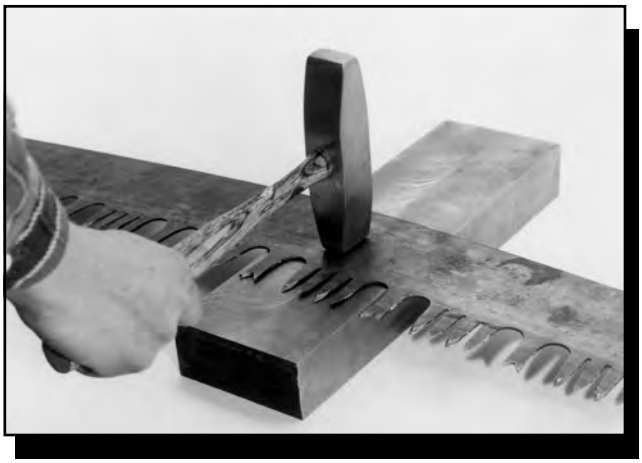


Figure 20—Hammering out a kink using a specially shaped saw hammer.

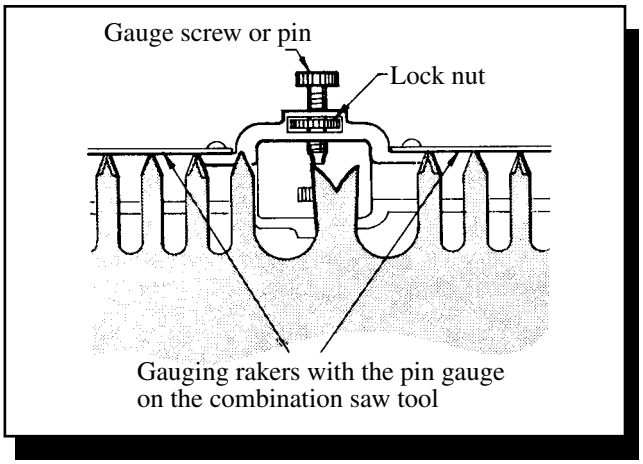


Figure 22—Gauging rakers.

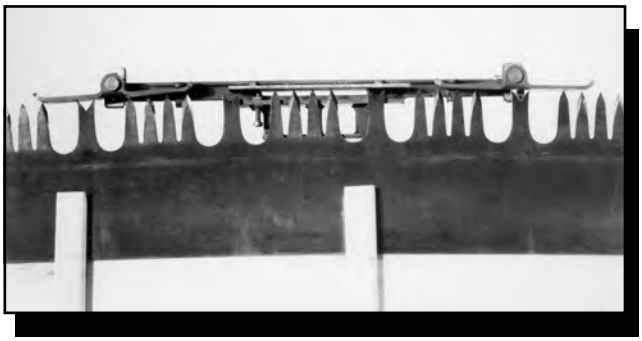


Figure 21—Jointing a saw with a long jointer, the preferred tool.



Figure 23—Striking the inside face of the raker tip with a hammer.

Fitting Rakers

I use a triangular file to shape the raker gullet. A raker gauge is placed on top of the cutters that have already been jointed to form the reference plane. With the rakers sticking up through the gauge, the rakers are filed down to a predetermined stop. Swedged rakers are fitted differently. They are hammered to a pin gauge (figures 22 and 23).

Tooth Pointing

Each tooth is sharpened to a point (figure 24). The filer has the option to make the bevel suit the wood that is being cut. It is very important that all the teeth are the same height in relationship to the rakers (figure 25).

Setting Teeth

The teeth need to be set so they track directly behind one another in a measured angle offset from vertical. The filer

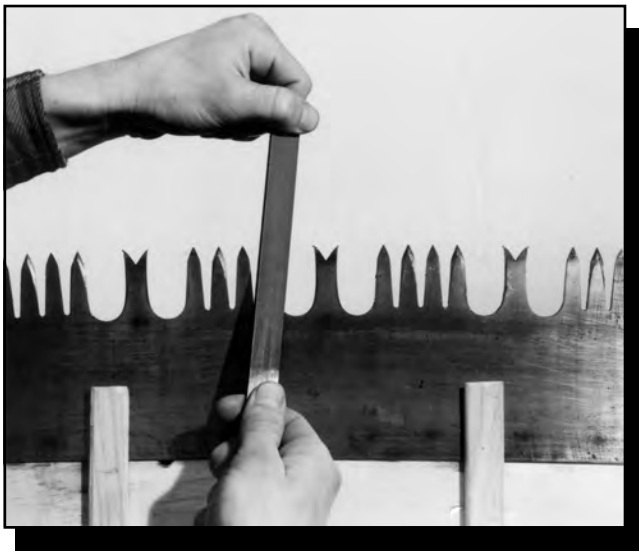


Figure 24—Filing a cutter tooth.

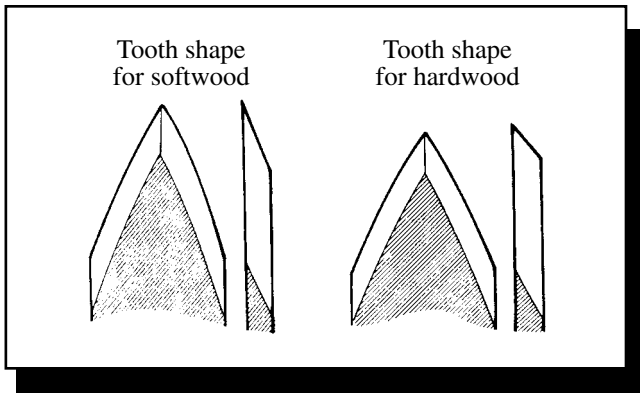


Figure 25—Shapes of crosscut saw teeth. Bevels can be adjusted to best suit the wood being cut.

puts equal set in all the teeth by hammering the point over a beveled hand anvil (figure 26). The set is checked using a tool called a spider to tolerances of $^{5}/_{1,000}$ of an inch.

After setting the teeth, I side-hone them to further ensure they all have the same set. I recommend this procedure even though it is not commonly mentioned in saw sharpening literature.

A final word about filing—If saws consistently come back from the filer but do not run smoothly and *sing*…find another filer.



Figure 26—Warren Miller setting cutter teeth.

Storage

Whether crosscut saws are stored at a backcountry guard station or in the district warehouse, they need to be stored properly.

Long-Term Storage

Store crosscut saws straight. Remove the handles and store the saws in a dry location.

Never store a saw flat on a metal surface. Although the saw can be laid horizontally if it is supported along its entire length, items may be dropped on a saw, damaging it. It is best to hang a saw from a nail through a handle hole.

Store the saw with a coating of heavy oil or grease diluted with solvent. The coating needs to be thick enough that it will not evaporate. Plant-based lubricants like canola oil are not appropriate coatings for long-term storage. These oils dry out and leave a hard residue on the saw that is difficult to remove.

Near saltwater environments, wash your saws in clean water to remove any salt residue before applying the heavy oil coating. Wear gloves when applying the oil.

Never lean a saw against a wall where the saw could develop a bend. Never leave a saw bent around a fire pack.

Do not store a saw in a sheath or with a guard on the blade. Rubber-lined firehose is particularly bad because it holds moisture next to the saw's teeth. If the teeth become pitted, the saw is useless because damaged teeth will not withstand the hammering needed during sharpening.

Do not hang a saw where people or animals could be injured by the unsheathed teeth. Do not store saws on top of one another. When the unsheathed saws rub against each other, the saws can be damaged.

I prefer to store my saws unsheathed on 16d finishing nails driven into the top plate of a wall in an isolated area of a building, where the saws do not present a hazard. Use 3-inch square pieces of corrugated cardboard as spacers between saws hanging on the same nail.

Storage in the Field

Moisture forms rust, and rust ruins saws, so take every effort to keep the saw dry. Saws can't always be kept dry in the field, so I place wet saws where they will dry quickly. Try hanging the saw under a heavily limbed tree where the branches will help protect it, or on the side of the tree that exposes the saw to the sun or wind. Remove the saw's sheath before drying, and tie the saw so it will not blow around in the wind.

Once the saw is dry, wipe it clean and rub it with an oily rag. Choose a storage location out of sight and away from game trails.

Remove the saw handles and sheath. Bears tend to gnaw on wooden handles. Rodents chew on leather straps and anything that has salt on it. Leave nothing but the metal parts in the field. If the saw is only being left overnight, it can be stored under a log with the teeth pointed in. If you are storing a saw longer than for just one night, hang it.

Saw Sheaths

Sheaths protect the saw and prevent it from causing damage or inflicting injury. Saws should be sheathed as much as possible unless they are being used or are in storage. Wear gloves whenever you remove or replace a saw sheath.

Saw sheaths can be rigid or flexible. Rigid sheaths are easier for hikers to carry for long distances because the saw blade doesn't flop up and down on the hiker's shoulder. One sawyer told me that his saw broke while he carried it over his shoulder. I assume the constant flexing led to metal fatigue.

Rigid sheaths can cover just the saw's teeth or the entire blade. Flexible sheaths provide protection while allowing saws to be bent around backpacks or over pack animals. Flexible sheaths also are lightweight and easier to carry when they are not on the saw.

A length of old firehose that has been split makes one of the best crosscut saw sheaths. Wipe the hose's rubber inner lining with an oily rag to repel water and reduce the possibility that moisture in the sheath will cause the saw to rust. Sheaths made of leather and nylon are available commercially. The Missoula Technology and Development

Center (MTDC) also has come up with a design for a saw sheath (figure 27, see *Crosscut Saw Guards* by George Jackson, 1997).



Figure 27—MTDC developed this saw sheath. The guard is made from 1½-inch discarded firehose using nylon straps and hook-and-loop fasteners.

Wear gloves to install the hose sheath. Begin by rolling the sheath inside out (rubber side out). Turn the saw so its teeth face up; unroll the hose down the saw, covering the teeth (figure 28). Attach the sheath to the saw using parachute cord or Velcro closures.

Some sawyers sandwich the saw between two rectangular pieces of plywood. The saw's handle holes are placed over pins at each end of one of the pieces of plywood, securing the saw.

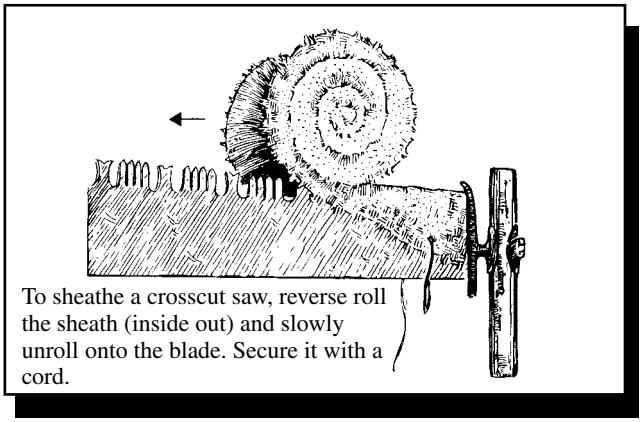


Figure 28—The proper way to unroll rubber-lined firehose onto a saw. Wear gloves to protect your hands.—*Copyright 1996. Reprinted with permission of the publisher of Robert C. Birkby's Lightly on the Land, published by the Student Conservation Association and The Mountaineers, Seattle, WA*

Transporting Saws

Saws that are being transported must be handled so they will not be damaged, so they will not injure people or livestock, and so they will not damage property and equipment.

Saws are difficult to transport because they are long and flexible. Vintage saws can be bent to make them easier for hikers or packstock to carry. You will not want to bend a vintage saw that has a nick or is not straight. Modern saws should not be bent. The softer metal will hold the bend, ruining the saw.

Because saws may be carried by a hiker, taken by boat, plane, helicopter, truck, dog sled, or packstock, or even be dropped by parachute during different legs of a journey, several types of protection may be needed. Sheaths should always cover saws when they are being transported.

Saws get hot in the sun. Be especially careful to wear gloves when handling a saw that has been lying in the sun. Also, gloves can prevent the cuts that would otherwise occur when you are putting on and taking off the saw sheath.

Boats

Particularly in Alaska, crosscut saws may be carried in boats. When a saw is carried as general cargo in large boats, it should be sandwiched between plywood and laid flat, if possible. In open skiffs, where space limitations preclude using a rigid plywood sheath, remove the saw's handles and place the saw on top of other cargo with only the teeth sheathed. On many boats, the saw may be kept out of the way if it is stored along the gunwales.

Open boats can take on a lot of spray. Saltwater spray can cause rust. Once the saw is on land, remove the sheath and rinse off any salt with freshwater.

Saws transported on kayaks are best secured to the bow, where they can be seen. In canoes, carry saws in the center on the floor. Transport the saw without handles in a rubber-lined hose sheath. Secure the saw by tying parachute cord through the handle holes and tying the cord to the canoe or kayak.

Aircraft

In small aircraft, firehose sheaths will allow the best flexibility so the saw can fit in tight quarters. Cargo and passengers must be separated, often by a nylon net. Sometimes the sheathed saw can lie flat. At other times, the saw needs to be bent into a loop. Normally, when a saw is bent, the handles are left on and tied together. In small aircraft, the handles often get in the way. If so, remove the handles, bend the saw into a loop, and secure the saw ends of the saw with **wire** through the handle holes.



Do not string parachute cord or any other nonmetallic material (including nylon ties) through a saw's handle holes to secure it for transport in a plane or helicopter. Jostling during the flight could cut nonmetallic materials, allowing the saw to spring to full length. What might happen to passengers or an aluminum cargo compartment is best left to your imagination.

When carrying saws aboard helicopters, crewmembers must exercise great care to ensure the saws do not stick up into the helicopter rotor.

Saws also can be transported by helicopters in external sling loads. External loads are carried in cargo nets, bags, or slings. If other pieces of rigid cargo are as long as the saw, the saw, sandwiched in plywood, can be secured to them.

When saws are tied in a loop, they are prone to damage or breakage. Bending the saw around a solid object is better than bending it around a soft object, such as a duffel bag. One way to reduce breakage is to bend the saw around a box. Place the box in the middle of the sling bag with the saw's ends down. Stack other materials around the saw, being careful to avoid a box at the top that could shift, applying pressure to the bend. The saw should be relatively safe unless the load tips over on landing.

Parachutes have long been used to deliver saws for firefighting. Because the bent saw is exposed during the landing, good vintage saws occasionally are broken (figure 29).



Figure 29—A crosscut saw rigged for a parachute drop.

Vehicles

When transporting crosscut saws in a pickup truck, lay the sheathed saw flat on the bed of the truck, preferably on a truck bed liner rather than on the steel bed. Don't place heavy tools on top of the saw. Do not carry saws in the passenger compartment of a vehicle.

Packstock

Be extra careful when carrying a crosscut saw on packstock. Select the gentlest animal to carry the saw. Put that animal in the lead where you can easily see the saw. Leave the handles attached to a two-person saw. The heads of the rivet attachment pins should face up, not down, so the pins won't slide out and cause the handles to fall off. Covering both sides of the pins with strips of duct tape gives further assurance the pins won't slide out. Sheathe the saw with firehose. Some packers wrap the saw in a separate mantie (canvas cover used to wrap loads) with the handles secure and exposed. Bend the saw and place it over the animal. Some pack the saw with the teeth facing the rear of the animal to minimize the likelihood of injury if the sheath falls off. Others pack the saw with the longest end of the handles pointing to the back, where they are less likely to get caught on trailside branches. Go with what works best for you considering the trail conditions you will be facing. Tie the saw handles down to the latigo or cinch ring (figure 30). Also tie the center of the bowed saw with a rope that goes to the front sawbuck or the "D" ring of a Decker saddle. It's important to secure the bowed saw to the packsaddle and not just to the load. With the saw fastened on top, it is more likely the saw will stay on top of the animal and not fall to the side if the rope on either side becomes untied.

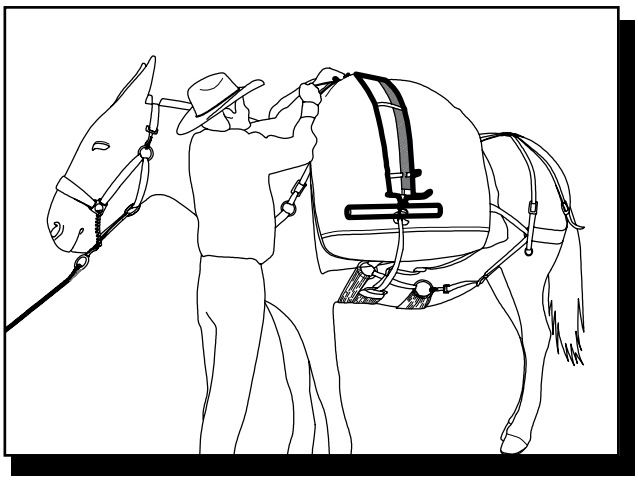


Figure 30–Securely tie each crosscut saw handle directly to the cinch ring or latigo, not to the load. Also tie the middle of the saw with a rope that attaches to the front sawbuck or the "D" ring of a Decker saddle.

Finish the packing job by using the cinch lash to tie the saw to the rest of the load (figure 31). That way, the saw is double-tied and unlikely to come loose.

Jim Thode of the Backcountry Horsemen of Washington has developed a rigid saw sheath that fits on a riding saddle (figure 32). This shoulder-to-rump sheath is loaded from the rear (figure 33). Fabrication details can be viewed on the Internet at *http://www.bchw.org/techtips.htm.* This sheath fits a 7-foot saw, unusually long for most trail work. A sheath sized for the more common $5\frac{1}{2}$-foot saw or single-person saw would be more useful. This type of sheath could be mounted under the load of a pack animal. It would be easy to slide the saw out alongside the animal from the rear to use to cut logs blocking the trail. Saws bowed and top-packed are difficult to unload and use enroute.



Figure 31–Finish the job by using the cinch lash to tie the saw to the rest of the load. This method is fine for moving a saw from home base to camp, but is very inconvenient if you need to use the saw along the trail.



Figure 32–A rigid saw sheath configured for a riding saddle. This design also could be sized for a shorter saw, or used on a pack animal.—*Photo used with permission of Jim Thode, Lewis County Chapter of the Backcountry Horsemen of Washington.*



Figure 33—The sheath is made of $^{3}/_{16}$-inch high-density polyethylene, held together with countersunk copper rivets.—*Photo used with permission of Jim Thode, Lewis County Chapter of the Backcountry Horsemen of Washington.*

One-person saws can be transported on riding stock in a leather or canvas sheath (similar to a rifle scabbard). A piece of hardwood inside the sheath protects the sheath from the saw's teeth. Position the sheath so users will pull the saw away from the animal's head when they remove the saw from the sheath.

Hikers

Saws should be sheathed when you are hiking to the jobsite. The person carrying the saw should be the last person in line.

Two-person saws should have the rear handle removed. If the handle is left on, it can snag on branches. The handle's weight also accentuates the saw's bouncing motion.

At the jobsite, the unsheathed saw can be carried on your shoulder with the teeth facing outward (figure 34). Avoid carrying the saw with the teeth pointing inward. Carry the saw on your downhill shoulder so you can throw it off if you slip or fall.



Figure 34—Transporting a crosscut saw to a jobsite by carrying the saw on the shoulder with the teeth facing outward. Saws need to be sheathed when they are carried for long distances.

Longer two-person saws have a tendency to bounce severely on uneven trails. For this reason, I prefer a solid wood sheath. Wood is more rigid than firehose, so wooden sheaths have little bounce and are less tiring to carry.

A vintage saw can be bent around a pack if the saw is being carried for long distances. Usually both handles are left on the saw to secure it in its bent position. Do not bend the saw any more than necessary. In very rough or extremely brushy terrain I remove the handles, securing the ends of the saw with 12-gauge wire through the handle holes. This reduces the risk that the saw will hang up in brush.

Axes

The ax is a constant companion of the crosscut sawyer. It is not possible to be a proficient sawyer without mastering certain ax skills.

MTDC has published detailed information about axes that will not be repeated here. See Bernie Weisgerber's report, *An Ax to Grind: A Practical Ax Manual* (1999), and the accompanying two-part video, *An Ax to Grind* (1999). Another video, *Handtools for Trail Work, Parts 1 and 2* (1998) show ax and saw experts Ian Barlow and Dolly B. Chapman using crosscut saws and axes in the field.

Our brief coverage of axes will be limited to applications related to crosscut saws. These include using an ax while underbucking, driving wedges, and holding log segments in place while logs are being bucked. The ax is also recommended for cutting the undercut when trees are felled.

Safety Considerations

- Always remove branches, underbrush, overhead obstructions, or debris that might interfere with limbing and chopping.
- Do not allow anyone to stand in the immediate area.
- Make sure workers know how far materials may fly.
- Require that all workers wear the appropriate personal protective equipment.
- Always position your body securely while working with an ax.
- Never chop crosshanded; always use a natural striking action.
- Be alert when working on hillsides or uneven ground.
- If you cut a sapling that is held down by a fallen log (a spring pole), the sapling may spring back.
- If you have no need to cut something, leave it alone.
- Never use chopping tools as wedges or mauls.
- Do not allow two persons to chop or drive wedges together on the same tree.
- When chopping limbs from a felled tree, stand on the opposite side of the log from the limb being chopped and swing toward the top of the tree or branch.
- Do not allow the ax handle to drop below a plane parallel with the ground unless you are chopping on the side of a tree opposite your body.

Single-Bit Axes

Single-bit axes used for driving soft metal or plastic wedges need to be relatively heavy, usually 4 or 5 pounds. Driving aluminum or magnesium wedges will not harm an ax, but driving steel wedges with the poll (back of the head) of a single-bit ax may ruin it. Instead, carry a small single-jack hammer for driving steel wedges. Some sawyers carry only a single-bit ax with a straight handle and attempt to do everything with just one ax.

Wedges

The proper selection and use of wedges is of utmost importance when working with a crosscut saw. The crosscut sawyer depends on wedges more than the operator of a chain saw, but many crosscut sawyers do not have a good understanding of wedges or their uses.

The size, weight, and shape of wedges, and the material from which they are made vary with their intended use and the preferences of individual sawyers. I always take several wedges to cover ALL crosscut saw operations. I carry plastic and metal wedges in a couple of sizes. As a minimum, I carry a pair of hanging wedges and two plastic wedges.

Because the kerf made by a crosscut saw is often only one-fourth as wide as the kerf of a chain saw, the leading edge of crosscut wedges needs to have a sharper bevel than the leading edge of wedges used for chain saws. New plastic wedges should be filed to a thinner bevel before using. Wedges can be single, double, or triple tapered (figures 35 and 36).

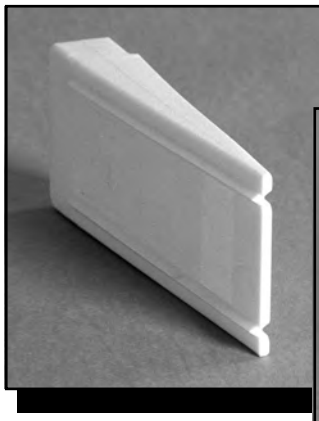


Figure 35—A rifled single-taper wedge is designed to provide lift when a tree is felled. The wedge can be stacked with additional rifled single-taper wedges. The rifling helps keep the wedges aligned and stacked as they are being driven.

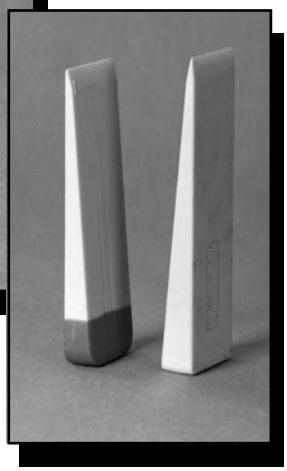


Figure 36—Double-taper wedges are designed to reduce bind.

Plastic wedges are good for felling operations. They do not split easily, and their textured surfaces provide additional holding power in the wood, helping to prevent the wedges from backing out when they are being driven. Plastic wedges are manufactured in a variety of sizes.

Although all wedges can be stacked (used one on top of the other), wedges may slip sideways if each wedge is not driven squarely. Newer wedge designs include "rifled" wedges. These wedges have a pair of grooves on one side and rails on the other. This design helps the wedges stay in place when they are stacked on each other.

Triple-taper wedges (figure 37) have a thin angle at the entry, an intermediate angle through most of the body, and a steeper angle near the top. I have not used many of these, but this design allows a shorter wedge to produce as much lift as a longer single-taper wedge. They are handy on small-diameter trees.



Figure 37—Triple-taper wedges allow a short wedge to provide as much lift as a longer wedge, but require more force to drive.

Always drive wedges by striking them squarely on the head. Drive them carefully to keep them from flying out of the cut.

Plastic wedges can break. If a long wedge can only be driven into the saw kerf a short way and refuses to go any farther, most of the wedge's length will be exposed, allowing a misplaced blow to break it. Use the shortest wedge possible that will accomplish your purpose. Hit the head squarely. Wedges should not be driven so tightly into the wood that blows deform the head of the wedge.

The sawyer should carry a single-bit ax or a single-jack hammer and an assortment of wedges. Plastic wedges occasionally get damaged, but they can be reshaped easily with a wood rasp or coarse file.

Wedges also are made of magnesium and aluminum. I like these soft metal wedges because they are so versatile (figure 38). They are light, stronger than plastic wedges, and



Figure 38—Wedges made from soft metals such as magnesium and aluminum are stronger than plastic, can be used as hanging wedges, and will not damage the saw.



Figure 39—Traditional metal wedges used for bucking and felling.

will not damage the saw. Unlike plastic wedges, they can be used as "tie wedges" or "hanging wedges" to keep a log from shifting as it is being bucked. Damaged soft metal wedges can be reshaped with a coarse metal file. Metal wedges can do the job of plastic wedges, but plastic wedges are no substitute for metal wedges.

Shallow grooves or depressions in the face of the wedge help prevent the wedge from backing out of cuts when the wedge is being driven. Wood fills the grooves and helps hold the wedge in place. Wedges with smooth faces can be roughened up with a cold chisel, helping achieve the same effect.

Felling Wedges

Felling wedges generally are longer and thinner than bucking or splitting wedges. Some felling wedges are only about 1 inch thick at the head and about 4 inches wide. Longer wedges—some as long as 13 inches—are available for large trees (figure 39).

Most felling wedges today are of the single-taper design and are made out of plastic or a soft metal, such as magnesium. Traditionally, wedges were made from durable wood or steel. Wooden wedges are not approved for crosscut saw use in the USDA Forest Service because they tend to split. For emergency use, wooden wedges can be fabricated in the field.

Felling wedges can be accurately described as lifting wedges. They are tapered on just one face and are truly an inclined plane. Metal and plastic single-taper wedges often have a groove on the flat sole face to increase holding power, while the inclined side is smooth to allow lifting.

Felling wedges exert force in the direction of the inclined plane. Two wedges can be stacked one on top of the other to produce more lift. Lifting wedges have many applications. They can be used to tighten, pry apart, or move materials. Exerting a force in one direction can be valuable. The sawyer may need to exert a force in one direction when getting a saw unstuck or when removing a chunk of log if the saw is bound.

When trees are being felled, single-taper wedges provide a way to lift the tree, preventing it from sitting back. A wedge must be inserted into the back cut as soon as possible. When logs are being bucked, wedges can reduce binds on the saw.

Bucking Wedges

Wedges used to reduce bind or split wood are double tapered, meaning that each of the broad faces tapers equally from the center. When such wedges are driven, wood moves away from both tapered sides equally.

Double-taper wedges are preferred for bucking, while single-taper wedges are used for felling. Both types of wedges keep the saw kerf from closing. However, the single-taper wedge used for felling performs a lifting function, while the double-taper wedge used for bucking pries the log apart. Crosscut saw bucking wedges are made of metal and are

shorter than felling wedges. They are wider at the bottom and have more of a fan shape than a felling wedge (figure 40).

Bucking wedges traditionally were called *hanging wedges*, or sometimes *tie wedges*, on the West Coast. Hanging wedges got their name because sawyers carried a lanyard, or cord, with a pair of wedges around their neck. The wedges are used as a pair, one driven across the kerf at the 10 o'clock position and the other driven across the kerf at the 2 o'clock position. Buckers usually sunk their ax on the uphill or least movable log segment tightly above the cord so when the log segments came free, the wedges would not fall onto the saw. I recommend that every crosscut sawyer have a pair of these metal bucking wedges.

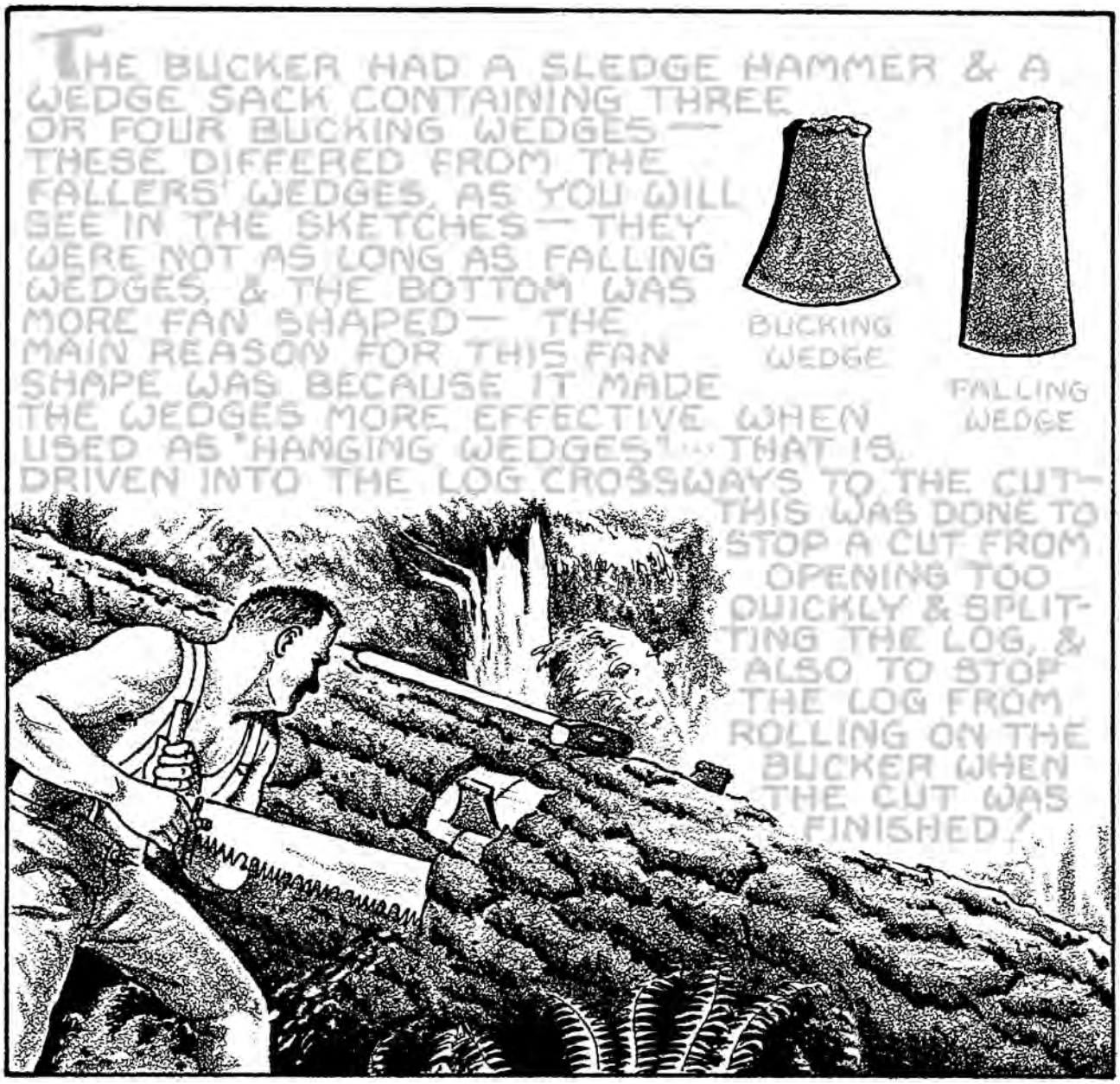


Figure 40—A bucking wedge being used as a hanging wedge. The wedge kept the cut from opening too quickly and splitting the log, and also stopped the log from rolling on the bucker when the cut was finished.—Now You're Logging, *by Bus Griffiths, with permission of Harbour Publishing, Madeira Park, BC, Canada*

Underbucks

Underbucks help hold the saw in position when the saw is cutting from underneath the log. They also act as a fulcrum. A good sawyer can cut as fast—or faster—from underneath a log as from the top. When the sawyer applies a downward pressure on the handle, the saw is forced up into the log.

Axes for Underbucking

Axes are often used to support the saw when underbucking. Axes used for underbucking typically have a straight, but slightly modified 36-inch wooden handle.

You can modify an ax for underbucking by cutting two series of three notches on one side of the handle about 6 inches from the end (figure 41). The grooves are far enough away from your gripping hand that they won't affect you when you chop with the ax. The series of three notches, placed about an inch apart, will allow you to line up one of the notches with the cut. The notches should be 30 to 45 degrees off perpendicular to allow room for the saw between the ax handle and the log. The shallow notches should not be cut into the grip portion of the handle.

Because it has a symmetrical handle, a double-bit ax is often the tool of choice for underbucking. Some less-experienced sawyers like to use a single-bit ax as an underbuck because they can drive the head with a single-jack hammer to better position the ax handle. I prefer the double-bit ax because of the versatility of having two blades.

Often a sawyer will dedicate a less-than-favorite ax to underbucking by flat grinding the cheeks of the ax head to a wedge shape. This shape allows more of the head to stick firmly into the log. This is great for underbucking, but ruins the ax for chopping because the blade sticks on every chop. However, if one blade of a double-bit ax is modified in this way, the other blade will remain usable for chopping.

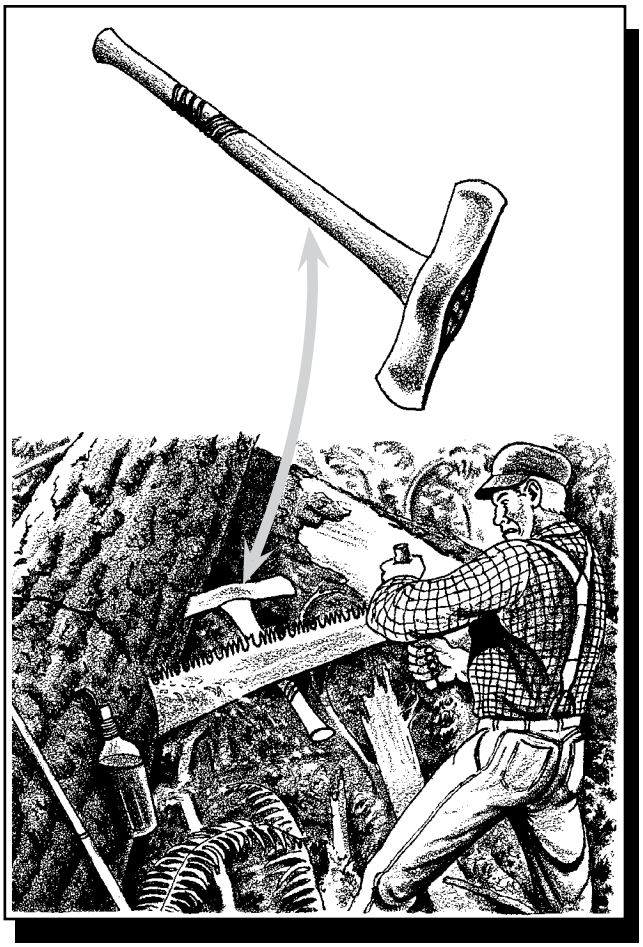


Figure 41—A double-bit ax that has been modified and grooved for underbucking. Usually a less-than-favorite ax was dedicated to this purpose.—Now You're Logging, *by Bus Griffiths, with permission of Harbour Publishing, Madeira Park, BC, Canada*



Figure 42—This vintage mechanical underbuck helps hold the saw up so it can cut from beneath the log. This is one design of many that were available.

Mechanical Underbucks

Sometimes mechanical underbucks (figure 42) are used instead of an ax. Some underbucks attach to an ax, others are sheaves that fit over an ax handle, and still others are

stand-alone tools. Most underbucks have a groove or roller on the end to serve as a guide for the back of the saw. This groove or roller needs to be adjusted properly to align the saw cut.

Vintage underbucks are hard to find. Homemade underbucks are easy to make out of a small leaf spring, a clamp, and a pulley. Custom underbucks also are available.

Mechanical underbucks are thought to increase production because they reduce friction as the saw traveled over the ax handle. But many buckers do not use them because they do not want to pack heavy tools through the woods.

I have a small vintage underbuck that clamps onto the ax handle. It allows the saw back to run in a sheave groove. I believe this lightweight underbuck, coupled with a modified, thinner ax head, is the best solution for much of our trail work.

A MTDC report by Chuck Whitlock, *Crosscut Saw Underbucking Tool* (2002), shows how to fabricate a similar lightweight underbucking tool (figure 43). This new model is not as good as my vintage underbuck. It would benefit by having a larger bearing surface on the ax, and a different clamp tightener that does not interfere with the saw at certain angles.

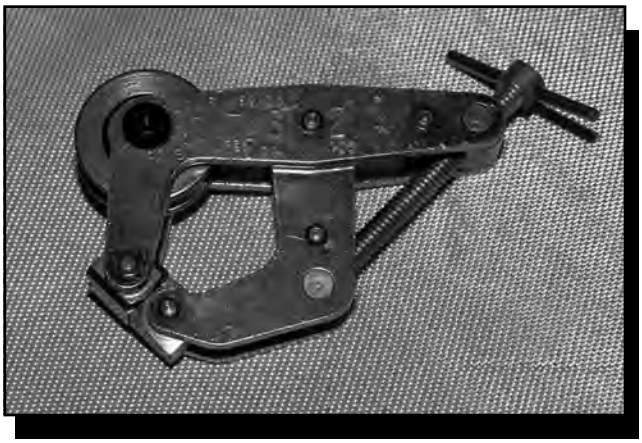


Figure 43—The MTDC underbuck features a 2-inch clamp with a shielded steel pulley. It attaches to an ax handle.

Lubricants

Lubricant is probably a misnomer in crosscut saw terminology, but it persists. Saw teeth do not need to be lubricated as they cut. The friction of the saw tooth set against the kerf keeps the teeth reasonably clean. Resin deposits on the lower part of the teeth and in the saw gullets do produce drag. Lubricants soften these deposits and help remove them. The lubricant serves more as a solvent than as a lubricating agent.

Cutting in extremely wet environments or during a hard rain can cause wood fibers to swell. In these conditions, a lubricant can help reduce drag.



Traditionally, crosscut saw lubricants were petroleum based. Diesel fuel and kerosene were the most common lubricants and were effective. Because of environmental concerns and the possible health hazards of petroleum-based solvents, the USDA Forest Service now recommends citrus or water-based solvents. Some tree resins can be removed with water.

Applying Lubricants

Squeeze bottles allow the sawyer or a helper to direct a stream of lubricant onto the saw's surfaces. On the push stroke, the sawyer keeps one hand on the saw handle and uses the other hand to apply the lubricant to one side of the saw blade. The sawyer lubricates the other side of the blade on the next push stroke.

Aerosol cans or spray bottles do not deliver enough lubricant to the saw blade to be successful. However, after the saw has been cleaned with a solvent at the end of the day, a thin coating of light oil can be applied with an aerosol can or spray bottle.

Old photos show crosscut sawyers using a corked whiskey bottle or Japanese sake bottle to hold their lubricants. I still like this method because it is simple and efficient (figure 44).



Figure 44—A traditional oil bottle applies liberal amounts of saw lubricant. The hook held the bottle to the log, conveniently within reach.—Now You're Logging*, by Bus Griffiths, with permission of Harbour Publishing, Madeira Park, BC, Canada*

To make a corked bottle, select a round bottle, about a quart in size, with a screw cap. Bottles need to be thick, with a neck that is easy to grab. Lash a sharp hook (that will stick in the tree or log) to the bottle's neck and insert a slotted cork or rubber stopper into the bottle's mouth. Rubber is easier to work. Two bottles, one for each sawyer, are convenient when bucking large logs. The slotted cork is used to protect the hook point, an important safety consideration, when the bottle's cap is screwed on for transport.

Experiment with the length, number, and size of the slots in the cork or rubber stopper. I usually cut three grooves in the cork, depending on the width and depth of each groove. You shake the liquid out instead of pouring it.

Some sawyers use a plastic squeeze bottle with a slotted cork. They remove the solid cap at the jobsite and insert the cork. The liquid is applied by simultaneously shaking and squeezing the bottle. Make sure the cork is tight so it won't pop off under pressure.

Instead of a slotted cork, sawyers in the past stuffed pine needles or grass into the top of the bottle to control the flow.

Preparation for Bucking and Felling

Safety Considerations

Great care needs to be taken when bucking or felling. The same principles apply whether a crosscut saw or a chain saw is used, but the sawyer is exposed to risks longer during crosscut saw operations. However, the crosscut sawyer can better bear the forces acting on the wood than a chain saw operator.



Never attempt any action that you cannot handle or if you are unsure of the prob-able outcome. Always be ready to adjust your cutting strategy based on how forces are affecting the cut.

Personal Protective Equipment

Less personal protective equipment is required to use a crosscut saw than is required to operate a chain saw. Although chaps and ear protection are needed to operate a chain saw, they generally are not required to use a crosscut saw.



Crosscut sawyers require eye protection because chips can fly when chopping or wedging and the wind can blow shavings into their eyes. Hardhats, work boots, appropriate gloves, long-sleeved shirts, and long pants also are required. Soft hats, tennis shoes, T-shirts, and shorts are not acceptable.

You should wear leather or cut-resistant fabric gloves. Handling a hot saw left in the sun, placing and removing sheaths, and other hazardous activities all require gloves. Cotton gloves are not acceptable. Wear proper-fitting gloves when sawing.

Boots are required when using a crosscut saw. Boots are defined in the USDA Forest Service's *Health and Safety Code Handbook* (FSH 6709.11) as: *Heavy-duty, cut resistant or leather, waterproof or water-repellent, 8-inch high laced boots with nonskid soles (hard toes are optional).*

A first aid kit must be available at the worksite. Other safety considerations such as a medical evacuation plan, provisions for radio use, and local policies (such as restrictions on working alone) must be followed by crosscut sawyers and need to be documented in the job hazard analysis (JHA).

Determining the Forces on the Log

When cutting a log, three main forces need to be considered: wood under compression, wood under tension, and gravity (figure 45).

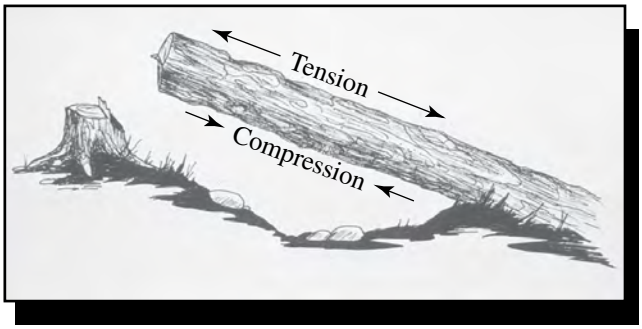


Figure 45—The log is being pulled apart by tension force and pushed together by compression force. Areas of tension and compression occur on opposite sides of the log.

Wood under compression wants to push together when it is severed. Compression wood causes crosscut saws to bind. Chain saws often can cut out minor compression, but crosscut saws cannot. Compression wood will completely bind the saw. Using wedges properly is more critical with crosscut saws than with chain saws. Crosscut sawyers should develop wedging skills to a high level.

Wood under tension wants to separate when it is severed. Tension, especially when combined with gravity, can be very powerful. Whenever wood is under tension in one part of a log, wood will be under compression somewhere else.

Understanding gravity helps the sawyer to work safely. Unlike the forces of tension and compression, the force of gravity is constant.

Situational Awareness

Plan the bucking cut carefully after considering:

- The escape route
- Slope
- Tension
- Compression
- Rocks and foreign objects on the log
- Pivot points
- Adequate saw clearance
- Overhead hazards
- The limits of your ability
- The length of the saw in relation to the log being bucked
- People and property in the cutting zone
- Spring poles
- Proper tool placement
- Falling or rolling root wads
- The log's tendency to roll, slide, or bind
- Broken-off limbs underneath the log that can hook the sawyer if the log rolls
- Safe footing

Bucking Sizeup

Sizing up the bucking situation means that the sawyer must visualize the hazards and consequences of each cutting action. This step is very important.

Overhead Hazards

Visually scan all adjacent trees. A fallen tree blocking the trail may have left broken limbs hanging in adjacent trees as it fell. These hanging limbs or trees are called widow makers.. They can become dislodged and fall at any time.

Do not work beneath any hazard that could come down on you or cause a chain reaction that may strike you. Winds can be a legitimate reason to suspend bucking when hazards are overhead.

Side Slopes

Assess the position of a fallen tree in relation to the slope. If the log lies straight up and down the fall line, end bind will be a concern. The safe uphill side of the log is easy to identify if the log lies parallel to the slope. If the log lies at a different angle, the safe uphill side will not be so easy to identify. Slope, pivot points, gravity, soil hardness and other factors all need to be considered.

Having good footing is extremely important. Take time to kick out a solid footing before beginning to buck.

On steep slopes it's sometimes a good idea to put a block of wood under the downhill side of the log to prevent it from rolling. The log may damage the saw and the trail if it rolls. The block of wood should be about a foot long with a sound limb on it. Remove the bark on the block to reduce friction and leave the limb up so you can pull the block out later.

When the log is severed, the wedges should allow it to settle against the block. While standing in a safe location, remove the wedges and use the limb to wiggle the block out. Never finish a cut on the downhill side of a log.

Spring Poles

Spring poles (figure 46) are limbs or saplings that are bent beneath a fallen tree. A spring pole can store a tremendous amount of energy. Spring poles can be dangerous if they are cut accidentally, or without careful planning. Cut a spring pole only when necessary.

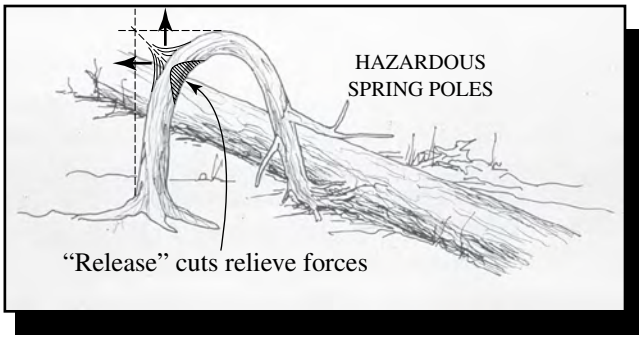


Figure 46—Look out for spring poles (trees or limbs that are being held down by other trees). Spring poles can release with great force, causing serious injuries. Make a series of small cuts on the inside of the bend when severing a spring pole.

Before cutting a spring pole, select the best spot to make the cut. One way to do so is to determine a point where two projected lines intersect. The first line extends vertically from the base of the spring pole. The second line projects horizontally from the extreme top of the pole's bend. From

the intersection of these lines, a 45-degree angle projected back to the spring pole marks the preferred place to make a series of release cuts. This technique is also used when determining where to cut bent limbs. In those cases, *horizontal* and *vertical* become relative terms.

If other safety factors do not prevent you from severing the spring pole at the calculated spot, make a series of small cuts on the side under compression. This is always the inside of the bend. Your cutting position and escape routes need to be carefully considered. You must understand the direction the cut ends will travel when planning a safe escape route.

Never use two sawyers when cutting spring poles.

Do not use a crosscut saw to release a spring pole unless the pole is very large. If a crosscut saw is used, a one-person saw with smaller teeth on the front is preferred. Regular crosscut saw tooth patterns usually do not allow the carefully controlled cuts needed to release spring poles.

Some sawyers prefer to use the small teeth on the extreme end of a crosscut saw because the teeth are finer and because doing so provides more distance from the cut material. My experience has taught me that being closer and in absolute control of my carefully placed cuts is safer than being farther back.

I prefer to use the small folding pruning saw that I carry in my day pack. It provides me the most control over the amount of wood fiber being severed. I do not use a crosscut saw for cutting spring poles except in rare situations, usually associated with limbing, where physical barriers prevent me from using the small saw. An ax or Pulaski also may be used, but be careful to limit the depth of each cut. Releasing compression with an ax requires light hacking or nicking rather than actual chopping.

When using a saw, I cut into the compression wood until the sapling moves or the saw starts to bind. I cut no farther and remove the saw quickly. I place an identical cut about one to one-and-one-half times the sapling's diameter away. When this cut binds, I remove the saw and place a third cut between the first two cuts but closer to the first cut than the second. Usually I can cut a little deeper than I did with the first cut. I continue alternating back and forth, working toward the center between these cuts, always vigilant for the tension side to rip apart and the spring pole ends to fly away from me. By the time I have made a number of cuts, some of the energy stored in the wood fibers has been removed, making the final break less violent.

The most common form of spring poles encountered by crosscut sawyers during trail clearing are the limbs on the underside of a green tree that has fallen across a trail. If the spring poles are directly under the tree, the limb usually strikes the dirt directly beneath it when the limb is severed. The more hazardous limbs are those located along the sides of the log. These limbs can fly outward when severed.

Avoid making the common mistake of severing bent limbs at the bole of the tree. Always cut at the spot indicated by the intersection of the projected lines, even if it means making a second cut flush with the bole later so the log can be rolled off the trail. Cutting limbs under great pressure at the bole of the tree rather than at the spot indicated by the intersection of the projected lines exposes the sawyer to much greater risk. Be especially careful to clean out a safe working area before cutting these spring pole limbs. I save them for last, after I have removed all other vegetation and have secured a safe working area with escape routes.

Suspended Logs

Cutting a suspended log is a single-buck (one person) operation. Often only one side is safe or has adequate footing for you to make the cut.

If you are standing on blowdown where several trees are jackstrawed in different directions, carefully evaluate the sequence in which trees should be removed. Resist the temptation to dive in and cut the first log you come across. Generally, the bottom logs should be cut and removed first. This practice reduces the chance that logs or other material on top will move.

Be sure there is a safe path for any cut log to follow. This is the reason I remove the bottom logs first. If you cut from the top down, the top logs can fall between bottom logs, making the bottom logs impossible to cut.

Proper use of skid logs makes dealing with jackstrawed blowdown safer and easier. Skid logs are placed underneath the log you are cutting to make it easier to move. Calculate

the results of your planned sequence of cuts, so that you will have skid logs properly positioned to help move the log where you want it to go. Sometimes those logs support the log as it is being cut.

It might not be possible to remove all suspended trees with a saw. Take out only the ones that can be removed safely. Other suspended trees could be removed with winches or explosives, if necessary.

Often, suspended logs roll when they are released. Be sure the log has a safe path to travel. Logs may ricochet off other objects, making their paths unpredictable. Be sure no snags or other weak trees are in the log's path. They could snap if the log strikes them. Fell snags or weak trees first, if they can be felled safely.

Pivot Points

Pivot points are high points on the ground, or a rock, stump, log, or even limbs on the lower side of a log, that catch part of a moving log and cause it to pivot unexpectedly. Pivot points can be very dangerous and may not be easy to detect. The pivot point acts as a lever in either the vertical or horizontal plane. A log lying on an undetected rock can shift violently upward when the log is bucked. A rolling log caught at its midpoint can swing back uphill or sideways toward the unsuspecting sawyer.

Side Binds

Side binds occur when one side of the log is under compression and the other is under tension. Side bind usually occurs when a log has fallen and is resting between a couple of trees or other obstructions. Cut the compression side first and finish by cutting the side under tension. This cut can be difficult, because it may require sawing from a vertical position. Instead of sawing out side binds, I usually chop them out if they are not too large. Chopping is safer.

Rootwad Movement

Take a close look at logs still attached to their upended rootwads. Are the rootwads going to move when they are severed from the rest of the tree? Where will they move? If the tree is green or the ground is very wet, the roots may be bent over and under a lot of pressure. Try to dig under the rootwad to evaluate any major roots you may not see. These are similar to spring poles, but are more difficult to detect. Spring pole roots also may act as pivot points, causing the tree to swing when the bole is severed.

Rootwads that have no firm attachment to the ground can roll easily, especially on steep slopes, or if the bole is severed near the rootwad. I sometimes secure rootwads by attaching a winch cable to them so I can apply direct holding pressure. This technique also helps to reduce end bind. A rope works just as well. The idea is to keep the rootwad in place.

Unsound Wood

Rotten wood can crack or break without warning. Logs may be sound in one part and rotten in another. Examine the ends of logs and look for indications of rot. Observe the color of shavings the saw is producing. Dark shavings indicate rot. Rotten wood doesn't hold wedges well, making them ineffective. Because rotten logs may hold more moisture, saws tend to load up with shavings, increasing the need for wedges to keep the kerf open.

Test for soundness by thumping the log with the poll of a single-bit ax. The ax will rebound from the sound wood and the thump will produce a high-pitch noise. Rotten wood has a hollow, low-pitch sound. Loose bark can be a problem to the crosscut saw bucker, although loose bark is not as hazardous on a fallen tree as on a standing tree. Remove loose bark before bucking. Vertical or spiral cracks may indicate weakness and can cause a log to spiral open, especially when it is bucked on steep side hills. Fire-weakened trees need to be sized up carefully as well.

Log Movement

Assume that most logs will move when bucked. Not all log movement is hazardous, but even the slightest movement can pinch a crosscut saw, bend it, or damage the saw's set. Larger logs present more potential risk because their center of gravity is higher and they are heavier.

Planning the Cut

Think the cut through. Make sure that you have the correct saw, the right complement of wedges, and an ax or single-jack hammer to drive them. Know exactly where each cut will go, the types of cuts you will need, and the sequence of the cuts.

Figure out what the severed log is likely to do, and what you would like it to do. You can sometimes control the log by managing the energy that is released when the log is severed. You can retard energy release with wedges or with blocks that prevent the log from rolling. You can accelerate energy release by using ramped skid logs. Expert crosscut saw users apply the principles of force and movement to get the log to its final resting place.



Can the log be bucked safely with existing skills and equipment? Sawyers should not feel pressured to perform any task that is beyond their ability. Ask other crewmembers to size up the situation silently. Discuss your findings afterward. Listen to dissenters. Sizeups based on "group think" where dissenters' views are not expressed or not considered often miss important factors.

Shattered logs are especially troublesome, because each splintered section may have its own bind. The sawyer may have to cut first from one side, then move to the other. Chopping out a V-notch with an ax is another good alternative to cutting it with a saw.

Types of Cuts

The three basic types of cuts are: the straight, compound, and offset. Each type of cut and its usual application (figure 47) is described.

A straight cut is made through the log, usually starting from the top. It can be performed by single or double bucking.

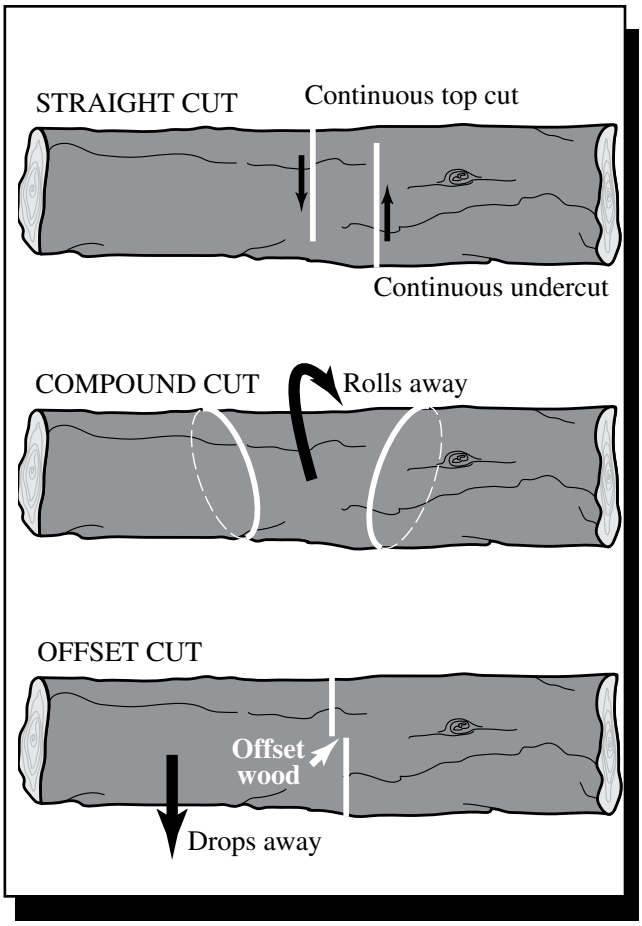


Figure 47—Three basic cuts: straight, compound, and offset.

It can also be cut continuously from underneath the log by a single sawyer using an underbuck.

The forces on the log allow the saw to cut through the log only with the help of wedges. Unfortunately, inexperienced buckers sometimes try to use a straight cut when a compound or offset cut is needed. When a saw is bound tight in a log, the bucker probably used a straight cut inappropriately.

A compound cut is placed at an angle that is narrower than perpendicular to the log and angled so that the bottom of the cut slopes toward the part of the log that is being removed. This cut typically is used when clearing a large log that is across a trail. Two cuts need to be made and the severed chunk of the log has to be removed.

By placing a compound cut so that the severed log is longer on the downhill side, the bottom of the cut log is

narrower than the top of the cut log. This reduces the chance that the log will bind when it is rolled out of the way. This cut is performed either as a straight cut or as a combination of top cut and undercut.

The offset cut is placed so that the bottom underbucking cut *does not* match up exactly with the top cut.

This kind of underbucking operation is used when a log is suspended and will drop free when severed. Once the top cut has been made, a single sawyer selects a groove (about $\frac{1}{2}$ inch toward the ax head from the top kerf) from the grooves cut into the saw handle or installs a mechanical underbuck. The ax head is always secured to the side of the log that won't move when the log is cut.

In underbucking, offset wood prevents the severed log from damaging the saw or causing injury when the log drops. This small amount of offset wood acts like the holding wood left when trees are felled. In felling, the holding wood keeps the tree from kicking back.

Determining the Safe Working Side of the Log

Whether you are sawing alone or in tandem, you need to determine the safe working side of the log. This is the side where the final cut will be made.

Planning and Clearing Escape Routes

Escape routes when bucking need to be thought of differently than escape routes when felling, but the principle is the same. Determine danger zones and plan an escape route that avoids them. Clear debris along the route. Although you may not have to use your escape route, your life may depend on it if a log pivots or another problem arises.

Establishing a Work Platform

Because crosscut sawing requires good balance, you need a fairly level platform under your feet. Remove logs, branches, brush, and other vegetation. Use a digging tool to create footholds on steep ground.

Saw blades work best when they are operated perpendicular to the force of gravity. Keeping saws level often requires cutting from a kneeling or crouching position. Kneeling or half-kneeling is better than crouching, both for ergonomic reasons and to maintain control over the cut. Too often a sawyer working from a crouch allows the saw to hit the dirt on the offside of the log, or the saw pinches because the sawyer left too much holding wood on the near side of the log.

Providing Adequate Saw Clearance

Remove rocks and dirt under the log that could dull the saw. I try to dig under the log and place bark or other soft material there to protect the saw when it finishes the cut. Remove all vegetation from the path of the saw.

Bark Removal

The bark on logs often contains sand, dirt, and small rocks that can dull the saw. Fire-charred logs also dull saws. Most crosscut sawyers remove the bark with an ax before starting to cut. In addition, bark is spongy and can reduce the effectiveness of wedges. Remove enough of the bark so that wedges will contact firm wood.

Tool Placement

I usually place wedges and axes on top of a large log where either the uphill or downhill sawyer can reach them. Do not place tools on top of the log if they can fall on the downhill sawyer. The sawyer at the uphill position will set the top- and near-side wedges and ensure the safety of the lower sawyer. The lower sawyer sets the hanging wedge on his or her side of the log, if it is needed.

I often place skids under the log so it won't drop into a hole or trench. Long steel rock bars work as skids; so do native poles. Leave branch stubs about 2 to 3 inches long on the bottom of the skid to help anchor it. If extremely heavy log segments need to be skidded, I use a green tree with the bark removed for a skid. I can make the peeled log slide more easily by pouring water on it.

Crew Communication

Clear communication among all crew members is vital for safety and efficiency. Be sure everyone knows the planned sequence of events. Know where the severed log is going to

roll. If a portion of the trail is below the path of the log, post a trail guard in a safe place to warn unsuspecting visitors of the hazard. Be sure everyone knows who will give the *all clear* signal.

Determining Binds

Understanding directional forces, or binds, is important. Binds determine bucking techniques and procedures.

Landforms, stumps, blowdown, and other obstacles that prevent a log from lying flat cause binds. The four types of bind are: top, bottom, side, and end (figure 48). It is possible for logs to have no bind. Normally, logs have a combination of two or more binds:

- **Top Bind**—The tension is on the bottom of the log. The compression is on the top.
- **Bottom Bind**—The tension is on the top of the log. The compression is on the bottom.
- **Side Bind**—Pressure is exerted sideways on the log.
- **End Bind**—Weight compresses the log's entire cross section.
- **No Bind**—This log could be cut without a wedge and it would not move. It is difficult to predict binds, so a safe practice is to wedge logs even though you don't think they have binds.

Determining Bucking Locations

It is best to start bucking at the top of the log and work toward the butt end, removing the binds in smaller material first. Bucking is generally a single-person operation. Two sawyers may be used when it is safe to do so.

Determine the offside (figure 49). The offside is the side the log will probably move to when it is cut, normally the downhill side. Watch out for possible pivots. Clear the work area and escape route. The work area should be at least 8 feet wide in the vicinity of the log to allow plenty of room for escape when the final cut is made. Establish solid footing and remove any debris that may hinder your escape.

Cut the offside first. If possible, make a cut about one-third the diameter of the log. This allows the sawyer to step back from the log on the final cut.

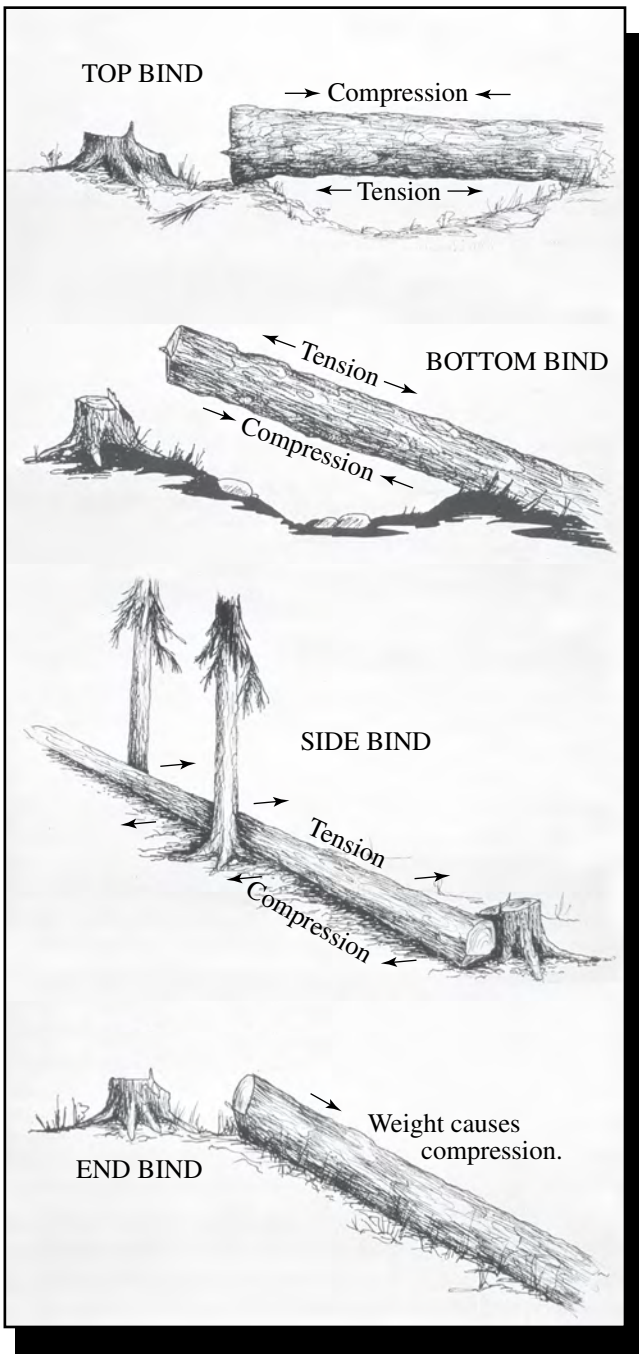


Figure 48—There are four types of binds. A log can have a combination of two or more binds.

Points to Remember When Planning the Cut

- Do a complete sizeup. Identify the hazards and establish your escape routes and safety zones.
- Use objects such as rocks, stumps (if they are tall enough), and sound standing trees (with no overhead hazards) to



Figure 49—Determine the offside (usually the downhill side), and stay clear of that side when you are single bucking.

protect you from the log if it springs sideways toward you when you finish the cut.

- Remember that removing a single section of log may require that other binds be eliminated first.
- Make angled bucking cuts, wide on top and on the offside, so that a single section of log can be rolled away from the rest of the log.
- Buck small sections of the log that will be easy to control when they begin moving.
- Be aware that binds and potential log movement will change as you cut. Reevaluate them as necessary.
- Warn workers who are working in and below an active cutting area. Give them time to move to a safe location. Verify their safety, visually and verbally.
- Announce when a bucking operation has been completed.
- Ensure that all logs are completely severed when they are bucked.
- Use flagging to mark an incompletely bucked log as a hazard.
- Never approach a cutting operation from below.

Single-Bucking Techniques

New sawyers should master the skill of single bucking before learning double bucking. If new sawyers can handle a long two-person saw alone, they have mastered the principles of keeping the saw running smoothly without buckling. Thinner, lighter felling saws are harder to use for single bucking than the stiffer, heavier bucking saws.

The reasons to single buck include:

- The sawyer starts out double bucking and needs to finish the cut from one side because of safety considerations or log movement.
- The log is too large for the length of the saw, so one handle has to be removed to increase the effective length of the saw. The end of the saw can be drawn into the log once the handle has been taken off, allowing shavings in the gullets to be removed when the end of the saw leaves the log.
- The sawing sequence starts or ends with underbucking, which can be done only by a single sawyer.

When making compound cuts, the length of the cut determines the length of saw that is required. The saw does not work as efficiently in a sloping or compound cut as it does in a straight cut. The more angle that is placed on a compound cut, the less effectively the saw will work. Compound cuts can make sawing difficult.

Single Bucking With No Bind: Top Cutting

- Remove the bark where the cut will be made.
- Lay the unsheathed saw on its side over the log. Sprinkle lubricant on both sides of the saw.
- Hold the saw with your dominant hand and guide the back of the saw with the other hand for a few strokes until the saw is securely in the kerf.
- Insert wedges as soon as they will clear the saw, driving them snug. Do not hit the back of the saw with the wedge.
- Lubricate the blade as needed just before the push stroke. On a smaller log, the sawyer may be able to lubricate the far side of the saw just before the pull stroke. Lubricate both sides of the saw blade equally.
- As you finish the cut, use only the teeth at the end of the saw blade. This technique prevents the log from damaging the "production" cutters near the center of the saw if the log rolls or pinches the saw.

Single Bucking With Top Bind: Underbucking Required

Underbucking is used when the log has a top bind and you can get under the log. Sometimes, a V-notch can be chopped out of the top of the log, then finished with underbucking. More frequently, the first cut must be started from the top because the top of the log is under compression. If the compression is not corrected, the kerf may close and pinch the saw.

After you have inserted the wedges and driven them snug, continue cutting down from the top, leaving enough uncut wood to support the log's weight. Because the top of the log is under compression, the bottom is under tension. The more compression you relieve, the greater the tension on the bottom of the log. The log will start to equalize this pressure by exerting pressure on the wedges. If you use two or more wedges spaced at the 10 and 2 o'clock positions, you can spread the force over a larger area. If only one wedge is used at the 12 o'clock position, all the energy is directed to that relatively small area.

Listen for the sounds of wood fibers popping as they are severed as an indication of the intensity of compression and tension. The louder the sound, the stronger the forces at work.

Watch the kerf to detect log movement. Position yourself so you can detect a slight opening or closing of the kerf. This is the best indicator of the log's reaction on the release cut. If the bind cannot be evaluated, proceed with caution. It may be necessary to move the saw back and forth slowly to prevent the saw from getting bound as compression pressure closes the kerf. Cut just far enough to place a wedge. Continue cutting. Watch the kerf. If the kerf starts to open, the log has a bottom bind. If the kerf starts to close, the log has a top bind.

Remove the saw from the top cut and prepare to finish the cut from the bottom by underbucking. A log or rock can be placed under one side of the cut, supporting the log so it will be less likely to drop as far as the ground when the cut is completed.

Underbucking—During sizeup, you determined which side of the severed log probably would remain the most stationary, providing the anchor point for the underbuck. A common mistake is to place the underbuck on the side that is easiest to reach. If this side of the log moves, the saw or ax handle could be damaged.

To underbuck, use a mechanical underbuck or plant an ax in the log (after removing the bark) so the handle can be used as a support for the back of the saw (figure 50). Line up the underbuck grooves in the ax handle with the top saw kerf and forcefully swing the ax into the log.



Figure 50—An ax planted in the lower part of the log can work as an underbuck.

Place the back of the inverted saw in the underbuck groove. The saw typically starts at an angle of about 45 degrees from horizontal. Your guiding hand holds the back of the saw. With a light downward pressure on the underbuck, push the saw forward. Pressure on the underbuck needs to be consistent on the push and pull strokes.

Oil in the underbuck groove will help the saw run easily and will reduce wear on the ax handle. Adjust the handle angle to allow room for the saw to be inserted and for the underbuck to be parallel to the saw kerf, but offset slightly closer to the ax head unless you are underbucking a compound cut.



If I'm finishing a cut by underbucking, I make sure that my undercut does ***not*** exactly meet the top cut. Rather, I align the saw on the ax handle so the saw is offset about a half an inch from the top cut in the direction of the ax head. When the log breaks away and drops, the saw is protected by remaining in the kerf. If the technique is reversed, the moving log will drive the saw into the ax, possibly damaging the ax and injuring the sawyer.

If you are underbucking a compound cut, the cuts must match exactly. Any offset could prevent the log from being freed. If the cuts do not match, several more wedges may have to be placed in the top cut to provide additional bearing pressure on the kerf faces, holding the log in place. If there is a chance that the wedges will not hold, remove the saw and start another cut, rather than risk damaging the saw.

After several strokes, you can remove your hand and continue normal cutting. With continued downward pressure, the end of the saw will be doing more of the cutting and the saw blade will level out. As the cut nears completion, be prepared in case the severed log drops.

Often the wedges hold the log stationary after the cut is completed. To remove the hanging wedges, stand on the near side and reach across the top of the log to remove the offside hanging wedge. Then remove the near-side wedge.

Single Bucking With Top Bind: Top Cutting

Several methods can be used to buck a log with top bind that does not have enough room underneath for underbucking.

All sawing will be from the top. After removing the bark and beginning the cut, wedge the log well to keep the kerf open. Follow the instructions for wedging given earlier. Periodically, drive all the wedges until they are snug. Do not allow the wedges to contact the saw.

The cut will want to open up at the bottom. Place a log or other material under the log segment that will drop when the cut has been completed, reducing the distance the severed section of log will fall and helping to direct it to the place you want it to go.

The severed log may roll. A log that drops and rolls may damage the saw. Inserting metal hanging wedges at the 10 o'clock and 2 o'clock positions across the kerf will reduce the likelihood that the log will roll.

For very heavy logs with serious binds, a steel plate can be driven into the saw kerf as added insurance that the kerf will not close. Because steel plates are thin, they can be driven deeply without spreading the log apart. Steel plates are easier to drive than wedges and provide a large surface area to hold back the top bind. I rig these plates with a lanyard that can be secured to an ax placed on top of the log. This technique prevents the plate from dropping onto the saw when the log is released. Often there is enough bind on the steel plate to keep it in place. I also use lanyards on my pair of hanging wedges to prevent them from dropping onto the saw.

Single Bucking With Bottom Bind: Top Cutting

When there is bottom bind and too little room to get the saw underneath for an undercut, all the cutting will be done from the top. The main problem with bottom binds is that standard wedging does not help. In addition, when the log is severed, sections of the log may drop or roll, possibly damaging the saw blade.

Cut the log as explained for top cutting with single bucking. Place a small plastic wedge snugly at the top of the cut. Do not drive the wedge in.

When this wedge starts to drop into the kerf and the kerf is beginning to open, drive two fan-shaped metal hanging wedges across the kerf at the 10 and 2 o'clock positions to slow the opening of the kerf and keep the log from settling or rolling.

As the kerf opens at the top, the uncut wood is under more and more compression. If the force becomes too great, the uncut wood may slab off, possibly damaging the saw. To prevent slabbing, the sawyer needs to keep sawing or even speed up sawing to keep the kerf opening and relieve the compression pressure. When the log is sawed through, the log's weight may pull out the metal wedges, allowing the log to drop and roll.

Perhaps the best technique to reduce the effects of a bottom bind is to insert a stick into the opening saw kerf just before driving the hanging wedges. A straight, finger-sized limb about a foot long can be inserted (figure 51) into the opening kerf at the top of the log (do not use plastic wedges).

As the kerf continues to open, the stick slides into the kerf. The stick will not drop to the back of the saw because it is too thick. As the cut is completed, the two halves of the severed log will hinge on the stick. The bottom opens up, allowing the saw to drop free.



Figure 51—A stick dropped into the kerf on a log with bottom bind will serve as a pivot when the log is cut through. This is a lost trick that is very practical and can prevent damage to the saw.—Now You're Logging, *by Bus Griffiths, with permission of Harbour Publishing, Madeira Park, BC, Canada*

Single Bucking With Bottom Bind: Undercutting

If you have bottom bind and can get under the log, make the first cut from the bottom. In this case, wedging is not as critical. If the first cut is from the top, fan-shaped metal wedges can reduce the speed with which the kerf opens. A stick can be inserted into the opening top cut if the log is large enough for the stick to fit into the kerf.

Finish the top cut, trying to match the bottom cut exactly. Offset cuts are not used unless you are finishing with an undercut.

Single Bucking With End Bind

If more than one cut is being made on a log, as is often the case during trail clearing, I usually make the first cut at the largest diameter, especially if it is uphill. This reduces the amount of end bind pressure on the second cut.

If you are cutting down directly from the top, use more plastic wedges around the cut, especially as the cut progresses below the centerline of the log. The wedges will reduce the possibility of binding.

Single Bucking With Side Bind

This is one of the most difficult and hazardous binding situations.

If there is room below the log for the end of the saw to clear, cut the side with compression wood first. The finish cut is on the side with tension wood. Alternately saw and chop out wood with an ax. The saw should be in a nearly vertical position. Always find a safe position before making the finish cut.

If the log is on the ground in a side-bind situation, options are limited. For trees larger than 20 inches in diameter, the only options are to place a cut beyond the side bind area or to cut out the area with an ax.

Double-Bucking Techniques

New sawyers should master the skills of single bucking before learning double bucking. The reasons to double buck include:

- Large logs can be sawed more easily by two sawyers.
- Two sawyers can transport equipment more easily than one.

Attach both saw handles before removing the sheath.

Do not use a saw with damaged handles or handles that are difficult to remove. After the sheath has been removed, the uphill sawyer normally hands the saw to the downhill sawyer by grasping one handle and the middle of the saw blade with the teeth facing away from the downhill sawyer who is receiving the saw.

Usually the uphill sawyer (the primary sawyer, who will finish the cut) lubricates the saw and positions a guiding hand on the back of the saw for the first few strokes.

If you are planning to roll the log out of the way, be sure to make a compound cut. The goal is for the sections of log to have as little surface resistance against each other as possible. The larger the log, the more careful the planning needs to be for the compound cut. Make the cuts where you will be safe and you will be able to move the log.

Your dominant hand (the power hand) should be placed firmly around the saw's handle. Your other hand can rest on top of the handle to guide the saw and to help you maintain your balance. Your dominant hand pulls the saw straight back to the side of your body. Sawyers often grip the non-power handle too tightly. This tends to pull the saw across their body.



Always pull. Never push! Allow your partner to pull. Pushing may cause the saw to buckle.

As one sawyer pulls, the other sawyer keeps a relaxed grip on the handle. The sawyer neither pushes nor holds back. Holding back is called riding the saw, which makes it harder for the other sawyer to pull. Your partner will not like this.

If you momentarily relax your grip, the saw will reposition itself in your hand for the pull stroke. Relaxing your grip also increases circulation in your hands and reduces fatigue.

If one sawyer needs to change body position (to drop to a kneeling position, for instance), the other sawyer needs to adjust the angle of the saw to accommodate the change.

Wedges should be placed as soon as there is room to insert them behind the back of the saw. Usually for large logs, two wedges are inserted at the 10 and 2 o'clock positions and driven firmly until they are snug. If the wedges are not snug, the saw could be damaged.

Be sure the saw travels into and out of the kerf in a straight line. Look down the saw toward the other sawyer to make sure the saw is traveling in a straight line.

If the log is going to be finished up by single bucking, whenever *either* sawyer determines it is time to stop sawing, both sawyers stop. If you are on the downhill side, you should quit sawing and leave whenever you feel you are in jeopardy. Do not allow your judgment to be swayed by your partner. Each partner must honor the other's request without pressure.

On flat terrain, be sure that the arc of the saw remains parallel to the ground. Do not raise one end of the saw higher than the other.

Usually the bottom bark has not been removed. Carefully look at the shavings. When they change to the color of the bark, the log has been severed and only the bark is holding it. If the log falls on mineral soil, the impact can force rocks into the bark. The rocks can dull the saw's teeth. Usually the cut is stopped when wood-colored fibers are no longer being removed.

When the cut is finished, or when it is being finished by single bucking, remove the handle on the downhill side of the saw and allow the uphill sawyer to pull the saw free. Make sure the downhill sawyer is in a safe location before the uphill sawyer continues the cut.

Do not remove the wedges before removing the saw. The wedges may be holding the log in position. If they are removed first, the severed log may shift, binding the saw. If the wedges are loose enough to be lifted straight up, it is safe to do so—but do not wiggle them out. Once the saw is free, the wedges can be removed safely from the uphill side. Be prepared for the log to move.

Crosscut saw cuts need to be made where the cuts are safe and in a manner that allows the log to be removed. Sawyers may need to make additional cuts to meet the visual or trail clearing width objectives once the log has been removed.

Felling

Except for firefighting and wilderness trail work, it is not common to fell trees with a crosscut saw. Much of my experience in felling with a crosscut saw was to obtain native building material for bridges, cribbing, puncheon, shake bolts, replacement logs for historical structures, or green logs for construction.



Felling is a dangerous operation. The USDA Forest Service requires that crosscut saw users working for or on behalf of the agency receive the required training and are certified to perform the specific crosscut saw work they plan to do. Simply reading this book is not enough training.

Safety Considerations

Safety considerations for felling apply whether you are using chain saws or crosscut saws. The forces acting on a tree are the same, whether hand or power tools are used. But different tools require different techniques. This guide discusses the correct procedures for felling with a crosscut saw.

Larger trees often require a two-person saw, so two fallers may be in the danger zone. There are some advantages to having two fallers. An additional set of eyes and ears will be alert to danger. Crosscut saw operations are relatively quiet, so a faller often can hear the stresses of wood as pressure is being released and the noises of branches breaking above the fallers.

The most important advantage of having a second faller is a change in mental and behavioral attitude evident in good teamwork. The saying, "Two heads are better than one," applies here.

Each faller requires an escape route and an alternate route. The two fallers should not use the same escape route. If fallers need to rest during the cut, they should move to the safety zone. The rest should be as brief as possible. Sawing the back cut should progress deliberately and continuously until the tree begins to fall. Avoid rest breaks during back cutting. Additional safety considerations include:

- Remove loop- or pin-style handles to make sure they don't stick before performing felling cuts. These handles on a two-person saw must detach quickly.
- Be sure all ax and saw handles are tight and in good repair.
- If metal wedges will be used, file off all "mushrooming" (deformed metal on the edges of the head) to prevent the wedge from splitting when struck.
- When sizing up the tree, determine the side of the tree where the head faller will stand. This is usually the side that best enables the faller to remove the saw from the cut and place it on the ground just before the tree falls.
- If one handle of a two-person saw is hard to remove, ensure that the handle is in the hands of the head faller who will not have to remove it.
- Drive wedges into the woody part of the tree, not the bark. Remove bark as necessary with an ax before sawing.
- Shout a warning before starting the back cut and again before finishing it.
- If several trees are being felled on steep ground, work from the bottom of the slope toward the top to avoid working around trees that have been felled.
- Do not undertake felling without all the required personal protective equipment, an ax, a set of wedges, and lubricant.



For felling operations, if two sawyers are needed or if an observer/spotter is needed, document justification for additional personnel and the implementation process in the job hazard analysis.

Direction of Fall



Snags and other hazard trees may be too dangerous to cut. Wedging snags produces vibrations that could dislodge material above the faller. Remember, a hazardous tree never needs to be cut. Explosives or other means can be used to bring it down with less risk.

In trail work, the purpose of felling is often to obtain construction material. You need to visualize the tree on the ground to make sure you can remove the logs you need for the project. Can a team of horses get to the site? Can the logs be winched out? Also, consider the visual effect of tree removal. Will the stump or slash be visible from the trail or structure? Is this acceptable?

Trees felled across the slope will be less likely to break, all other factors being equal. Trees felled downhill are in the air longer and pick up more speed. Uphill felling should be avoided, especially on steep slopes. The tree strikes the ground quickly, often bounces and kicks back over the stump. This is dangerous.

If a tree is not leaning more than 5 degrees from vertical and other factors are favorable (limb weight and distribution are even, winds are light, and so forth) a faller can generally drop the tree in any desired direction with proper placement of undercuts and wedges. Big trees with uneven limb distribution or noticeable lean can seldom be felled against the natural lean, even with wedges.

Situational Awareness

Analyze the tree you plan to fell:

- Health of tree (live or dead)
- Footing
- Species
- Heavy snow loading
- Size and length
- Bark soundness
- Soundness or defects
- Direction of lean
- Twin tops
- Degree of lean (slight or great)
- Type of lean (both the predominant, or head, and side lean)
- Heavy branches or uneven weight distribution
- Nesting or feeding holes
- Punky wood (swollen or sunken areas)
- Spike tops
- Knots
- Splits and frost cracks
- Rusty (discolored) knots
- Deformities, such as mistletoe damage
- Frozen wood
- Damage by lightning or fire

Analyze the base of the tree for:

- Thudding (hollow) sound when struck
- Insect activity
- Conks and mushrooms
- Feeding holes
- Rot and cankers
- Bark soundness
- Shelf or bracket fungi
- Resin flow
- Wounds or scars
- Unstable root system or root protrusions
- Split trunk

Examine surrounding terrain for:

- Steepness
- Stumps
- Depressions or humps in the ground
- Loose logs
- Debris that can fly back or kick up at the sawyers
- Rocks

Examine the immediate work area for:

- Snags
- People, roads, or vehicles
- Reserve (leave) trees that should not be damaged
- Powerlines
- Structures
- Widow makers
- Openings to fall trees
- Hangups
- Other trees that may be affected
- Fire-weakened trees
- Other trees that may have to be felled first
- Hazards such as trees, rocks, brush, or low-hanging limbs

Felling Sizeup

Most accidents are caused by falling debris. When you approach the tree to be felled, observe the top. Check for all overhead hazards that may come down during felling. Throughout the cut, glance regularly at the saw, the kerf, and the top of the tree.

Look at the limbs. Are they heavy enough on one side to affect the desired felling direction? Do the limbs have heavy accumulations of ice and snow?

Are the limbs entangled with the limbs of other trees? If so, they can snap off or prevent the tree from falling after it has been cut.

Is the wind strong enough to affect the tree's fall? Wind speeds higher than 15 miles per hour may be strong enough to affect the tree's fall. If so, stop felling. Strong winds may blow over other trees and snags in the area. Erratic winds require special safety considerations.

Check all snags in the immediate area for soundness. A snag may fall at any time with a gust of wind, the vibration of a tree fall, or as the snag's roots succumb to rot. If it is safe to do so, fell any snag that is a hazard in the cutting area before cutting the tree you intend to fell.

Clear small trees, brush, and debris from the base of the tree. Remove all material that could cause you to trip or lose balance. Also remove material that will interfere with your use of the saw, wedges, and ax. Don't fatigue yourself with unnecessary swamping. Remove only as much material as needed to work safely around the base of the tree and to provide escape routes.

The importance of sound holding (hinge) wood cannot be overemphasized. Determine the condition of the holding wood by sounding it with an ax. Look up while doing so, in case debris is dislodged. Check for frost cracks or other weak areas in the holding wood. The desired felling direction can be adjusted to compensate for weak areas in the holding wood. The depth of the undercut also can be adjusted to best take advantage of sound wood that can serve as holding wood.

Most trees have two natural leans: the predominant head lean and the secondary side lean. The leaning weight of the tree will be a combination of these two leans. Both leans must be considered when determining the desired felling direction. The desired felling direction can usually be chosen within 45 degrees of the combined lean, provided there is enough sound holding wood to work with, especially in the corners of the undercut.

Use a plumb bob or ax to evaluate the tree's lean. Project a vertical line up from the center of the tree's butt and determine if the tree's top lies to the right or left of the projected line.

A pistol-grip tree (one with a trunk that may be nearly horizontal near the ground before turning straight up) may appear to be leaning in one direction while most of the weight is actually leaning in another direction.

Look at the treetop from at least two different spots at right angles to each other. Do so again later during the sizeup, taking every opportunity to determine the correct lean.

In summary, during felling sizeup:

- Check for snags.
- Observe the top.
- Assess the soundness of the holding wood.
- Swamp out the base.
- Assess the lean.

Establishing Escape Routes

Look for a large, solid tree or rock for protection. The tree or rock must be at least 20 feet away from the stump and not directly behind it. Clear any debris that could trip you from the escape route. Practice your escape (figure 52).

Walk out the intended lay of the tree. Look for any

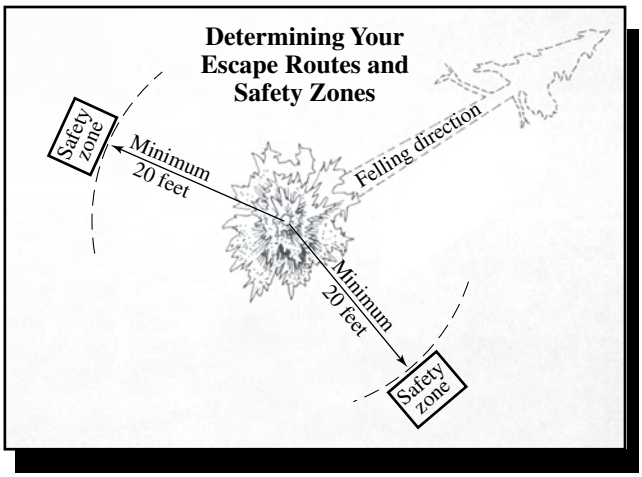


Figure 52—Keep the felling direction in mind when planning escape routes.

obstacles that could cause the tree to kick back over the stump or cause the butt to jump or pivot as the tree hits the ground. Look for any small trees or snags that could be thrown into your escape route. Ensure that the cutting area is clear of people.

Using the observations you made when walking out the intended lay of the tree, reexamine the escape route. Be sure that your chosen route (figure 53) will be the safest escape by walking out the entire length of the route—before you begin to cut.



Figure 53—Check the intended lay of the tree for unwanted obstacles.

Placing the Undercut

I am going to discuss just the conventional undercut because of its broad application for all timber types and because it provides a solid foundation from which to learn additional cutting techniques.

Before beginning the undercut, prepare the tree for cutting (figure 54). Thick bark should be removed to:

- Prevent the bark from dulling the saw
- Prevent bark chunks from choking up the saw
- Make wedges more effective
- Better view the cuts to make sure they line up

I like removing the bark at the corners of the undercut because I can see the amount of holding wood that remains. Trees that have burned or that have large plates of bark or



Figure 54—An ax can be used to remove bark from a log.

stringy bark often collect blowing dirt and sand that could dull the saw. In addition, removing bark may allow the saw to start into the cut more easily.

Not all trees need to have the bark removed. If the tree is small or if it has smooth, clean bark, usually there is no need to remove the bark.

It takes three cuts to fell a tree. Two cuts form the undercut (or face cut) and the third forms the back cut. The correct relationship of these cuts results in safe and effective tree felling. Before discussing the felling procedure, I will analyze the mechanics of the felling cuts. The undercut and back cut form the hinge that controls the direction and fall of the tree.

The undercut serves three purposes.

- It allows the tree to fall in a given direction by removing the tree's support in the direction of the face.
- It enables control because the tree slips off, rather than jumps off, the stump.
- It prevents the log from kicking back as it begins to fall.

The undercut can be made by:

- Chopping out the entire undercut with an ax
- Making the undercut with a crosscut saw
- Making a horizontal cut with a crosscut saw and chopping the face out with an ax

Chopping Out the Undercut With an Ax

Although this approach may appear to be the hardest, it has advantages in certain situations. If this method is used, the cut must be level so that the back cut, which is parallel to the undercut, also will be level.

Some advantages of chopping out the undercut include:

- Chopping out the undercut is about as fast as sawing, at least on smaller trees.
- Chopping out the undercut may be best in restricted areas where one side of the tree does not offer standing room for the second sawyer or does not have adequate clearance for the end of the saw.
- Chopping out the undercut will allow the sawyer to limit the number of cuts. It is hard to apply lubricant to the bottom edge of a saw in the horizontal felling position. Chopping is especially useful if the tree is extremely pitchy.
- Chopping out the undercut is a good alternative when the saw handles cannot be vertical, when a stiff bucking saw is used, or when any combination of factors leads to an uncomfortable sawing position.
- The lower side of the tree has compression wood, which is hard on the saw set and makes work tiresome and slower.

Someone inexperienced at chopping may have trouble getting the chips to fall out properly. The best way to effectively remove the chips is to plant part, but not all, of the edge of the ax. Chop the near side of the tree, leaving the inside corner of the ax outside the tree. On the next stroke, chop the far side of the tree, leaving the outside edge of the ax outside the tree. Finish off with a keenly placed cut in the middle between the first and second cuts. A large chip will be removed (figure 55).

Using a Crosscut Saw and an Ax

Making the horizontal cut with a saw and chopping out the undercut with an ax uses both tools to their best advantage. It is often the preferred method. The horizontal saw cut is put in first, allowing the sawyer to place a level cut. The ax is often the best tool for the sloping cut, ensuring that it matches up with the horizontal cut and does not extend past the horizontal cut, forming a dutchman.

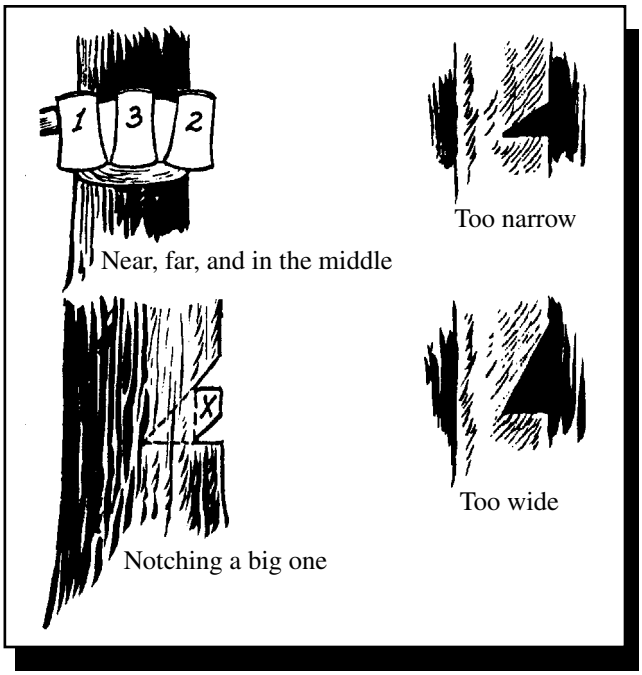


Figure 55—Notching a tree to determine the direction of fall.—Bernard Mason's *Woodsmanship* with drawings by Frederic H. Kock

Making the Undercut With a Saw

This method reduces the vibration delivered to a tree, but is generally not recommended because:

- A high degree of skill is required to have both cuts meet exactly. When the cuts don't meet exactly, they create a dutchman. Careful ax work *MUST* be used to clean out the dutchman.
- Saws do not function well when they are used to cut diagonally. The body position of the faller's arms and the handle placement make for cumbersome sawing because the saw blade and handles are on a 45-degree angle. Awkward positioning also can be a safety concern.

Observe overhead hazards and look up frequently during the undercut (figure 56).

The face of the undercut should be in the general direction of the tree's lean. Depending on structures, roads, other trees, trails, and plans for removing the log, the desired felling



Figure 56—Hazard trees need to be removed to prevent anyone from working under them.

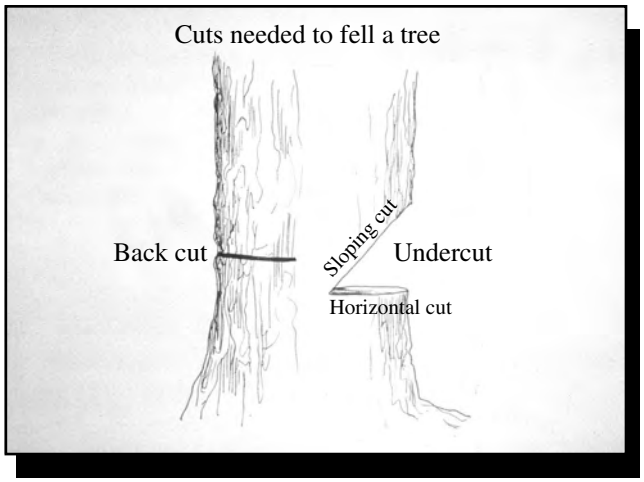


Figure 57—An undercut and a back cut are required to fell a tree. A horizontal cut and a sloping cut make up the undercut. The sloping cut is often made with an ax instead of a crosscut saw. The back cut is the third cut needed to fell a tree.

direction may be to one side or the other of the lean. Normally, the desired direction is less than 45 degrees from the lean.

I recommend that inexperienced fallers make the sloping face cut first. Remember that the saw must still be level, even though it's tilted at a 45 degree angle. It is easier to line the horizontal second cut up with the ends of the sloping cut than it would be to line a sloping cut up with the ends of the horizontal cut.

A general rule for the sloping cut is to make a 45-degree angle cut to a depth of at least one-third the diameter of the tree. The face of the cut must not close until the tree is fully committed to your planned direction of fall (figure 57). As the face closes, the holding wood breaks. If the holding wood breaks and the tree is still standing upright, the tree could fall away from the desired direction.

The horizontal cut is a level cut. If the proper relationship of the three cuts is maintained, the horizontal cut dictates the direction of fall. When there is any danger from above, the cutting should be done while the sawyer is standing, allowing the sawyer to watch the top and escape more quickly.

After selecting the desired felling direction, estimate one-third the tree's diameter and begin the horizontal cut. On larger trees you may need to place a wedge in the horizontal cut to prevent the saw from binding.

Short snags sometimes require an undercut deeper than one-third the tree's diameter to offset the tree's balance. Trees with heavy leans may not allow you to insert the horizontal cut as deep as one-third of the tree's diameter without pinching the saw.

When the horizontal cut is complete, remove the bark from an area on both sides of the kerf. The bark can be removed with an ax.

Lining up the horizontal cut with the sloping cut so that they meet, but do not cross, is one of the most difficult tasks in felling. When the cuts cross, a dutchman is formed (figure 58). If a tree with a dutchman was felled, first the dutchman would close, then the tree could split vertically (barber chair), or the holding wood could break off. Felling control would be lost. A weak tree might snap off somewhere along the bole or at the top.

It is difficult for one sawyer to make the sloping cut and the horizontal cut meet correctly on the opposite side of a large tree. This is because the sawyer cannot look behind the tree while sawing. Practicing on high stumps will help you become skilled at lining up these cuts.

The holding wood is the wood immediately behind the

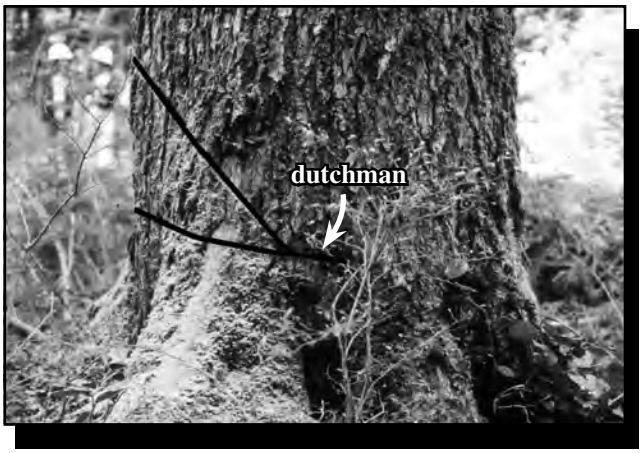


Figure 58—When the sloping cut and the horizontal cut do not meet exactly, a dutchman is formed. This kerf-wide cut makes the direction of the tree's fall harder to predict. It can also cause the tree to barber chair, lifting the log off the stump and placing the sawyers at great risk.

undercut. The most important portion of the holding wood is in the very corners of the cut (the first 4 to 8 inches inside the bark).

If the horizontal cut is so low that cleaning it up will create too deep of an undercut, stop the horizontal cut directly above the end of the sloping cut. This will leave a step face in the undercut, but that is better than creating a dutchman or having too deep of an undercut.

The undercut needs to be cleaned out to a V-shape. Any remaining wood will cause the face to close prematurely. This causes the holding wood to break behind the closure, which can alter the direction of the fall or cause a barber chair.

The sloping face cut must be large enough to keep the tree under control until it is close to the ground. If the "mouth" is too small, the face cut will close quickly and all control of the tree will be lost. In most cases, the size of the face cut is adjusted for the lean of the tree. Never leave a dutchman in any undercut.

Once the face has been cleaned, recheck the felling direction. Place the saw back in the face and check by gunning, visualizing an imaginary line perpendicular to the saw that indicates the expected direction of fall. Alternatively, place an ax head in the face and look down the handle (figure 59). The back of the undercut should be perpendicular to the desired felling direction.

If the tree is not aimed in the direction that you want it to fall, extend the horizontal and sloping cuts as needed, keeping each cut in its original plane.



Figure 59—A double-bit ax is being used as a T-square to indicate the direction of fall in this 1939 photo from West Virginia. Today, hardhats and eye protection would be required dress.

Each sawyer pulls alternately. The sawyers should be facing the direction the tree will fall. The saw is pulled back and forth with a slight upward arc at the end of the stroke.

Making the Back Cut

With a well placed undercut established, half the job is done. To successfully position the tree's direction of fall, the back cut needs to be sawn.

The relationship of this cut to the face cut is important for positioning the tree's direction of fall and the sawyer's safety. The back cut can be made from either side of the tree. Choose the safest side of the tree to cut from, (not under any lean, with a good escape route, and so forth).

The two most important elements of this cut are the holding wood and stump shot. The best way to envision these cuts is by the use of a rectangle. The bottom corner is the back of the horizontal cut. The opposite upper corner will be the back of the back cut (figure 60).

The height of the rectangle is referred to as the stump

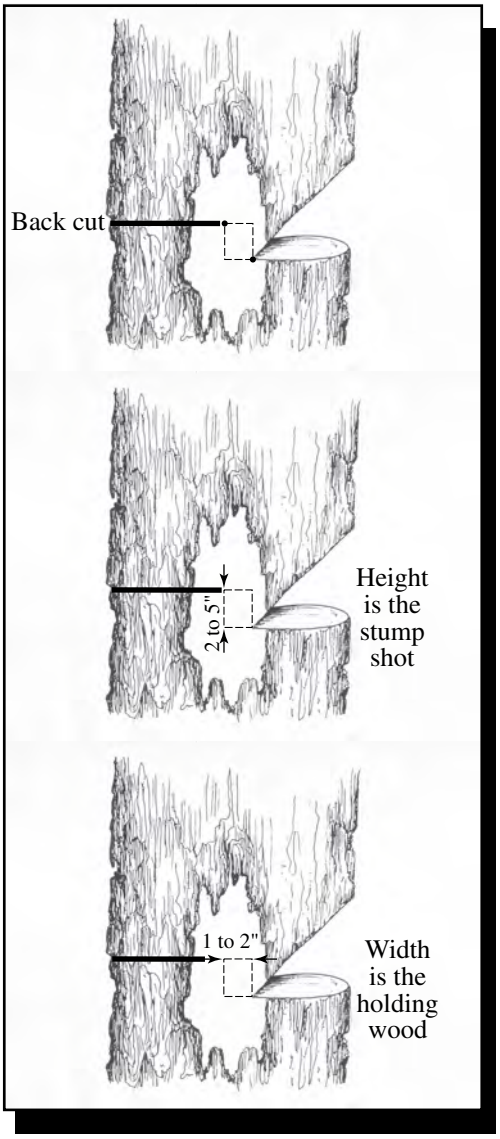


Figure 60—An imaginary rectangle can help the sawyer understand the importance of the back cut. The dimensions of this rectangle are based on a 24-inch diameter tree.

shot. It is an antikickback device to prevent the tree from kicking back over the stump if it hits another tree on its fall. This is especially important to sawyers who are felling trees through standing timber.

The width of the rectangle is the holding wood. As the back cut is made, the sawyer must be sure not to cut this wood. Maintaining the holding wood is the key to safe and effective felling.

Hold the saw level so that the back cut will be level when the cut is complete. Make sure that when the back cut is finished, it will line up with the top corner of the opposite rectangle. If the cut is angled, wedging power and the height of the stump shot could be altered.

Keep at least three wedges and an ax or single jack hammer readily accessible. The ax should be within arm's reach. The size of wedges you will need depend on the tree's diameter.

If there is any wind, two wedges are recommended. The second wedge adds stability. With just one wedge in place, the tree can set up a rocking action between the holding wood and the lone wedge. A strong wind could tear out the holding wood.

Remove thick bark immediately above and below the back cut, where the wedges will be placed. The bark could compress, reducing the wedge's lifting power. Before starting the back cut, lubricate both sides of the crosscut saw. A saw in the horizontal position in the back cut is more prone to accumulate pitch than a saw used vertically for bucking. If the tree is very pitchy, the saw may need to be removed from the cut when you apply solvent. Sometimes solvent can be splashed or sprayed from the underside of the saw.

Sound a warning before the back cut is started, just in case someone has wandered into the cutting area. The sawyers position themselves with their backs toward the center of the tree. This position is natural, and also allows the sawyers to face their escape routes. The back cut should be sawn parallel to the face cut, keeping the holding wood equal from corner to corner. The sawyers need to keep an eye on the top of the tree as the back cut progresses. If the tree is a heavy leaner, each of the corners can be cut out first, finishing the cut by sawing parallel to the face cut. This technique reduces the chance that a tree might barber chair.

Once the cut provides enough clearance from the back of the saw, a wedge or wedges can be driven into place. On smaller trees, a single wedge can be used, but usually two or more wedges are needed. After every couple of inches of sawing, stop and drive the wedges in a little. Wedging redistributes the center of gravity of the standing tree by hinging the tree on the holding wood. It also prevents the tree from sitting back and binding the saw.

Observe the top of the tree to coordinate the strike of

each blow against the wedge with the forward sway of the tree. The wedges are easier to drive when you do so. Striking the wedge when the tree's pressure is on the wedge not only damages it, but also causes excessive vibration and could dislodge an overhead hazard.

The sawyers need to communicate so each of them knows about how many inches of holding wood remain so they can adjust their cutting to ensure that the back cut remains parallel to the face cut. A sawyer working alone needs to look around the tree periodically to accomplish this. Progressing too far and cutting the holding wood from one corner could mean the loss of felling control.

The back cut must not proceed so far toward the undercut that it removes the holding wood. This narrow strip of holding wood must be left completely across the stump. The holding wood controls the tree's fall and prevents it from slipping off the stump prematurely.

Sound another warning when the back cut is completed and the tree is ready to fall. If the tree has not committed to fall and the holding wood is narrowing, the tree is sitting back on the wedges. Stop sawing and leave the holding wood intact. The second faller removes the saw handle and proceeds along the escape route to the safety zone. At the same time, the head faller removes the saw and places it behind the tree in a predetermined location away from the escape route. Never take the saw with you along the escape route—it could impede your progress.

With the second faller watching, the head faller drives the wedges, causing the tree to lift and commit to fall. You can see the top of the tree begin to move before you can see the saw kerf widen. The head faller proceeds along the escape route to safety before the tree actually falls.

If for any reason the sawyers feel unsafe or unsure, they should proceed immediately along the escape route. ***Leave the saw wherever it lies.***

Once you've reached a safe location, both sawyers need to continue looking up for overhead hazards. There is a tendency to look at the tree as it hits the ground, leaving the sawyers unaware of limbs that may be thrown back from other trees near the stump. ***LOOK UP!*** If rocks or other material are dislodged when the tree hits the ground, yell a warning!



Fell no tree if you are uncomfortable with the task. If you have started to fell a tree but are having second thoughts, do not feel that you are committed to finishing the job in an unsafe manner. If a cut has been started but is terminated before the tree is on the ground, you MUST flag the area around the tree, declaring it a danger zone. Warn people to remain clear of the area until someone else can take the tree down.

o o book can teach you all there is to know about crosscut

Concluding Principles

Now saws and their safe use. I hope that this guide will help establish the basis for a safe learning experience. As you practice some of these techniques and come to recognize and appreciate the timeless elegance and efficiency of a finely tuned crosscut saw, bear in mind that ***you*** are in charge of your own well-being. With that in mind:

- Never work above your skill or certification level.
- Never be talked into something you're not comfortable doing.
- Walk away from any situation that is unsafe.
- Select the correct saw, wedges, and other accessories for the job at hand.
- Have your saws professionally sharpened—never use a misery whip!

My parting wish for you is to be



David Michael bucking a 44-inch-diameter Sitka spruce on the Tongass National Forest in Alaska (1991). Experienced sawyers will note both a dutchman and removal of holding wood in the felling cuts. These were done purposely to fell the tree in an exact spot. Such techniques should only be done by highly skilled sawyers, and then only rarely. The photo points out how much more there is to learn beyond the basics presented in this guide.

safe and content in your work using a saw that ***sings!***

References Cited

Note: Visitors to the technology and development Web site (*http://www.fs.fed.us/t-d*) must provide the **username (t-d)** and **password (t-d)**.

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Sources for Crosscut Saws and Accessories

The following list of crosscut saw and accessories providers is neither intended to be all inclusive nor to imply USDA Forest Service approval or recommendation of these suppliers.

Vintage Saws

Electronic auction sites such as the *eBay* Web site (*http://www.ebay.com*), yard sales, and antique shops are likely places to buy a used crosscut saw and sharpening tools. Small businesses selling vintage crosscut saws sometimes can be located though Internet search engines. Most trail workers consider a well-tuned vintage saw to be superior to a new saw. New saws usually need sharpening before they are suitable for use.

Agency employees should search the back corners of their fire caches, guard stations, and work centers for vintage crosscut saws that can be restored and used to outfit the crew. Don't throw them out! It is not difficult to find someone to professionally restore and sharpen vintage saws at a reasonable cost.

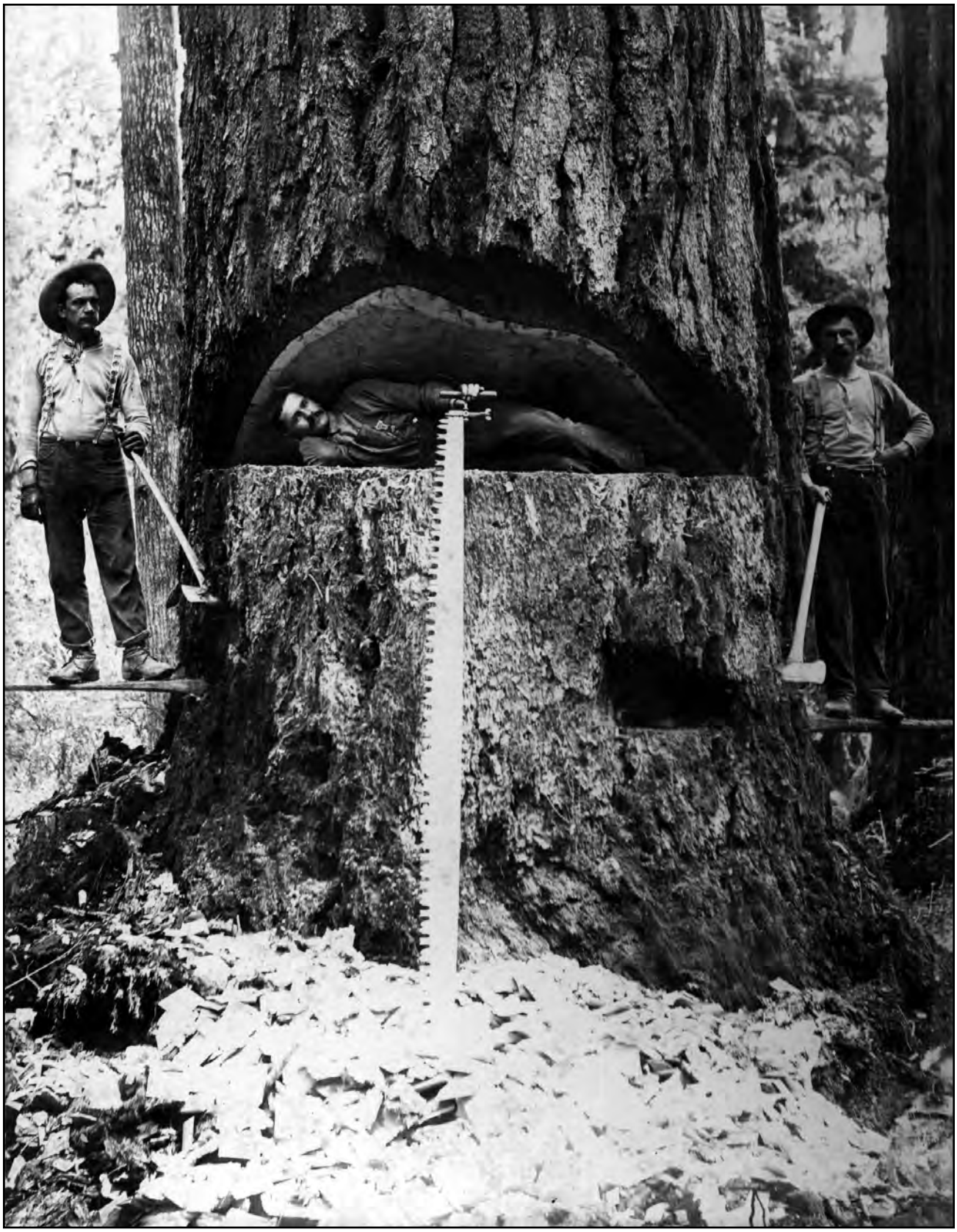
New Crosscut Saws and Accessories

- **The Crosscut Saw Co.** sells new and vintage crosscut saws and tools.
  Crosscut Saw Co.
  P.O. Box 787
  Seneca Falls, NY 13148
  Phone: 315–568–5755
  Web site: *http://www.crosscutsaw.com*
- **Flicker Forge** offers replica vintage saw handles.
  Flicker Forge (Japheth Howard)
  39184 School House Rd.
  Salisbury, MO 65281
  Phone: 660–777–3508
  Fax: 660–777–3302
  Web site: *http://www.flickerforge.com*
- **Jim's Crosscut Saw**s sells reconditioned saws and accessories, and sharpens saws.
  Jim's Crosscut Saws (Jim Talburt)
  7914 Northbank Rd.
  Roseburg, OR 97470
  Phone: 541–673–6940
  Web site: *http://www.jimscrosscutsaws.com*

- **Lehman's** offers several one- and two-person saws and handles.
  Lehman's
  P.O. Box 41
  One Lehman Circle
  Kidron, OH 44636
  Phone orders: 1–877–438–5346
  Customer service: 1–888–438–5346
  Fax: 1-888-780-4975
  Web site: *http://www.Lehmans.com*
- **Tuatahi Axes and Saws** offers crosscut saws for forest workers and for sawyers who compete in races. Bailey's is the United States distributor for Tuatahi products.
  Tuatahi Axes and Saws
  203 High St.
  Masterton
  New Zealand
  Phone: (011) 646–377–3728
  Fax: (011) 646–377–5343
- **Bailey's**
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  44650 Highway 101
  Laytonville, CA 95454
  Phone: 707–984–6133
  Fax: 707–984–8115
  Web site: *http://www.baileys-online.com*
- **Woodcraft** offers at least two types of crosscut saws.
  Woodcraft
  P.O. Box 1686
  Parkersburg, WV 26102–1686
  Phone: 304–442–5412
  Web site: *http://www.woodcraft.com*

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Felling crew working on a Douglas fir in Skagit County, Washington, 1902.—*USDA Forest Service photo, photographed by D.R. Kinsey*

Notes



David Michael (retired)

About the Author

David E. Michael was the trails program manager for the Tahoe National Forest. He also served as the crosscut saw coordinator for the Pacific Southwest Region of the USDA Forest Service and helped develop the Chain Saw and Crosscut Saw Training Course coordinated by MTDC. Michael has more than 35 years of experience in the woods, working for the Forest Service on the Tahoe, Apache-Sitgreaves, Coconino, Mt. Baker-Snoqualmie, Shasta-Trinity, Tongass, and Klamath National Forests in engineering, recreation, and wilderness management. He also worked in private industry as a timber consultant, cruiser, cadastral surveyor, vocational instructor, and logger.

Library Card

Michael, David E.; Vachowski, Brian. 2004. Saws that sing: a guide to using crosscut saws. Tech. Rep. 0423–2822P–MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 64 p.

This comprehensive guide presents time-tested techniques for using and maintaining vintage crosscut saws. It includes descriptions of different types of crosscut saws, saw handles, and wedges, as well as instructions for bucking logs with crosscut saws. Numerous illustrations and photos explain the key points.

Keywords: bucking, felling, logging, handtools, hand tools, traditional tools, wilderness management

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Single copies of this document may be ordered from:

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