



# PRECISION Tree Felling, SAFETY and best SAW-HANDLING Practices

*The open face notch provides for a greater degree of control because the hinge is intact longer, helping guide the direction of fall. Here, the author uses a bore cut to establish the hinge.*

By Ken Palmer

Chain saw operators have to be able to think on their feet (or in the saddle) and adjust to their surroundings. Accidents can be dramatically reduced, and productivity increased, when workers have the knowledge, training and the skill they need to operate a chain saw properly. The more they have developed the skills required to safely and productively carry out chain saw operations, the more successful and consistent the results will be. And as with any profession, it is vital that tree care workers be familiar with and abide by industry regulations, safety guidelines and best practices.

With today's chain saw technology, safety, skill, productivity and compliance can be attained with a thorough understanding and ability to assess:

- ▶ a saw's basic design and limitations
- ▶ basic saw maintenance
- ▶ reaction forces
- ▶ wood fiber/hinge wood
- ▶ tension, compression, torsion and

potential spring poles

- ▶ knowledge to formulate a felling/cutting plan
- ▶ the ability to skillfully work this plan

## Chain saw operations

Operating a chain saw or attempting to fell a tree alone can be very dangerous. If it is an option, don't work alone. Always wear the appropriate personal protective equipment, which includes a hard hat, eye protection, hearing protection and approved work boots.

Leg protection, such as chaps or chain saw pants, is required when running a chain saw on the ground and leg protection is strongly recommended when climbing with a chain saw and required in some jurisdictions/organizations.

Always be aware of the reaction forces that result when running a chain saw. When you cut with the bottom part of the bar, the saw tends to pull away from you and into the cut. When you cut with the top of the bar, the saw tends to push back toward you and out of the cut. When the lower front

quadrant of the chain saw bar comes in contact with the wood, the reaction force is for the bar and the chain to be pulled into the wood. When the upper front quadrant (kickback quadrant) of the tip of the chain saw bar contacts an object, the chain saw reacts by rotating back toward you.

One reaction force can lead to another. For example:

When cutting with the top of the bar, the saw can be pushed back, exposing the kickback corner to the wood.

When cutting with the bottom of the bar, the saw can be pulled forward, pulling the kickback corner into the wood – in either case, causing a kickback.

Kickback occurs at a rate seven times faster than a human can react. Dodging the saw's reaction is not an option. So, stay aware of the potential of reaction forces when you are cutting and always know where the kickback corner is.

When operating a chain saw, stand with your feet firmly planted. Always operate the chain saw with both hands on the saw. Your left hand should be on the upper han-

dle with your thumb wrapped around the handlebar. Use your body to brace the saw when practical and do not get into the habit of positioning yourself directly over the chain when you are cutting, in case of an unexpected kickback. Always engage the chain brake if you must take one hand off the saw to move a limb, or when taking more than two steps with the saw running.

### Five-step felling plan

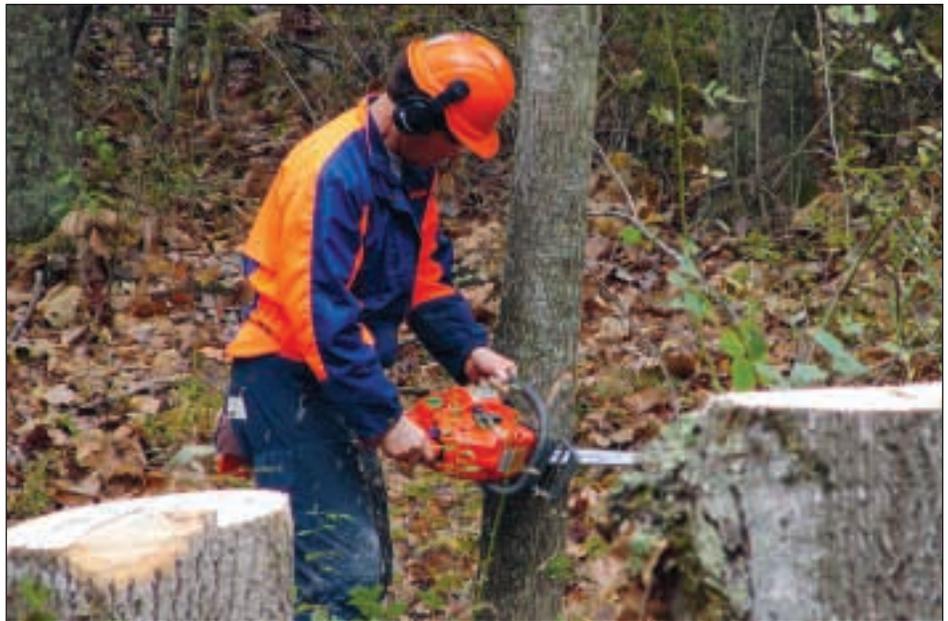
Daniel Webster defines an accident as an unplanned event. So, to avoid accidents, plan! When felling trees, it is vital to have and use a felling plan. A five-step felling plan that incorporates up-to-date cutting methods is widely used by professional chain saw operators worldwide. Using it will help you to achieve successful results consistently:

1. Identify height and hazards – Look for tree defects, decay, heavy lean, electrical conductors or any other characteristics of the tree that may affect the felling plan. Consider obstacles within the felling site, such as structures, pavement and outdoor furnishings. Some can be moved, if necessary; others will have to be avoided. Assess the strength and direction of the wind. Decide on the felling direction.

2. Assess the side lean – This often determines whether or not the hinge will hold and the “good” and “bad” sides of the tree on which the feller should stand when



*Make the top cut first when making the face notch. Line up the top cut using the felling sites provided on today's professional chain saws.*



*Use the upper cut as a sight through which you can line up the lower cut, and avoid sawing too far and creating a bypass. Bypassing cuts into the crucial fibers of the hinge must be avoided. Photos courtesy of Ken Palmer.*

making the final cut.

3. Escape route – Always think about your escape route before you begin the felling operation. The escape route should be at a 45-degree angle opposite the felling direction. Be sure your escape route is clear of obstacles or hazards before beginning.

4. Hinge plan – The face-notch and hinge are critical to safe, accurate, consistent results. Plan the size, depth and placement of the notch. Determine the desired thickness and length of the hinge.

5. Back cut technique – The back cut is often taken for granted, yet is often the cause of felling accidents. Forward or back lean may determine what kind of back cut you will use: the straight forward back cut or the bore cut. The degree of forward or back lean will determine how many wedges and/or whether a pull rope will be necessary and how much power may be required to pull the tree over. Remember that if the tree is too thin, there may not be enough wood for a notch, hinge, bore cut and back/holding strap. In that case, it will be necessary to use “the straight forward back cut.”

Remember to finish the felling cut on the “good” side of the tree and use your escape route as soon as the tree begins to fall.

### Equipment

Once you have worked through the planning process but before you begin cutting, decide on the equipment you will want to

have on hand and make sure everything is in place and ready to go. What chain saw(s) will be best to use for this tree? Is it sharp, fueled and running properly? Do you have felling wedges on hand? Will you be using a pull rope and if so, is it properly set? Will you be using block and tackle for mechanical advantage?

### Using a pull line

Using a pull line provides extra assurance that the tree will be felled in the desired direction. If a pull line is used, it must be set high enough in the tree to provide the needed leverage or mechanical advantage from the ground. Be sure that there are no significant defects in the tree below the pull line as pulling on the line could cause the top to break out when tension is applied.

Do not apply too much tension on the pull line and do not apply tension too soon. Using a truck to pull trees is a recipe for disaster because there is no way to know if you might break the rope (as many people have learned the hard way). Applying tension too soon can cause the tree to barber chair (split vertically) or cause the hinge to break rather than bend. Remember, the main function of the pull line is to pull the tree past center so that gravity will then bring it to the ground and the hinge will do the steering. Avoid creating a pull that can cause a twisting action on the tree causing the hinge to be twisted off the stump and

the tree to fall in the wrong direction.

It is possible to install the pull line without climbing the tree. Setting a throw line and then installing a larger pull rope can be readily accomplished with practice. A running bowline can be tied from the ground and then pulled into place. Or, many times it is easier and quicker to simply tie off one end of the rope just above the felling cut.

### Estimating a tree's height

A very important part of felling trees is the ability to estimate the height in order to determine the approximate position of the tree once it hits the ground. Accurate height estimation also allows you to avoid hitting obstacles and to determine if felling the whole tree is possible in a given situation. Remember that the height of the felling cut will affect the position of the tree when it reaches the ground.

There are various tools and instruments to help determine a tree's height. One very handy field technique is the stick method. Hold a straight stick such that the distance from your eye to your hand equals the distance from your hand to the top of the stick. Hold your arm horizontally and the stick vertically. Walk forward or back until the distance from your hand to the top of the stick is proportional to the distance from the felling cut to the top of the tree. This will be the approximate point where the top of the tree will land. If the tree is not truly vertical and/or the ground is not level, adjustments need to be made. Adjustments need to be made for sloping grades and you must be able to see the true top of the tree.

Another similar measuring method takes place off to the side of the tree and back so you can see the top of the tree. Using the stick, held at arm's length, measure the height of the tree and rotating the stick parallel to the ground, notice where the top of the tree will land.

No matter what method you use, you must use it regularly in order to learn how to use it well and correct for the variables, especially in tight situations.

### The face notch

The traditional, 45-degree face notch was developed many years ago. It consists of a flat cut on the bottom and an angled cut down into it creating a 45-degree face notch. One limitation of this notch is that



*Line up the top cut while bracing your body against the tree and facing the desired felling direction.*

the tree can only fall 45 degrees before the notch closes and the hinge breaks, causing a loss of control. The limitations were set years ago by the tools available, i.e. cross-cut saws and axes. A crosscut saw (especially in those days) will only cut effi-

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*Remember, clear, concise, complete communication is a key ingredient for team safety as well as productive work flow. Every worker on the job must have a clear understanding of his or her role.*

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ciently across the grain and 90 degrees to it. An axe (as some of us old timers know only too well) cut most efficiently at 45 degrees to the grain of the wood, resulting in a 45 degree opening that was known as a common notch or 45-degree face notch.

With today's (chain saw) technology, the limitations have changed dramatically and it is now possible to significantly increase safety and productivity. The open face notch is defined as a face notch that is open 70 degrees or more. It allows the worker to take full advantage of the hinge (provided sound hinge wood exists) with a greater

degree of control because the hinge does not break until the tree is almost on, or on, the ground, if at all.

Because of this greater degree of control, the back cut can be made level with the apex of the open face notch, unlike the back cut with a 45-degree/conventional notch, which requires a stepped back cut to help keep the tree on the stump when the face notch closes and breaks while tree is only about half way to the ground. The open face notch is a classic example of modifying technique in order to maximize technology, safety and productivity.

The traditional rule of thumb for the depth of the notch is one third the depth of the tree. Another technique to set the depth of the notch is the percent-of-diameter method. The length of the hinge should be approximately 80 percent of the tree's diameter at the cut. This will vary depending on the felling direction because many trees are not really round or symmetric in cross section. The depth of the notch may influence the length of the hinge. When felling a full tree, avoid cutting the notch deeper than 33 percent of the diameter of the tree at the cut. Often it is not even necessary for the face notch to be made one-third, or 33 percent, deep to establish a hinge length that is 80 percent the diameter of the tree. On the other hand, some situations, such as notable side lean, may justify a longer hinge length.

Make the top cut first when making the face notch. Line up the top cut while bracing your body against the tree and facing the desired felling direction. Use the felling sites that are provided on today's professional chain saws. Avoid placing the hinge where there are cracks, cavities, knots or decay as these factors can severely limit the amount of actual hinge wood or the ability of the wood fiber to provide a strong hinge. Use the upper cut as a sight through which you can line up the lower cut, and avoid sawing too far and creating a bypass. Bypassing cuts into the crucial fibers of the hinge must be avoided. Bypass cuts reduce the effectiveness of the hinge and will cause it to fail prematurely. Avoid bypass cuts by sighting through the top cut and checking both ends of the notch frequently while cutting. (Remember to use the chain brake any time you do not have both hands on the saw)

## The hinge

A proper hinge causes the tree to be directed on the stump by the hinge wood in the desired direction of fall. If the hinge is the proper thickness, the wood fibers will fail gradually and evenly under tension in the back of the hinge and under compression in the front of the hinge as the tree falls. The rule of thumb for hinge thickness when felling trees is 7 percent to 10 percent

of the tree's diameter at the cut depending on the flexibility of the wood fiber, moisture content, temperature (frozen wood) and the overall diameter of the tree. Hinge thickness is reduced for thicker trees and drier wood fiber.

A skilled operator will use the hinge to his or her advantage depending on the felling conditions. Do not cut into the predetermined hinge when making the back cut, as this can result in immediate loss of control.

Now, let us continue by more closely examining back cut methods, completing the hinge, the release and the escape:

### Conventional back cut and 45-degree face notch

With a conventional back cut, the hinge is formed as the back cut approaches the apex of the face notch on both sides, though slightly higher. It can be especially difficult to establish a predetermined hinge with a forward leaning tree or limb as it may begin to fall before you can finish your back cut!

Position yourself and orient the chain saw bar to be level with the apex of the face notch on both sides and "stepped" slightly higher (typically 1-3 inches) than the apex of the notch, leaving a step to reduce the tendency of the tree to kick back off the stump toward the operator when the hinge breaks.

Remember, when using a 45-degree notch opening, the face notch will close and the hinge will break while the tree is only about half way over and hinge control is lost at that point.

### Open face notch/70 degrees or greater

The open face notch is defined as "a face notch that is open to 70 degrees or more," and it can allow the hinge to work longer (provided sound hinge wood exists) with a greater degree of control because the hinge does not break until we want it to – if at all.

Because of this extra control, the back cut can be made level with the apex of the open face notch – unlike the "stepped back cut" we must use with a 45-degree face notch.

### Back cut: The bore cut

The bore cut is another way of making the back cut and establishing the hinge.

## Have a felling plan

Having a carefully determined felling plan and skillfully working your plan will help assure a safe, efficient felling operation with precision results!

The 5 step felling plan can offer consistently predictable and measurable results:

1. Height and hazards (access and identify)
2. Lean assessment of the tree relative to the landing zone. (Side, forward or back lean)
3. Escape route (access, identify, clear in advance and use it!)
4. Hinge plan (hinge thickness, face notch opening and depth)
5. Back cut plan (Bore cut release: establish and complete the hinge, then release the tree)

Using the lower front quadrant of the bar and chain to "bore/plunge" the saw into the tree, the cutter/feller can establish the felling hinge before the release cut is made. Though it does require education, training and practice, it presents some clear and distinct advantages. One advantage is that it can virtually eliminate the possibility of "barber chairing," a term for what can take place when a tree splits vertically upward from the back cut before the hinge is completed. The tree will typically pivot at some point up the split, causing the back section to kick back from the cut out and up toward the person felling the tree – then usually crashing to the ground in a very dangerous and uncontrolled way. Barber chairing is most likely to occur when felling a tree with heavy lean or where significant tension and compression forces exist in the marginal fibers of the tree trunk or section being cut. However structural defects (decay, cracks, etc.) and environmental factors (wind, vines, etc.) can contribute to the failure of a stem while it is being cut. So, during Step 1 of the felling plan – Hazards! – always inspect the tree carefully for structural defects, consider wind speed and direction, and inspect for and remove any vines or limbs that may be interlocked with other trees.

Another advantage of the bore cut tech-



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*The bore cut is another way of making the back cut and establishing the hinge, reducing the chance of “barber chairing” and establishing the hinge while the tree stays locked on the stump by the back strap.*

nique is that the predetermined hinge can be completely established to the desired thickness while the tree stays locked on the stump by the back strap. Thus the integrity and condition of the hinge can be assessed before releasing the tree, giving you the opportunity to make any final adjustments

before actually felling the tree. Or possibly allowing you to change your mind and start over, if something is going wrong, right up until the moment of release.

#### Starting corner

Before practicing the bore cut, your chain saw, bar and chain must be serviced and cutting properly. You must understand the concept of the “starting corner.” The starting corner is the lower front quadrant of the tip of the bar and chain. When making a bore cut, always start cutting into the wood with the starting corner to avoid kickback.

#### Kickback corner

The kickback corner is the upper quadrant of the tip of the chain saw bar. Start cutting with the chain saw at full throttle and avoid contacting the tree with the kickback corner when beginning the cut and until the entire tip of the bar and chain have bored into the wood where it is unable to kick back.

#### Executing the bore cut

Bore into the tree (several inches) behind the apex of the notch. Be sure to start the cut at the starting corner of the chain saw bar. Start the cut well behind the desired position of the hinge! Then, once you have bored into the wood and through the tree, carefully cut to the desired thickness of hinge leaving a strap of wood that will continue to hold the tree in place.

Always finish your cutting on the “good

side” of the tree. The side toward which the tree leans is considered the “bad” side of the tree. So, if you are cutting a tree that is thicker than the length of your bar, you will want to start your cut from the bad side first (no more than 50 percent to avoid pinching) so that you can finish the cut on the good side of the tree. It is not necessary for the back cuts to meet exactly in the center; as long as the cuts overlap, the wood fiber will separate vertically.

If the tree is larger in diameter than the length of your chain saw bar, bore cut only about 50 percent through from the bad side of the tree and establish your predetermined hinge thickness on that side. Then, bore cut the remainder of the way through from the good side of the tree and establish your predetermined hinge thickness on that side, slightly overlapping the first cut and out toward the back of the tree, leaving a “holding strap” of wood that will continue to hold the tree in place.

Now that you have established and completed the desired hinge thickness behind the apex of the face notch, and cut back from the hinge on both sides of the tree leaving a strap of wood at the back of the tree opposite the direction of fall, it is time to execute the final cut.

The final cut releases the holding strap of wood allowing the tree to fall. Turn off the saw and move away from the tree through your pre-established escape route – at a 45-degree angle opposite the felling direction – to a safe position as soon as you make the final cut! Remember to check and clear the path for your escape route ahead of time if necessary.

#### Felling wedges

An often-overlooked tool for felling trees is the felling wedge. It is a good idea to have a couple of good wedges available whenever felling trees. Placed appropriately, a wedge can prevent the chain saw bar from becoming pinched in the back cut, particularly if the tree has some back lean.

Lifting a tree one-inch with a wedge at the back cut can move the top of a tree several feet. The amount that the tree top can be moved depends on the height and girth of the tree.

Wedges are also very useful for bucking wood and even limbing trees with large limbs.

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## Summary

Using a planning process and a carefully determined felling plan is the foundation for a safe and efficient felling operation. It is important to plan the entire felling operation before beginning to cut. Always check for hazards and obstacles that may affect the felling operation. Consider the height, spread and lean of the tree when deciding how, when and where to fell a tree.

Keeping both hands on the saw at all times unless the chain break is engaged, walking with a running chain saw only when the chain break is engaged, and understanding the reactive forces of the bar and chain are important parts of handling a chain saw safely.

Using pull ropes and establishing a mechanical advantage can make the difference between a routine and a difficult felling operation. Many of the intricacies of installing ropes and setting up rigging for mechanical advantage were not within the scope of this article, but do merit more in-depth study.

Knowing how to estimate the height of a tree in order to determine whether or not it will fit into an acceptable drop zone without causing unwanted damage is a vital part of making the decision between a tree felling scenario or having to climb and dismantle a tree in sections.

The opening size, angle and placement of the felling notch are critical in determining the felling plan. The hinge controls the fall of the tree and the back cut sets up the hinge. If you have always used the common, 45-degree notch, give the open face notch a try. It has many advantages, primarily increasing control and safety in the felling operation. And, do not dismiss the bore cut as a logger's technique. Once mastered, the bore cut's many benefits will become evident.

As always, the overriding consideration when felling trees is safety. Although this is an operation that can be inherently dangerous, education, training, adherence to safety regulations and today's precision tree felling methods and best practices can all but eliminate the risk. However, if a tree

is storm damaged, has extremely heavy side lean or if a tree has been let stand dead for so long it is decayed beyond the point of any remaining wood fiber for a hinge, it may be necessary to dismantle the tree by other means.

An arborist is a tree care professional who is able to diagnose a tree problem or issue, prescribe the best treatment options and/or actions, and carry out or direct the correct treatment or action. As a professional, one of our first responsibilities is to safety and best practice. Knowing when to say no to a person with the wrong idea – co-worker, boss, client or whoever – and being able to prescribe and describe the correct treatment or action is what defines us as professional!

Please climb safe, cut safe and rig it right – and we'll see you at the top!

*Ken Palmer is president of ArborMaster, Inc. ArborMaster trainers will provide skills demonstrations at the tree in the center of the trade show floor during TCI EXPO 2008 in Milwaukee in November. ⚡*

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