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The Woodland Workbook

Marketing Forest Products

Acquiring and Using a Portable Sawmill

T.D. Brown and N.E. Elwood

Contents

Many woodland owners, and others who have ready access to timber, are intrigued by the idea of sawing lumber for their own use or for sale. There are times when it's advantageous to use or buy a portable mill for this purpose. At other times, it's far better to sell the logs and buy lumber.

This publication discusses the types of mills available, operation and maintenance, and the economics involved in deciding whether to purchase one.

What is a portable sawmill?

A portable sawmill is any sawing device that you can move without a great deal of difficulty from one site to another and that you use to convert logs into lumber. There are quite a few different types of mills (hereafter, we'll refer to a portable sawmill as just a *mill).*

These types include: chain sawmills, circular mills with moving log carriages, circular mills with moving saw and stationary log, band mills with moving carriages, and band mills with moving saws.

Such mills may use diesel fuel, gasoline, or electricity. Most can be run by one operator.

Why own or lease a mill?

There are several reasons why a woodland owner might be interested in buying or leasing a mill.

1. You want to produce lumber for your personal use. Consider carefully the volume and grades you need and whether you can use the lumber in a rough green state. If you need only a small amount of lumber, an

Terence D. Brown, Extension forest products specialist, and Norman E. Elwood, Extension forest management specialist, Oregon State University.

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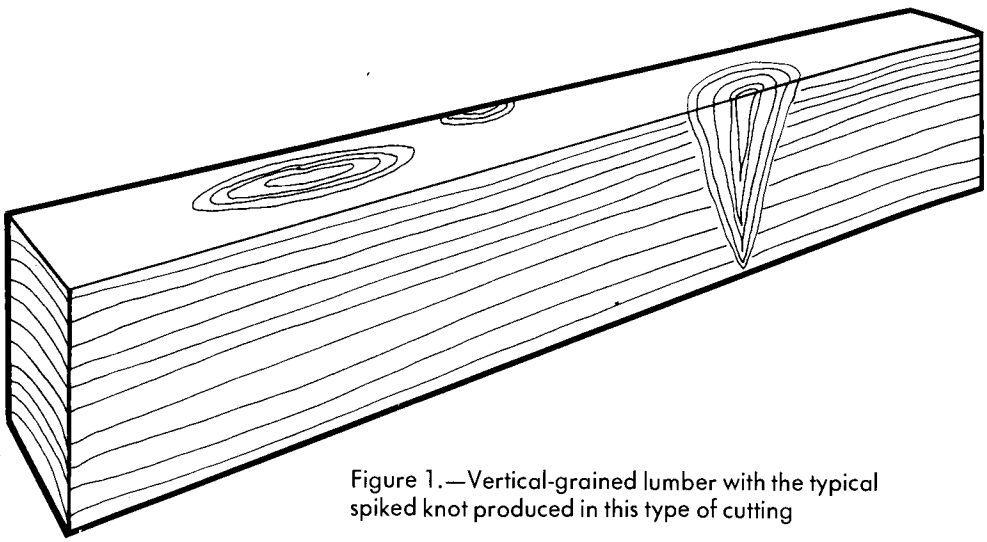


Figure 1.—Vertical-grained lumber with the typical spiked knot produced in this type of cutting

alternative is to cooperate with others who also want to produce lumber for their own use—often, this is an effective solution, especially if several people share the cost of buying the mill.

2. You want to do custom cutting for customers who have their own logs.
3. You want to sell the lumber commercially.

Lumber grades

Before discussing the various types of mills in more detail, we need to review general grades of softwood and hardwood lumber and relate those grades to the types of logs that you can cut with a mill. A basic familiarity with these concepts will help you understand the capabilities of the various mills.

When a tree is young, it has many branches. As it grows in height and diameter in a stand of other trees, a natural pruning process may cause the lower branches to die and (in some species) fall off. Because it's the branches of the tree that create the knots in lumber, any wood that grows over (outside) a knot left by a fallen branch will be clear wood without knots.

For a small second-growth tree, the pruning process may not have occurred. Thus, the knots in the log from that tree extend from the center to the surface of the log. Softwood logs of this type most often produce dimension or framing lumber for housing, the most common sizes being 2 × 4's to 2 × 12's. The most desirable grades are "2 & Better" and "Standard & Better."

Softwood lumber is produced in even-foot increments, usually from a minimum of 8 feet up to 24 feet, or the practical limitation of the particular mill. Lumber thicknesses range from 1 inch to over 24 inches from big logs.

In hardwoods, boards are cut to yield the greatest amount of clear wood. Widths are random, and the widest clear boards yield the highest grades. Lumber lengths are in 1-foot increments from 4 to 16 feet. Thicknesses range from ⅜ inch to 6 inches.

In cutting for grade in pine, boards are cut to yield the widest board. In many ways, requirements for cutting pine for "Common" and "Select" (high grade clear) boards are very similar to the requirements for hardwood cutting for grade.

In large-diameter trees, clear wood exists near the surface of the log. This is the highest value wood and produces clear boards. An especially attractive type of lumber that can be produced from the clear portion of the log is vertical grained or VG lumber.

When viewed from the end of the board, the growth rings in VG lumber run across the narrow thickness from face to face (figure 1). If the log was slow-growing, the growth rings will be close together, producing a very fine even grain on the wide face of the lumber as shown. Producing VG lumber requires a specific cutting method (see "Cutting patterns and yields," page 3).

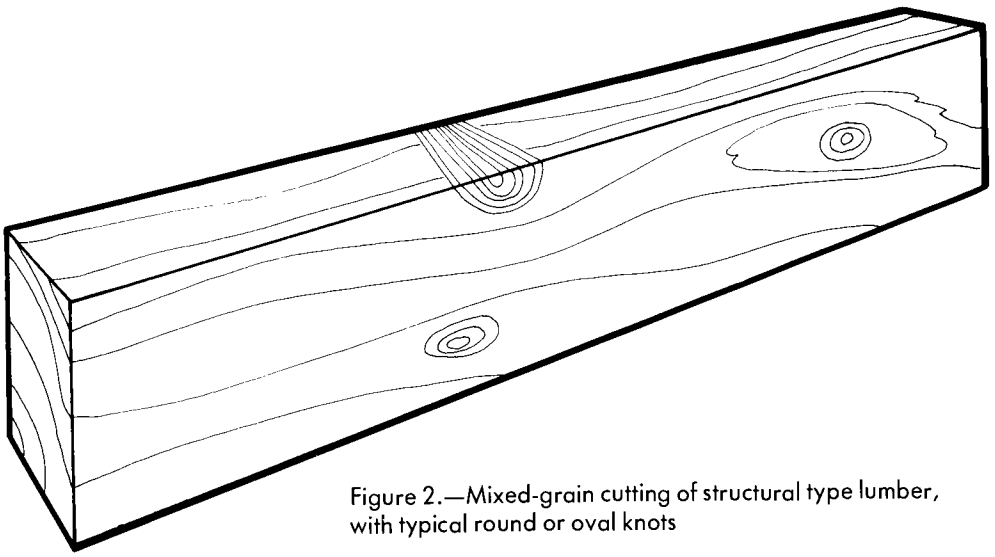


Figure 2.—Mixed-grain cutting of structural type lumber, with typical round or oval knots

It's important to note that when you cut dimension lumber from softwoods, producing VG lumber is not desirable. As you can see in figure 1, if VG lumber has knots, they're likely to be spike-shaped knots, running across the width of the piece.

The presence of spike knots in dimension lumber greatly weakens the piece. Don't use lumber with spike knots for structural purposes. Spike knot boards have been eliminated from commercial lumber graded for structural uses.

Figure 2 illustrates the grain orientation and resulting round or oval knots produced in cutting structural lumber.

Cutting patterns and yields

Methods of cutting logs into lumber, and the amount of sawdust generated by the saw blade, are the major factors affecting the grade and volume of lumber cut from a log. This is important if you want to get as much lumber as possible from a log with minimum waste.

Think of a log as a tapered cylinder with a large-diameter end and a small-diameter end. The small-diameter end dictates the maximum size of full-length lumber that you can cut from the log.

If you expect to cut logs that have a significant amount of clear wood, you'll want a mill that will "full taper saw" the logs. "Full taper sawing" of logs means that the first few cuts along the outside of the log are made parallel to the surface of the log.

This creates a full-length board from the clear outside of the log instead of the short piece that would result if you were to use the more conventional cutting methods ("no taper" or "split taper"). In "full taper" sawing, the shorter or tapered pieces come from the inside of the log, where the lowest grade wood is located (because of the presence of knots).

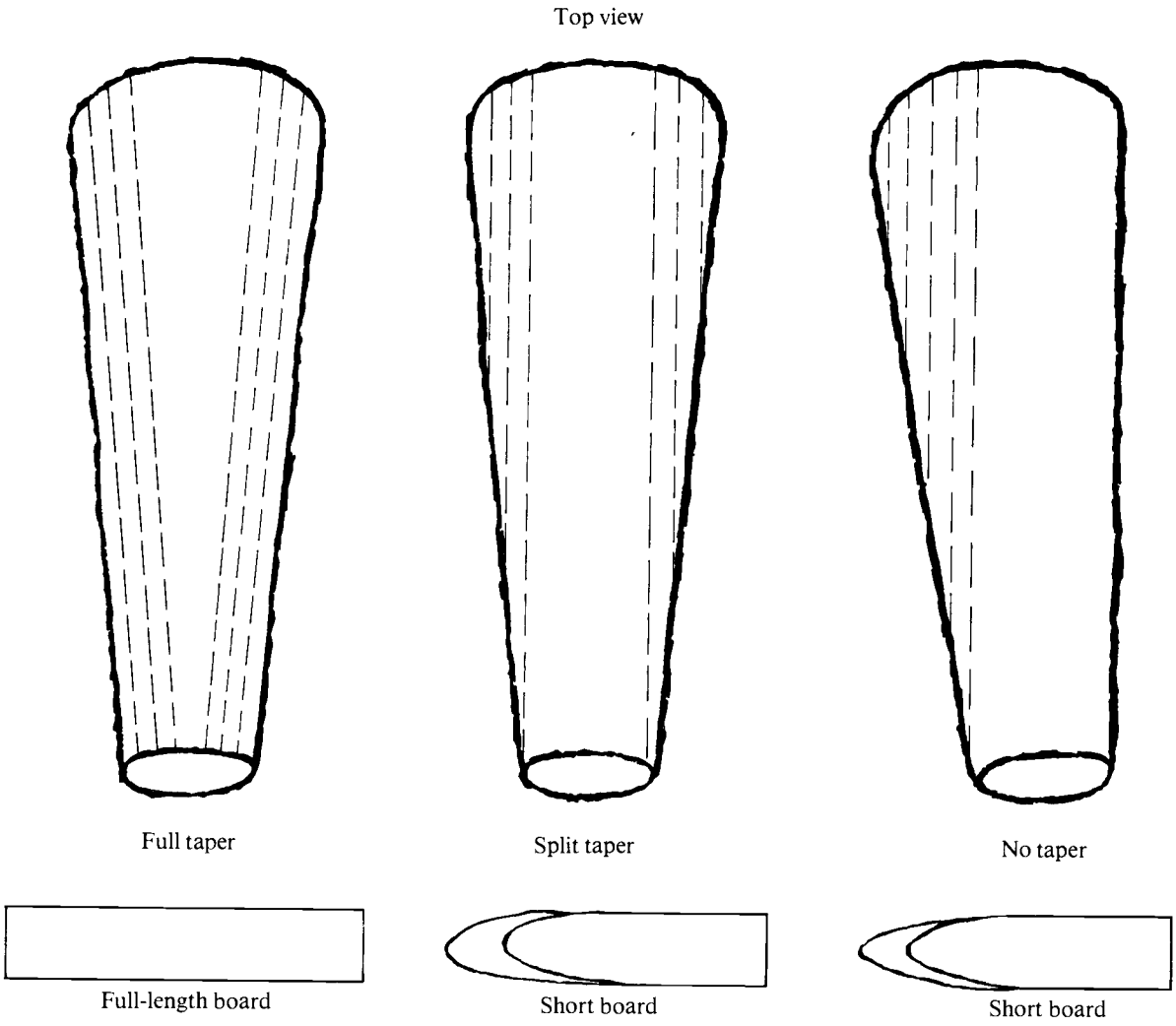


Figure 3.—Sawing methods (the resulting boards are shown by dotted lines)

Figure 3 shows the length of the boards that result from full, split, and no taper sawing, looking in from the outside of the log.

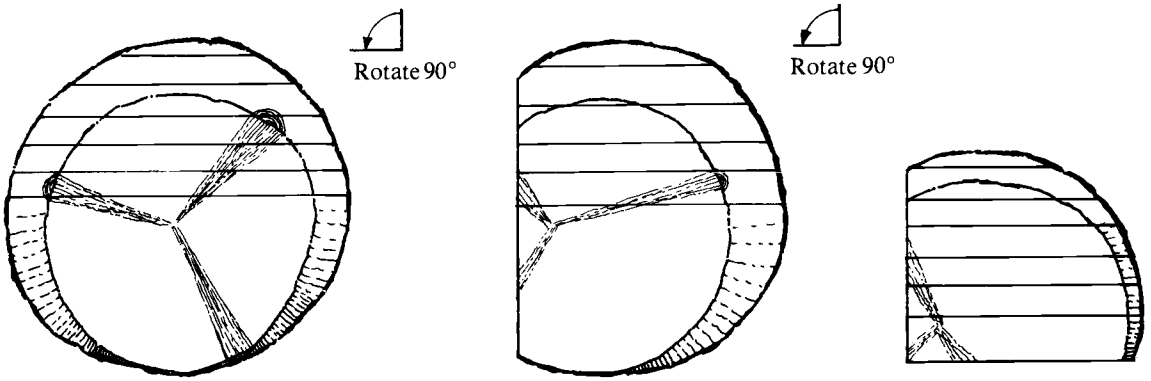
Most mills with movable saws and fixed platforms to hold the log cut with no taper. They will not "full taper saw" unless you shim the log on the platform. There are a few exceptions, however.

Full taper sawing without a shim usually requires a moving carriage that can shift the log sideways on the carriage independently at either end from front to back. For many applications, however, people are more concerned with cutting lumber for building purposes, which produces dimension grades. This eliminates the need to full taper saw.

As we mentioned in "Lumber grades" (page 2), deciding how to place the log in relation to the line of cut affects grade and lumber yield. Another factor affecting grade and lumber yield is the sawing pattern you use. Some mills are limited by the cutting patterns that they can achieve, thus reducing the yield from the log. This is more important to mill users who produce lumber paid for on a board foot yield or grade basis. If you're cutting logs for your own use, maximizing board foot recovery is less important—though you might still want to cut for clear boards.

No taper sawing

Variation 1 (1″ or 2″ lumber in any combination)



Variation 2 (no rotation, 1″ to 6″ lumber in any combination)

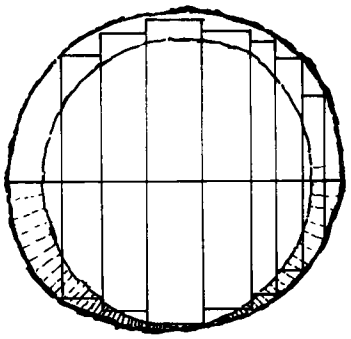


Figure 4a.—Variations available with no taper sawing

Figures 4a, 4b, and 4c illustrate some of the variations you can achieve with three of the most common cutting patterns—no taper, full taper, and split taper sawing. The small circles represents the small-end diameter; the large circles, the large-end diameter.

There are numerous ways to cut a log into lumber, depending on the sawing method and the sizes and types of lumber to be cut. As we discuss each mill type, we'll include the most appropriate sawing methods of those shown in figures 4a, 4b, and 4c.

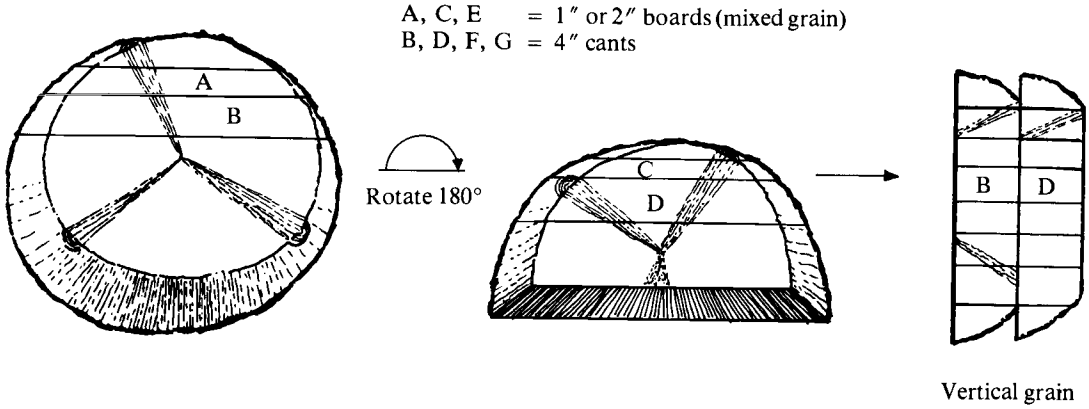
The mill operator will then have one or two basic methods for cutting logs, cutting for grade or for volume recovery.

Many mill operators will do custom cutting for themselves or someone else. Getting the absolute maximum board foot recovery from a particular log in that situation won't be as important as cutting the material desired. Using the appropriate sawing method from figure 4a, 4b, or 4c will be important.

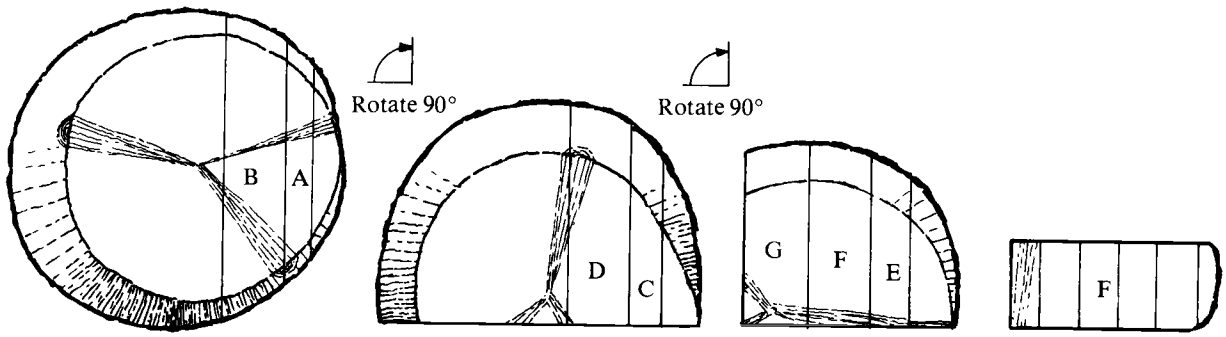
Full taper sawing

Variation 1 (1″ or 2″ vertical grain lumber)

A, C, E = 1″ or 2″ boards (mixed grain)
B, D, F, G = 4″ cants



Variation 2 (1″ or 2″ vertical grain lumber)



Variation 3 (1″ to 6″ lumber in any combination)

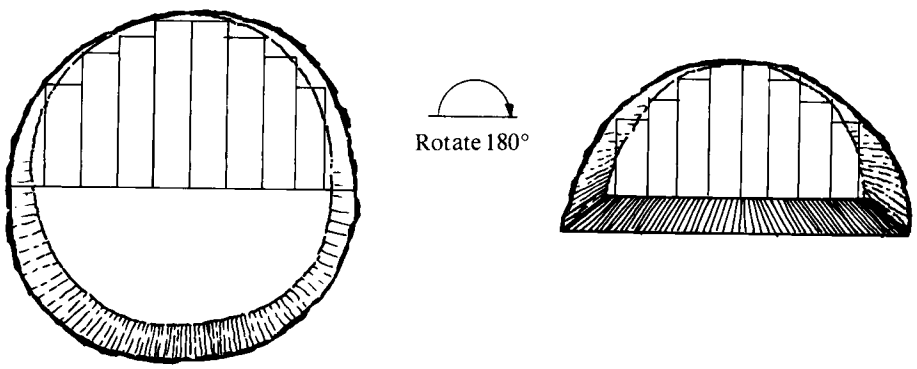


Figure 4b.—Variations available with full taper sawing

Split taper sawing

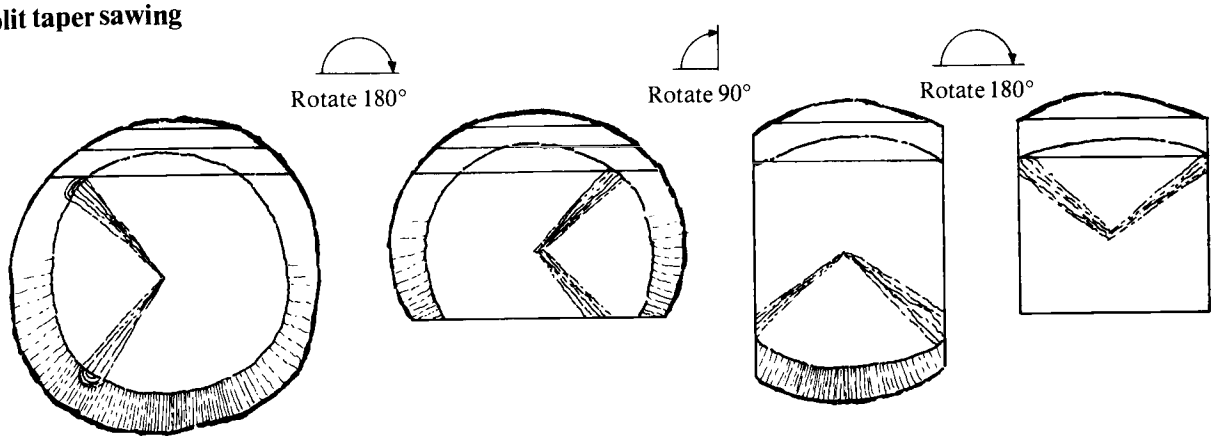


Figure 4c.—Split taper sawing

For the commercial producer of lumber who's cutting primarily dimension or structural lumber, cutting for maximum volume is important. Diameter and taper are critical in cutting for maximum board foot recovery. Because of the great number of possible combinations of diameter and taper and length, it's beyond the scope of this publication to cover cutting for maximum board foot yield.

It's important to note, however, that the commercial user must make certain that the logs being processed are of the lengths that will yield the most valuable lumber.

For users who may wish to cut for maximum board foot yield, *Is There a Best Sawing Method?* would be a good reference.

Mill location

Because slabs, edgings, and sawdust accumulate, the location you choose for the mill must be accessible to vehicles that can remove this residue, especially if you plan to operate the mill semipermanently. Residue removal is less of a problem if you move the mill often. One of the advantages of a portable mill is the ability to place it close to the logs to be processed.

The disadvantage is the need to transport the lumber from the forest to the job site or point of sale. Obviously, it's easier to transport lumber than logs. It's also easier to leave the residue, especially the sawdust, in the woods, rather than to haul it away from the building site or point of sale.

At the mill site, it's important to blow sawdust well away from the area of operation. Pile slabs and edgings well away from the work area, and away from streams and drainageways. Be sure to allow for enough room to stack boards.

In both personal and commercial use situations, be sure to investigate local zoning regulations that may affect where you can locate your mill or the site requirements of your chosen location. County governments differ in how they define and treat portable (vs. stationary) and personal-use (vs. commercial) sawmills. Protect yourself by checking with your county planner or government office before you acquire and place your mill into operation.

Oregon State law (ORS 477.620 and 477.625) requires that operators of mills within ⅛ mile (660 feet) of forest land obtain a written permit from the nearest Oregon State Department of Forestry office. Furthermore, operators of power-driven machinery must take certain fire prevention precautions. These are quite specific; we include excerpts in the appendix.

References to other publications

When you're referred to another OSU Extension Service publication, or to one from another publisher, you'll find additional information in "For further reading," page 17.

Overview of mill types

A wide variety of mills is currently available. They can be grouped into three general categories:

1. Circular mill with a moving carriage. Here, the circular saw remains stationary, and the log is loaded onto a carriage that moves the log through the saw.
2. Circular mill with a moving saw. Here, the log is loaded onto a stationary platform, and the saw passes over the log to cut the lumber.
3. Band mill with moving saw. The log is loaded onto a stationary platform, and the bandsaw passes over the log to cut the lumber.

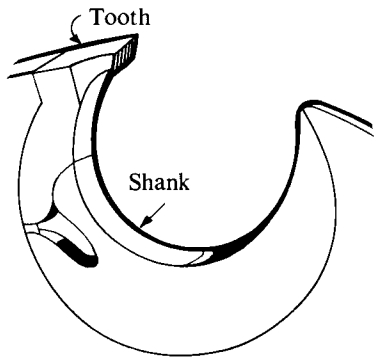
Instead of including the mill specifications as we discuss each mill type, we've grouped them together in table 1.

Table 1.—Portable sawmill specifications

	Circular mill, moving carriage	Circular mill, moving saw	Band mill, moving saw
Characteristics			
Minimum log diameter	4″	4″	4″
Maximum log diameter	36″	No limit	36″
Minimum log length	[a]	4′	Varies
Maximum log length	[a]		Varies
Daily production	4-10 MBF	3-8 MBF	1-2 MBF
Mill cost	$7,000-$15,000	$6,000-$20,000	$4,000-$20,000
Power source[b]	G,D,E,T	G,D,E	G,E
Weight (lb)	3,000-8,000	700-3,500	200-6,000
Transport method[c]	P,T,F	P,T	P,T
Setup/operations			
Area required	50′ × 100′	50′ × 100′	50′ × 100′
People			
Setup	2	1-2	1-2
Operations	2	1-2	1-2
Time required (hr)	1-2	.5-2	1
Carriage			
Moving	Yes	No	No
Stationary	No	Yes	Yes
Cutting pattern[d]	F,S,N	F,S,N	F,S,N
Requires assembly	Yes/No	No	No
Maximum feed speed[e]	60 fpm	10-100 fpm	15-25 fpm
Saw blade			
Kerf	3/16″-3/8″	3/16″-1/4″	1/16″-1/8″
Blade type	Circular	Circular	Band
Filing method	Manual or auto.	Manual or auto.	Manual or auto.
Sharpening frequency	4-5 MBF lbr	4-5 MBF lbr	1 MBF lbr
Sharpening before replacement	30-50 MBF lbr	30-50 MBF lbr	8-10 MBF lbr

[a]Distance between headblocks varies, with clearance at both ends and overhang beyond headblocks.
[b]G = gasoline, D = diesel, E = electric, T = tractor with power takeoff.
[c]P = pickup truck, T = towed trailer, F = flatbed truck.
[d]F = full taper, S = split taper, N = no taper.
[e]fpm = feed speed in linear feet per minute.

Figure 6.—Inserted tooth and shank for circular sawmills



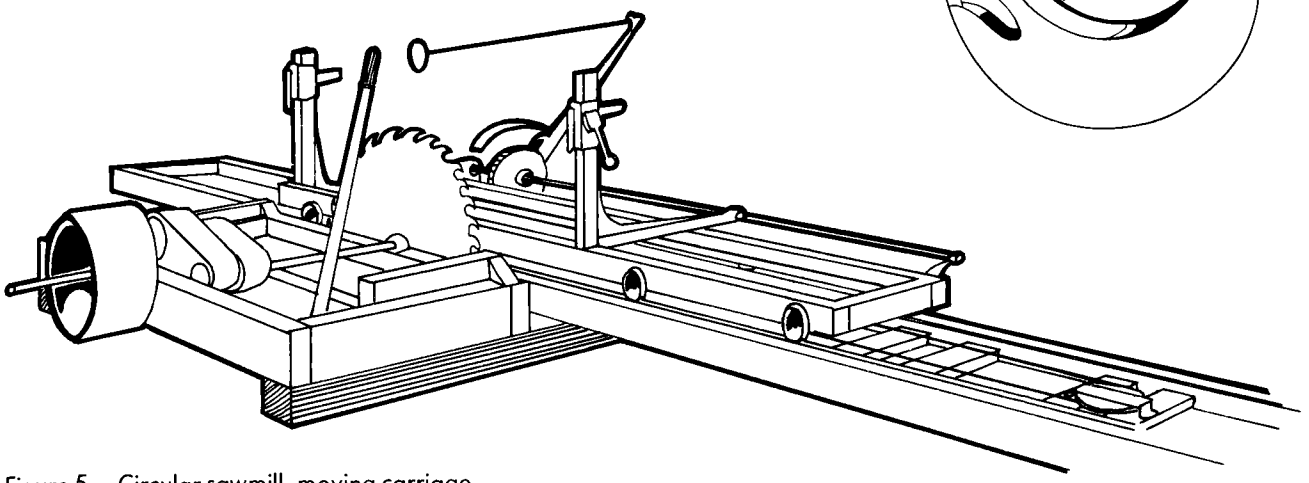


Figure 5.—Circular sawmill, moving carriage

Circular sawmill with moving carriage

This mill uses a fixed circular saw and a moving carriage to hold the log and move it past the saw. This type is one of the original designs for portable use. These mills are patterned on the type of cutting equipment used in fixed-location commercial sawmills, but on a smaller and simpler scale.

With this mill, you load the log onto the carriage with an angled platform or log loader, rotate it on the carriage to the proper position for cutting, and clamp it firmly into place by using two or more "dogs." An electric cable drive moves the carriage and log on two tracks past and through the saw.

The operator determines the size of the board to be cut by adjusting the set works on the carriage. The set works determine the thickness of the board being cut. Figure 5 illustrates a typical mill of this type.

Advantages and disadvantages. The use of a moving carriage on which you can rotate the log, and the stationary saw system, offer maximum flexibility for cutting full, split, and no taper configurations. The ability to rotate the log easily to cut the high grade material from the outer portion of the log is an advantage.

This mill will allow you to cut any of the taper methods and variations we've discussed except the no taper variation 2 (figure 4a) and the full taper variation 3 (figure 4b). These two are more suited to mills that cut and edge at the same time.

All mills of this type use inserted teeth in their circular saw blades. Figure 6 shows a typical example of inserted teeth.

Saw blades with inserted teeth have the advantage of being easy to sharpen and lasting longer between saw changes. Their disadvantage is that they take a wide cut (or kerf) through the log. This is most important when you use the mill to produce lumber commercially or when you cut very valuable logs.

Sometimes, the greater production rates possible with this type of mill will offset the loss in fiber. Edging requires a separate operation with the moving carriage circular sawmill.

Any of the side boards produced (boards marked "A" in figure 4b) will need to be edged on another piece of equipment, or by reloading these pieces on the carriage, where you can edge them on the circular sawmill.

With this type of mill, it's not advisable to cut cants, or square timbers that you'd have to cut again, because you'd have to remove the cants from the output side of the mill after your first cuts, then load them up again on the carriage.

Cutting the lumber. In cutting logs that don't have a great deal of clear material, it's unnecessary to cut with the full taper method. The logs can be cut by the split taper method. It's not advisable to cut no taper with a sawmill of this type (the yield is usually less). With this mill, you've purchased the flexibility to move the log relative to the saw with the moving carriage.

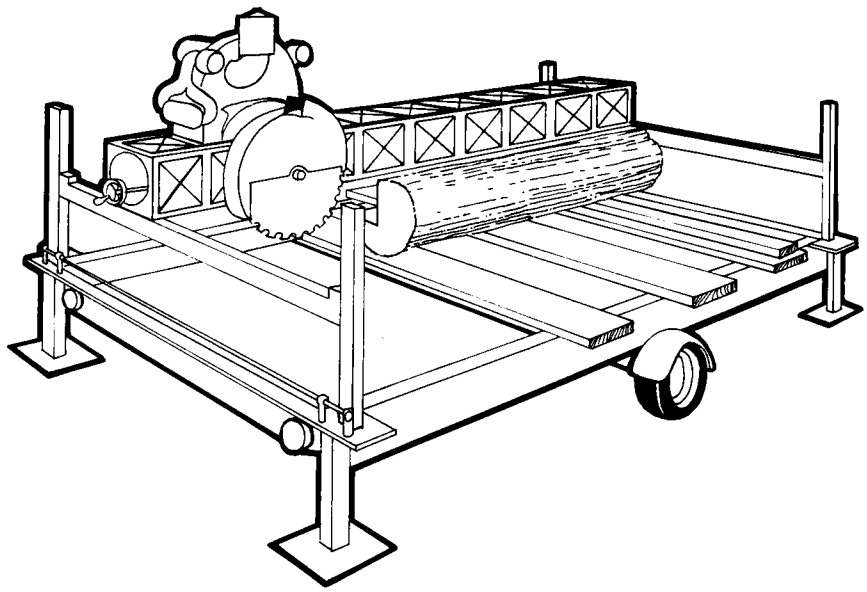


Figure 7.—Stationary log, moving circular sawmill

Circular sawmill with stationary log and moving saw

This mill was developed during the mid-1960's. Small logs are loaded onto a fixed platform, or large logs are sawn right on the ground. A portable track is placed next to the log, and the saws and power plant move down the track to cut the log. With this design, it's possible to cut the log completely without rotating it.

The logs can be rotated if you desire, however. The saw cuts through the log in horizontal layers from top to bottom, as shown in full taper sawing variation 3 (figure 4b) and no taper sawing variation 2 (figure 4a).

There's a main vertically oriented saw and one or more edger saws set at a right angle to the main saw. Using multiple saws eliminates the need to edge the lumber in a separate step. Figure 7 illustrates a sawmill of this type, and figure 8 shows the multiple saw configuration.

With this mill, you can attach track extensions to increase the maximum length of log being cut. You can add 4-, 8-, and 10-foot sections of track to the basic track section. There are several methods used to position the track correctly next to the log. For large logs, some mills require bolting setup boards to the ends of the logs. The track is then mounted on the setup boards. An example of this configuration is shown in figure 9.

Another method of positioning the track is to use end stands. Manufacturers provide all-steel end stands, and some also offer end posts to which you attach lumber cut by the mill as the horizontal members. You attach the track to the end stands, which are located at each end of the log. You can raise or lower the end stands, thus moving the track and the attached saw carriage. This allows you to determine the width of the board being cut. Figure 10 shows a typical end stand configuration.

Some manufacturers provide trailers that have at least one section of track and the carriage already

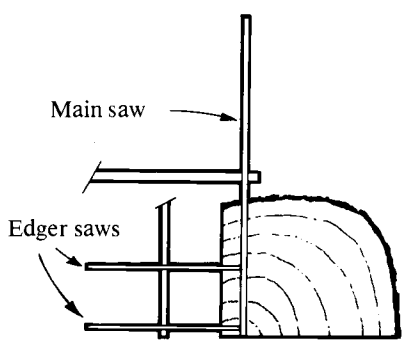
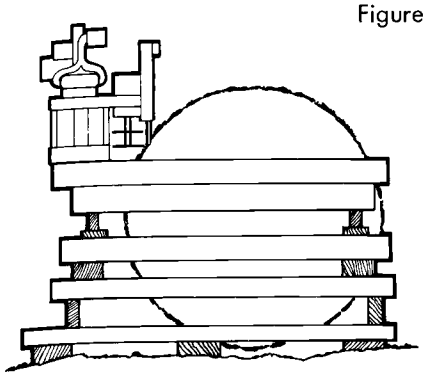


Figure 8.—Edger saws and main saw setup

Figure 9.—Cutting large logs with setup boards



installed. With this arrangement, you need to add only track extensions to make the mill operational. The greatest use of this trailer system is when cutting smaller diameter logs, usually less than 20 inches.

After assembling the track, the carriage is attached to it. The carriage is the heart of the mill. It consists of the engine or motor and the saw assembly. The controls for operating the feed works is also located here. The feed works transports the carriage down the track as the saws cut the lumber and then returns the carriage back to the operator.

When you use end stands, you must move the logs into position for cutting. Sloped ramps are used to move the logs onto the log holders, which firmly hold the log in place while being cut.

There are several different ways to move the logs onto the log holders. Electrically driven cables can be used. For smaller logs, manual cant hooks or peaveys work well.

Advantages and disadvantages. One advantage of this mill is that the saw edges at the same time that it cuts a board. The boards are cut from top to bottom of the log as well as left to right in the log. This allows for flexibility in selecting the cutting method.

In addition, large logs can be cut lying on the ground without having to be moved onto a carriage.

The main disadvantage is the mill's inability to cut vertical grained lumber as the cutting proceeds to the center of large logs that can't be conveniently rotated.

Cutting the lumber. Before beginning a cut, be sure the log is anchored well and the blade rpm has reached operating speed. The first cuts will take place along the top of the log. With these mills, the cut proceeds from left to right, cutting layer by layer down the log as is shown in figure 4a, variation 2 (no taper sawing), or figure 4b, variation 3 (full taper sawing).

After each pass of the saw through the log, a board return plate drops down from the carriage and pulls the board from the log back to the operator as the carriage returns to its starting position. As the carriage returns, the operator takes the board as it moves closer and stacks it along with the lumber already cut.

Unless a great deal of log rotation takes place, and adjustments of the end stands are made, it's not easy to cut full taper lumber from the outside of each log.

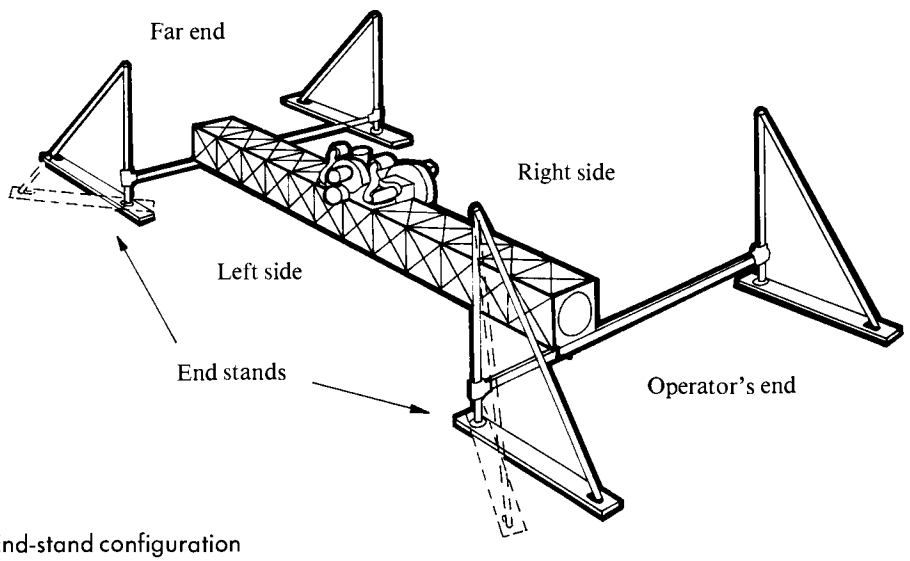


Figure 10.—End-stand configuration

Horizontal band sawmill with stationary log and moving saw

This mill uses a horizontally mounted moving band saw, which travels on a carriage and passes over the log as it cuts successive boards downward from the top of the log. The log may lie flat on the ground, near the ground on horizontal supports, or elevated on a level platform. You place logs into position for cutting with a cant hook or a mechanical winching mechanism.

In some mills of this type, the horizontal band saw moves on a carriage placed on either side of the log. In others, the band saw moves on a carriage with one track above the other on one side of the log. Figure 11 illustrates a horizontal band sawmill with a moving saw.

The cutting method most used with the horizontal band mill is the no taper, live-sawing method shown in figure 4a, variation 1. The log may or may not be rotated.

If you want full taper sawing, you can adjust the log on the sawing platform (using the taper adjustment available on some models), or you can shim the log. You'd use the full taper sawing variation 1 of figure 4b. The log can be sawn to produce finished dimension boards or thicker cants.

Advantages and disadvantages. The production rate of the band mill with moving saws will generally be less than that of any of the mills we've already discussed. Band mills can cut between 1,000 and 2,000 board feet per day. The thinner kerf, or smaller amount of sawdust removed by the saw, will offset the difference somewhat.

By no means should this lower production rate keep you from considering this type of mill. Some band mills are extremely lightweight and portable, require only one person to set up and operate, and are fairly easy to maintain.

Some of these mills don't require as level an area for operation as others. This may be an advantage. If this is a consideration for you, be sure to ask the specific manufacturer if the mill needs a level location for operation.

The most time-consuming part of setting up this mill is positioning the log. It's more of a task for mills that require the log to be rolled up an incline to the sawing platform than for others with platforms closer to the ground. This only becomes a factor when you cut large logs.

A disadvantage of this mill is that when you're cant sawing, you must remove the cants from the mill, then reload them onto the mill on edge for cutting into boards.

Unlike the circular mills that both cut and edge the lumber (page 10), the horizontal band mill won't edge the boards during the initial cutting. If you're edging the boards being produced, you must accumulate them,

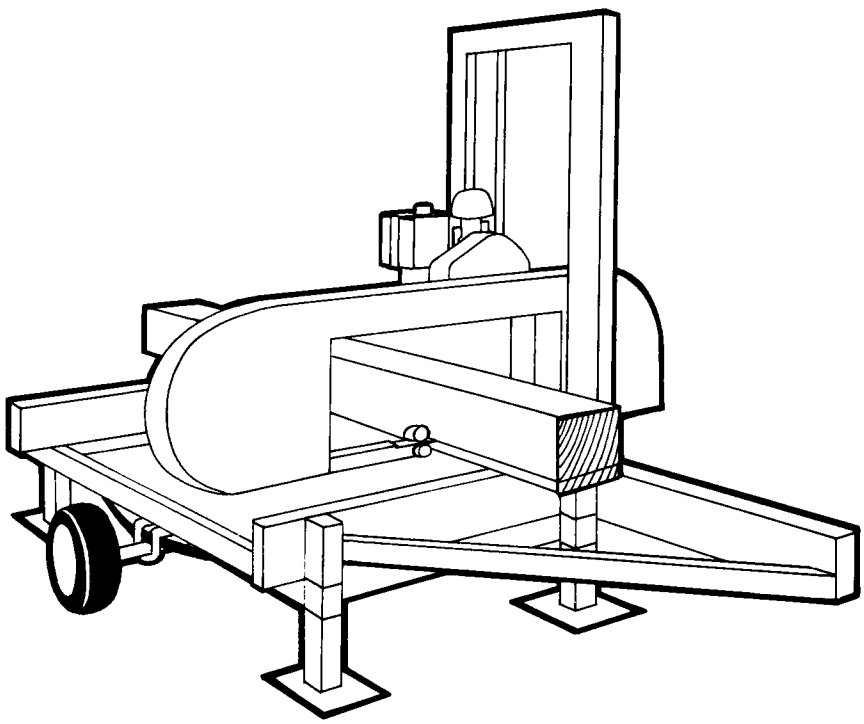


Figure 11.—Fixed log, moving band mill

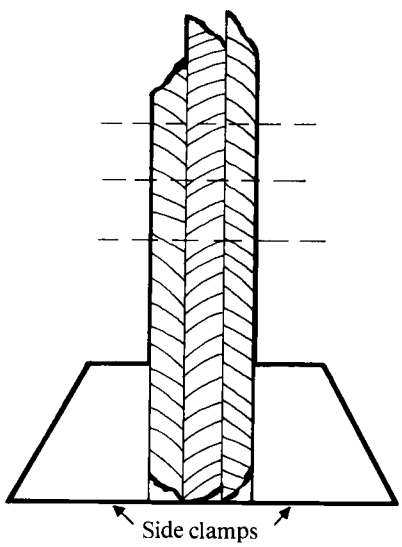


Figure 12.—Side clamps used for edging cants with horizontal band mill

place them on edge between the side clamps (figure 12), and make the cut. You may consider this a disadvantage.

Cutting the lumber. The first cut takes place along the top of the log. If the log is being cut full taper, the first slab will extend the full length of the log. If not, the first slab (and possibly some of the lumber) will be shorter in length.

If you want timbers (cants), you can rotate the log and cut rectangular timbers. After cutting completely through the log, the boards must be edged as shown in figure 12.

Safety considerations

Recognize the potential danger that can arise from operating the mill. A primary cause of accidents is running a mill without adequate training. Before using any mill, become thoroughly familiar with the operating instructions provided by the mill manufacturer. If possible, talk to someone who's familiar with the running of the mill and who can help you with its initial operation.

Use proper personal safety equipment. Wear clothes that are not loose or floppy. Also wear nonslip shoes, a hard hat, gloves, safety glasses, and ear plugs or ear muffs.

Never attempt to operate your mill without first checking to see that it's working properly and that everything is adjusted. An obvious danger is the saw or saws themselves, even when they're not moving.

A high-speed saw cuts skin and bone easier than it cuts wood. You can instantly lose a finger or hand if you get careless around a saw. Saws can also catch and throw wood, knots, or bark. Keeping saws sharp will reduce the risk of injury.

Less obvious are the dangers from loading heavy logs onto your carriage or log-holding platform. Hot exhaust mufflers on gasoline or diesel engines can easily burn you.

The manufacturer will, most likely, include in the instruction manual a diagram of the safe and unsafe areas around your mill while it's in use. If this isn't included in your mill's manual, contact the manufacturer for assistance.

Fire is another danger that you must prepare for when running your mill during the hot, dry summer months (see the appendix). Sparks from the engine exhaust—or from hitting a rock or metal while cutting—can cause a fire. Be sure to have a shovel and water with you when you operate during the dry seasons.

General sawmill maintenance. You must perform regular maintenance if your mill is to function properly. Maintenance falls into two broad categories, the mill itself (including the engine) and the saw blades. The best procedure for maintaining a mill is to set up a schedule for doing certain tasks, and recording when those tasks are accomplished. Table 2 illustrates the most commonly recommended maintenance procedures and their frequencies.

Table 2.—Typical maintenance schedule for a portable sawmill

Every 2 hours
- Check for dull or broken saw teeth
- Inspect and lube band saw guide bearings
- Remove excess sawdust buildup

Daily
- Check engine oil level
- Remove sawdust from air cleaner
- Oil feed works and throttle linkages, pulleys, slides, bushings, rack and pinion guides
- Inspect for loose/broken screws and bolts and loose belts

Weekly
- Check all belts for correct tension
- Oil moving carriage parts
- Oil lumber transport rollers
- Grease all gears and bearings
- Clean out spark arrester
- Clean engine cooling fins and oil cooler
- Check battery level and connections
- Grease end-stand gears
- Oil drive chains

Every 50 to 100 hours, or monthly
- Drain engine oil and replace
- Clean air filter and reoil
- Check any hydraulic pump oil level
- Check hydraulic lines and connections
- Inspect for loose/broken nuts, bolts, and screws
- Inspect plugs, wires, and ignition points
- Inspect and lube all drive chains
- Inspect carriage track for breaks

Bimonthly
- Drain and replace engine oil
- Check hydraulic cylinders

Every 300 hours, or yearly
- Adjust engine valves
- Steam clean engine cooling fins

Maintaining saw blades requires attention to both the blade and the teeth. Circular blades and the large (4- to 6-inch) band saw blades must be properly tensioned to show a small amount of "dishing" when laid on a flat surface. This is essential to cutting straight when the blade is hot. Most owners will have to seek professional assistance for this service. Small band saw blades (1- to 2-inch) are not retensioned.

Most owners can resharpen and reshape teeth on both circular and band saw blades—either by hand filing and resetting or by using an electric grinder and resetting machine, available from most manufacturers. Many band saw blades are considered "disposable" and are not intended to be resharpened.

Economic considerations in acquiring a portable sawmill

Acquiring a portable mill is a significant decision. Making that decision involves several aspects beyond just running the mill, including purchase price, insurance needs, operating and maintenance costs, tax considerations, and purchase or lease arrangements. We'll discuss these here and present general examples of how to approach the decision to acquire a mill.

Buying a mill. When you plan to buy a mill, probably foremost in your mind is the purchase price. Your perspective of the price may vary with the reason for buying the mill (personal vs. commercial application). The prices quoted in table 1 aren't trivial. Buying a mill is a substantial investment. Mill prices vary, so do some comparison shopping!

Two aspects of insurance are important when owning and operating a mill. First, and related to purchase price, the mill is a substantial capital investment worth insuring, especially if you'll move the mill from site to site, thus increasing its exposure to damage.

Second, mill operation can be a dangerous activity with a high chance for personal accident. Adequate liability insurance is a necessity, whether coupled with your personal policy or part of your business coverage. Don't overlook this important aspect of mill ownership. Your insurance agent can help you obtain adequate protection. Because of the unusual volatility in policy premiums, be sure to consult your agent before acquiring a mill.

Lump sum cash purchases or purchases with loans are the most common methods. When paying cash, be sure to examine the effect of the outlay on your business and/or personal cash flow.

Don't overlook the possibility of a short-term loan or a cash-loan combination to ease potential cash flow problems. Cash flow worksheets or other aids to projecting cash flow, such as those in *Managing a New Business,* may be useful.

Remember that there are possible taxation consequences of purchasing a mill. When you use it in a commercial manner to generate income, the mill qualifies for depreciation treatment. Income received will also be taxable. If you purchase the mill with a loan, interest paid qualifies as a taxable deduction, providing the mill is for business and not personal use.

Check with your local assessor about specific details of how your mill will be taxed. Portable mills are usually taxed as personal property, but there may be different procedures depending on the permanency of the mill's setup.

Evaluate the tax consequences before purchasing with a loan. While depreciation and tax considerations are the same as when purchasing with cash, interest paid on the loan may be a tax-deductible item.

Finally, when you use borrowed money, be sure that you're comfortable with the payments. If your situation changes, can you repay the loan early without penalty? How are late payments handled? What insurance coverage, if any, does the loan require? Is additional insurance required beyond what you now have?

Operating cost and repair. Operating cost is another important consideration when acquiring a mill. It naturally varies with the amount and type of use, and the quality of maintenance. Routine maintenance includes regular lubrication, inspection, and servicing of fuel lines, filters, and fittings, and other items recommended by the manufacturer.

Saw blades and teeth must be regularly inspected, sharpened, and replaced when necessary. Drive belts, chains, gears, and pulleys must be regularly inspected and serviced when needed. Hydraulic fluids and batteries may be other necessary supplies.

Prices for these parts will vary with supplier, but a range from a few dollars to $50 should cover most typical items.

Inevitably, the mill will need repair. Often you can reduce the cost by doing the repair yourself. Despite the fact that some manufacturers use standard hardware or implement store parts, portable mills are precision machines that can require expensive repair.

When major repair is required, many manufacturers will either send a representative out to service your mill or accept shipment of the damaged part(s) for factory repair.

Other considerations. Two factors with economic implications are important. First, can the mill handle the log size, volume, and species you want to cut? Second, is sufficient log volume of adequate quality available to produce the size, grade, and volume of lumber you want cut?

Verify that the mill you're considering can physically accommodate the size of logs you want to cut. If modifications are needed, is the cost included in the purchase price, or is it an "extra"? Will the modifications detract from the mill's normal performance?

The mill must be able to handle the species of log you'll be cutting. If you plan to cut dense hardwoods like oak, maple, madrone, or ash with a thin kerf band sawmill, be sure to examine long-term performance records. Thin kerf band saws may require more frequent blade maintenance and replacement when sawing hardwood at production levels.

Ensure that the lumber cut is of the size and grade you want and that you can cut it promptly, if time is a constraint. Remember that safety usually suffers when people and machines are pushed beyond their intended function or production rates. If profitability or "break even" production is important, don't overlook the necessity of having sufficient log volume to cut.

Finally, it's valuable to consult others who own and use the same type of mill you're considering. What has been their experience with the mill's performance, durability, and service requirements? Some time spent getting and evaluating others' experiences could save you considerable headache and money.

Leasing a mill. Leasing or renting a portable mill is not a common practice. Leasing could be advantageous if you need a mill for only a short time or a specific job, or if you're trying your hand before purchasing. If you do lease, be sure to examine the lease agreement regarding:

- insurance considerations,
- maintenance and repair requirements,
- usage restrictions, and
- payment procedures.

The lease agreement should specify who's responsible for insuring the mill. If you're required to insure the mill, there may be a minimum coverage specified to maintain the agreement. Also, the agreement will probably specify who's responsible for maintaining the mill, and (if the responsibility is shared) who's responsible for what.

Given the nature of the mill's cost and danger in operating, you may find that the agreement requires a specific person to act as mill operator.

The agreement should identify the lease payment amounts and their frequency. It should also clarify what constitutes a late payment and any associated penalty. Check the agreement concerning missed payment consequences—hopefully, none will occur.

Finally, you may want to consider leasing with a later option to buy. Include this in the agreement even if you're only remotely interested in this possibility.

Making the final decision. In making the final decision, carefully assess your purpose for having the mill. Are you acquiring it for personal use only (to cut lumber for yourself and/or friends for no charge)? Will you sell the cut lumber? Examples used here will illustrate general decision making methods for both types of use.

There are few, if any, tax advantages associated with personal use. Thus, a higher dollar return will be needed to economically justify the mill. There are, however, reasons beyond economics for having the mill—enjoyment of cutting your own lumber, service to friends, desire to cut lumber in custom sizes that you can't buy, and using small quantities of minor species.

Using the mill in a personal rather than commercial situation may mean less cutting; with proper maintenance, this may give the mill a longer operating life. Finally, you may be able to "pay" for the mill with the savings realized in one large project like building a house or other major structure.

Commercial use of the mill will allow for more tax advantages and will likely give a faster payback of the mill's cost. More maintenance will be required, however, than in a strictly personal application, assuming that the mill is run more. Under the same assumption, there may be a shorter service life from the mill even with proper maintenance, just because the mill is used more.

Next, we illustrate two examples of financial calculations when using portable mills in commercial applications.

Example 1: Commercial cutting your own logs and selling the lumber

When using the mill commercially, your most pressing question will generally be, "What price should I ask for my cut lumber?" The calculation is quite simple.

Selling price (SP). You're merely trying to recover money invested in the mill and its operating cost, plus income given up by not selling your logs as logs, plus an amount for profit. This is the selling price, which can be expressed on a basis of dollars per thousand board feet of lumber (MBF).

By making the following assumptions, we can develop a formula to show the calculation: We obtain the selling price (SP) in $/MBF in two steps.

1. We add three figures: the fixed cost (FC) to recover, the earnings forgone (EF) by selling lumber rather than logs, and the operating cost (OC) of the mill.
2. We multiply this total by the profit multiplier (PM). So...

$$SP = (FC + EF + OC) \times PM$$

The next three sections tell you how to determine your fixed cost, earnings forgone, and operating cost. (In the formulas that follow—and in example 2—we show similar calculations for both band and circular sawmills.)

Fixed cost (FC). To obtain the annual fixed cost that must be recovered ($/MBF), we use this formula:

$$FC = \left[\frac{MI - SV - D}{\text{Years to amortize}} \right] \div AP$$

Where:

MI = total mill investment
SV = mill's salvage value
D = total depreciation deduction realized
AP = mill's annual production rate (MBF/year)

When you calculate FC, salvage value (SV) and depreciation (D) are important assumptions. We assumed that both mill types would have a salvage value equal to 25% of their original value. For depreciation, we assumed that the mill owner was in a 30% tax bracket and that depreciation was being handled in a straight line approach over a 4-year recovery period.

Thus, over the 4 years, $2,400 depreciation savings ($8,000 × 30%) was realized for the band sawmill, and $5,400 ($18,000 × 30%) for the circular mill. Over a 4-year amortization period, FC then becomes:

$$FC = \left[\frac{(\$8{,}000 - \$2{,}000 - \$2{,}400)}{4 \text{ years}}\right] \div 225 \text{ MBF/yr } \textit{band}$$

$$FC = \left[\frac{(\$18{,}000 - \$4{,}500 - \$5{,}400)}{4 \text{ years}}\right] \div 900 \text{ MBF/yr } \textit{circular}$$

FC = $4/MBF *band* sawmill or $2.25/MBF *circular*

Earnings forgone (EF). You forgo earnings when you cut your own logs into lumber rather than selling them as logs. From a business perspective, when cutting your own logs into lumber, this sacrificed income is something you'll want to recover.

You can recover it either directly as money when setting a sale price for your lumber as shown here, or as extra volume that must be cut to make your mill pay for itself. Earnings forgone will vary and are calculated as follows:

EF = Mill price for logs − Logging and transport cost

(You may want to make an additional deduction for taxes, including income and severance taxes.)

In the examples that follow, we've assumed a mill delivered price of $225/MBF for logs, and logging and transport costs of $100/MBF. Thus:

EF = $125/MBF

It's important to recognize that our assumed earnings forgone may vary considerably, with an important effect on the selling price. When you do this type of analysis for decision making, we recommend that you contact several buyers for current mill prices.

Get a professional forester to help you determine the best logging method and its estimated cost. Don't decide on the basis of a single figure for log value forgone. At the minimum, calculate a high and low value.

Operating cost (OC). We calculated it using a $10/hour wage for 8 hours/day and 150 days of operation/year. Divide the resulting annual wage ($12,000) by the annual production for each type of mill, 225 MBF/year for the band sawmill and 900 MBF/year for the circular mill. This gives $53/MBF for the band sawmill and $13/MBF for the circular mill. Add to the results $15/MBF to cover maintenance supplies, tools, etc.

Thus operating cost becomes:

OC = $68/MBF *band* or $28/MBF *circular*

Profit multiplier (PM). We want a 15% return on investment and labor, making the profit multiplier

PM = 1.15

Calculating selling price (SP). Collecting all these values into the formula we first stated on page 15, we now calculate SP for each mill type:

SP = (FC + EF + OC) × PM
SP = ($4 + $125 + $68) × 1.15 *band* or
($2.25 + $125 + $28) × 1.15 *circular*
SP = $227/MBF *band* or
$179/MBF *circular*

You now have a selling price for your rough (unplaned), green, ungraded lumber. Potential buyers will compare your lumber's quality and price with the price of planed, graded, and green or dry lumber from a lumber yard.

Therefore, before deciding to cut and sell your own lumber, you should get prices for commercially cut lumber from several sources and compare these with the calculated selling price of your lumber. Yours must sell for substantially less to justify buying the mill on an economic basis alone.

Finally, a possible alternative to selling your lumber to individual customers is to negotiate an agreement with a sawmill to cut lumber for them. Some sawmills will buy lumber from portable mill operators—then dry, plane, and grade it, and sell it as their own.

Example 2: Custom cutting someone else's logs

You may cut someone else's logs regardless of whether you purchased your mill for personal or commercial use. What to charge for custom cutting is an important question. Here's one way to calculate the cutting price per MBF of lumber cut.

Cutting price (CP) is very similar to selling price (SP) from example 1. The only difference in either value or calculation procedure is that here we assume you're cutting someone else's logs. This means you don't have to recover earnings forgone from selling lumber rather than logs. Now, you're merely selling a service and need only set a CP high enough to cover your fixed and operating costs plus profit, if desired.

Using the same approach as in example 1, we determine cutting price by adding the fixed cost to recover to the operating cost of the mill, then we multiply by the profit multiplier:

CP = (FC + OC) × PM

FC, OC, and PM are exactly the same as in example 1, where:

FC = $4/MBF *band* or
2.25/MBF *circular*
OC = $68/MBF *band* or
$28/MBF *circular*
PM = 1.15

CP thus becomes:

CP = ($4 + $68) × 1.15 *band* or
($2.25 + $28) × 1.15 *circular*

CP = $83/MBF *band* or
$35/MBF *circular*

Summary

Buying and using a portable mill to produce lumber for yourself and others can be a profitable and satisfying experience. There are many possible reasons for having a mill. Having the type of mill best suited to accomplishing your objectives, however, is a key ingredient in both profitability and satisfaction.

In this publication, we've discussed transportation, setup, and operating considerations for circular and band sawmills. We've given an overview of lumber grading as it affects cutting patterns and yields from a portable mill. We've also discussed safety considerations and general maintenance requirements.

Finally, we discussed and illustrated with examples important economic considerations surrounding a portable mill. This publication is not intended to replace consultation with your financial and tax professional, nor is it intended to replace careful study of the manufacturer's operating and maintenance manuals.

For further reading

A Guide to Legal Requirements for Preventing and Controlling Fires by Operators Logging, Clearing and Constructing on or Near Forest Land in Oregon, 1984, Oregon State Department of Forestry, Protection Division (2600 State St., Salem, OR 97310).

Is There a Best Sawing Method? U.S. Forest Service Research Paper FPL 280, U.S. Forest Products Laboratory (Madison, WI: 1976).

Woodley, Elizabeth, and Larry Burt, *Managing a New Business: A Beginner's Guide to Financial Concepts and Tools,* Oregon State University Extension Service Circular 1222 (Corvallis, 1985). Single copy $1.00 plus 25¢ shipping and handling. Order from Agricultural Communications, Publications Orders, Oregon State University, Corvallis, OR 97331-2119.

Appendix: Legal requirements for preventing and controlling forest fires

Oregon state law places several requirements and restrictions on logging and power machinery owners and/or operators to help prevent and control forest fires. The full requirements are published in the Oregon Statutes and a booklet titled Oregon Forest Laws, available from the State Forestry Department, 2600 State St., Salem, Oregon 97310.

We've highlighted certain aspects of the requirements. They're not intended to replace your own reading of the statutes to assure compliance.

The following are general provisions excerpted from the Oregon Revised Statutes (ORS) 477.001:

477.620 Requirements concerning installation or operation of mill or plant. (1) Any person operating a mill or plant from which refuse is burned in or within one-eighth of one mile of forest land shall provide and maintain a closed refuse burner of a type and size which, in the judgment of the forester, is adequate to prevent the spread of fire, unless the forester specifies other measures as equally adequate to prevent the spread of fire. The ground around the mill or plant, including the required refuse burner, shall be cleared for a distance of not less than 200 feet unless a lesser distance is specified by the forester.

(2) Any person operating a mill or plant for the prefabrication or manufacture of forest products, from which refuse is disposed of in forest land without burning, shall clear the ground around the mill or plant for a distance of not less than 200 feet, unless a lesser distance is specified by the forester. The forester, during a closed season affecting such forest land, shall require a cleared fire line around such refuse which in the judgment of the forester is adequate to reduce fire hazard conditions.

(3) Any person who constructs or installs a mill or plant for the prefabrication or manufacture of forest products in or within one-eighth of one mile of forest land shall first obtain a written permit from the forester. The permit shall contain requirements which in the judgment of the forester are adequate to prevent the spread of fire from the mill or plant or refuse. [Formerly 477.215]

477.625 Permit to use fire or power-driven machinery; conditions. Every person conducting an operation using fire in any form or power-driven machinery shall first obtain from the forester a written permit for the calendar year, which shall require that the holder of the permit:

(1) Take reasonable precautions which in the judgment of the forester are necessary in the use of fire and to prevent the spread of fire on or from an operation.

(2) Designate a representative authorized to act on all matters having to do with fire control, which representatives shall be available at all times by direct means of communication with the forester.

(3) If operating west of the summit of the Cascade Mountains, close down any part or all of the operation during any period of time when notified that, in the judgment of the forester, conditions exist as described in ORS 477.670.

(4) If operating west of the summit of the Cascade Mountains, furnish and maintain such weather instruments as the forester may prescribe as adequate in the judgment of the forester to indicate fire hazard conditions. [Formerly 477.286]

We've excerpted the following material from *A Guide to Legal Requirements for Preventing and Controlling Fires by Operators Logging, Clearing and Constructing on or Near Forest Land in Oregon:*

Permits:

Obtain a permit from a forest protection office before operating any power driven machinery on forest land.

New permits are required each year. Permits are enforced all year.

Notification of Intent to Operate:

File a notification of intent to operate with a forest protection office. A notification must be submitted for each operation. (This uses the same form as the permit to operate power driven machinery.)

Action to Control Fires:

The operator must immediately proceed to control and extinguish any fire starting in his operation while he is operating or which results from his operation or any fire which is started from escaped debris or slash burning....

Clearing Landings:

Clear away all flammable debris 50′ or more around each machine used for yarding or loading. If an area cannot be cleared, check with the forest officer about leaving the debris and wetting it down when operating. This is acceptable in a few cases. Enforced during the closed fire season....

Hand Tools for Fire:

Supply hand tools for each operation site or at a location designated by the forester. The number of tools depends on the number of people. This chart shows the requirements:

Tool Table

No. of people in operation	1-4	5	6
Tool box	1	1	1
Axes or Pulaskis	1	1	1
Shovels	2	2	2
Hazel hoes or Pulaskis	1	2	3

Box for Fire Tools:

Store all hand tools for fire in a sturdy box(es) marked "For Fire Only." It is recommended a latch be attached to the lid that can be closed with a metal seal. The forest officer will seal the box after each inspection. Supply at least one box for each landing or each powered machine. Enforced during the closed fire season.

Fire Extinguishers:

Each internal combustion engine used in an operation, except as provided in OAR 43-036 shall be equipped with one chemical fire extinguisher rated by the Underwriters' Laboratories as not less than 4-BC. Extinguisher shall be placed so as to be visible to the operator and ready for instant use.

Spark Arresters and Mufflers for Engines:

Equip gasoline-powered engines with approved spark arresters unless the forest officer authorizes a muffler under certain conditions.

All gasoline engines of less than 50 cubic inch displacement must be equipped with factory-installed mufflers. All non-turbo charged engines must be equipped with an approved spark arrester. Diesel trucks must be equipped with a baffled muffler and exhaust system in good repair. The exhaust must extend above the cab or to the end of the truck frame and discharge upward or to the rear.

Fire Tools and Extinguishers for Trucks:

Equip each truck (3,000 pounds GVW or larger) driven in forest areas for industrial purposes with one round pointed No. 0 shovel or larger, one axe or Pulaski with 26″ handle or larger, and one fire extinguisher rated by the Underwriters' Laboratories as not less than 4-BC.

Woodland Workbook is a collection of publications prepared by the Oregon State University Extension Service specifically for owners and managers of private, nonindustrial woodlands. The *Workbook* is organized into 11 sections, containing information of long-range and day-to day value for anyone interested in wise management, conservation, and use of woodland properties: Management Planning, Forest Measurements, Reforestation, Stand Management, Forest Protection, Logging, Marketing Forest Products, Multiple Use, Forestry Issues, Business Management, and Kinds of Assistance.

The *Workbook* is available in a three-ring binder with tabbed dividers for each section. For information about how to order, and for a current list of titles and prices, write Agricultural Communications, Publications Orders, Oregon State University, Corvallis 97331-2119, or inquire at the office of the OSU Extension Service that serves your county.

Extension Service, Oregon State University, Corvallis, O.E. Smith, director. This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties.