

Forest Landowner's Guide to the Measurement of Timber and Logs

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As a forest landowner interested in selling timber, you are naturally interested in the price you will receive for your product and how that price is determined. The measurement of standing timber and logs may seem strange and complicated to you, and it is possible that you may be quoted dramatically different prices based upon different estimates of the amount of timber you have and the units of measurement used. Methods of measuring timber and the units of measurement often differ between buyers, and, as a seller, you should understand these methods, the units of measurement, and have an idea as to a reasonable price for your timber.

Measurement of Standing Timber

The standing timber in your woodlot has a certain value, which is commonly called the stumpage value. Expressed in terms of dollars per unit volume of wood, this is the amount of money you can expect to receive upon sale of your timber. Many factors determine your stumpage value, but the most important are the species of trees you have, the quality and size of the trees, the location of your woodlot, the prevailing market conditions, the terrain, and the amount of wood you have to sell. Naturally, there are great variations in stumpage prices among woodlots, depending upon changes in any of these factors. Thick, mature stands of a valuable species like northern red oak, located on level ground near a mill, will obviously bring far more money than stands of smaller trees of lower quality species located on steep terrain far from a mill.

Buyers of timber will always need to conduct a survey of your woods before they can make an offer. This survey is often called a timber cruise and involves a series of measurements of individual trees, as well as an assessment of factors that will influence the price



Figure 1. Forester measuring the diameter of a white oak tree using a diameter tape held at breast height, or 4 1/2 feet from the ground (Photo by R. Griffiths).

of your timber. Such factors include the terrain, the amount of road building required, the need for culverts, the access across adjoining properties, and the need for special best management practices (BMPs) to protect against erosion and site deterioration after logging.

When the timber buyer measures your trees, he will locate a series of plots on your land and will measure each tree on each plot. Measurements will include the diameter of the tree (Figure 1), the merchantable height of the tree, the tree species, and often a subjective nota-

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tion of the tree quality. The tree dimensions, diameter and height, are used to determine the volume of the tree. It is this volume, summed over all the trees on your land, that will ultimately serve as the basis for your stumpage price.

It is at this point that the measurement of your timber becomes confusing. The volume of an individual tree can be expressed in a variety of ways, depending upon the product or the desire of the buyer. For example, trees that are sold for pulpwood are often measured in cubic feet, cords or more common recently, weight in tons. A cubic foot of wood is an obvious unit of measure; however, a cord is a stack of wood measuring 8 feet long, 4 feet high, and 4 feet wide. A solid cord, therefore, contains 128 cubic feet; however, wood is not bought and sold in terms of solid cords. When wood is stacked into cords, there is a considerable amount of air space between the pieces, so that an actual cord generally contains from 80 to 90 cubic feet. Another volume term sometimes used is the cunit. A cunit is simply 100 cubic feet of solid wood.



Figure 2. One way of sawing boards out of a log. The number of board feet of lumber that can be sawn from a log depends largely upon the sizes of the boards cut (Photo by T. E. Avery, from Avery, T. E., and H. E. Burkhardt. *Forest Measurements*, 3rd edition. McGraw-Hill Publishing Co., New York, NY. Reproduced with permission).

The weight of your wood will not be determined until it passes over the scale at the mill. The weight of pulpwood will depend on species, how long it has sat on the landing, and time of year.

Even more confusing than the pulpwood measurement of your timber is the measurement of the larger trees that will become sawlogs. These larger trees, usually at least 10 inches in diameter (at a point 4 1/2 feet from the ground, referred to as breast height), are termed sawtimber trees and contain significantly more value than pulpwood trees. Sawtimber trees are also measured for diameter and merchantable height, where the merchantable height is the number of 8-foot logs that could be cut out of the tree up to a minimum top diameter of 8 inches. The diameter and height are then used to determine the volume of the tree in board-foot units. A board foot is a piece of wood measuring 1 inch thick, 12 inches wide, and 12 inches long. The volume of a tree, therefore, is measured by the number of board feet of lumber that can be sawn out of it. This seems simple enough, but there are actually many different ways that boards can be cut out of logs, and thus over the years many different ways of determining board-foot volume have evolved (Figure 2). Although dozens of different ways of expressing board-foot volumes exist, only three are commonly used in Virginia. These three log rules are the Doyle Rule, the Scribner Rule, and the International 1/4-Inch Rule.

Although these rules were developed to express the volume of logs, they are also applied to standing trees that contain one or more merchantable logs. The volume of a tree is simply the sum of the individual logs that it contains.

Unfortunately, the different log rules result in different volumes when applied to logs (or trees) of the same dimension. In addition, these differences are not always consistent across the normal range of log or tree sizes. Therefore, as a seller of timber, you should be aware of these important differences so that you can compare offers based on different log rules.

Measurement of Logs

The measurement of the wood volume contained in sawlogs is commonly known as log scaling (Figure 3). A log of a certain length and diameter (always measured at the smallest end of the log) will contain a certain number of board feet. Just how many board feet a log contains depends upon the log rule used by the scaler. Since logs often contain defects that reduce the merchantable wood volume, scalers will often apply deductions to remove the estimated useless volume in a log from the total.

General Features of Log Rules

Since the first sawmill was built in the United States, over 100 log rules have been developed, using a variety of methods. Some were based upon the lumber tallies of individual mills, others were developed by diagramming the cross-section of boards in the ends of logs (Figure 2), while still others were developed using mathematical formulas. In general, log rules must account for the taper that exists in all logs, saw kerf (or the loss of wood as sawdust), and a fixed procedure for removing wood on the outside of the logs for slabs. The Doyle, Scribner, and International log rules are probably the most widely used rules in the eastern United States.

Doyle Log Rule

The Doyle Log Rule, developed around 1825, is based on a mathematical formula and is widely used throughout the southern United States. This rule allows for a saw kerf of 5/16 inch and a slabbing allowance of 4 inches, which is about twice the normal amount. Because of this, the Doyle Rule is somewhat inconsistent; it underestimates small logs and overestimates large logs. As a seller of timber, you must be aware that for smaller logs the Doyle Rule will underestimate the actual volume of wood that you have in your trees.

Scribner Log Rule

The Scribner Log Rule, developed around 1846, is a good example of a diagram rule. It was created by drawing the cross-sections of 1-inch boards within circles representing the end view of logs. A space of 1/4 inch was left between the boards to account for saw kerf. The Scribner Rule does not have an allowance for log taper and typically underestimates logs, particularly if the log length is long. The Scribner Decimal C is a different form of the Scribner Rule; it rounds the volumes to the nearest 10 board feet. For example, 392 board feet on the Scribner is equivalent to 390 board feet on the Scribner Decimal C scale.

International 1/4-Inch Log Rule

This rule was developed in 1906 and is based on a reasonably accurate mathematical formula. The rule allows for a 1/4-inch saw kerf and a fixed taper allowance of 1/2 inch per 4 feet of log length. Deductions are also allowed for shrinkage of boards and a slab thickness that varies with the log diameter. Overall, the International 1/4-Inch Log Rule is the most consistent and is often used as a basis of comparison for log rules.

Comparison of Log Rules

Since each of the log rules was developed using different methods with different assumptions, it is logical that they will not always result in the same volumes for given size logs. Table 1 shows a comparison of the three log rules for 16-foot logs ranging in diameter from 6 to 40 inches. Compared to the International Rule, both the Scribner and Doyle Rules underscale logs of smaller diameters. For example, a 12-inch-diameter log contains 95 board feet on the International scale, 80 board feet on the Scribner scale, and 64 board feet on the Doyle scale.

Table 1. Comparison of log rules for 16-foot logs.

Log Diameter (inches)	Log Rule (board feet)		
	International 1/4-Inch	Scribner Decimal C	Doyle
6	20	20	4
7	30	30	9
8	40	30	16
9	50	40	25
10	65	60	36
11	80	70	49
12	95	80	64
13	115	100	81
14	135	110	100
15	160	140	121
16	180	160	144
17	205	180	169
18	230	210	196
19	260	240	225
20	290	280	256
21	320	300	289
22	355	330	324
23	390	380	361
24	425	400	400
25	460	460	441
26	500	500	484
27	540	550	529
28	585	580	576
29	630	610	625
30	675	660	676
32	770	740	784
36	980	920	1024
40	1220	1200	1296

If you are selling stumpage or logs, it is important to recognize the differences in volume associated with the different log rules. Since stumpage or log prices are based on the timber or log volume, you will receive substantially more income with the rules that scale your sizes higher. For example, take a log of 16 inches diameter x 16 feet in length and a value of \$100 per thousand board feet. This log would have the following volumes and values based upon the different log rules:

Log Diameter (in.)	Log Rule	Volume (board feet)	Value (\$)
16	International	180	18.00
16	Scribner Decimal C	160	16.00
16	Doyle	144	14.40

Log Rule Controversy

It is fair to say that not everyone agrees on the appropriate log rule to use. Sellers of logs and timber prefer the rules that give them the greatest return, while purchasers obviously prefer log rules that underscale the actual volume in trees or logs. It is important for you, as a seller of timber, to realize that buyers are in a risky situation. Trees and logs often have hidden defects that may greatly reduce their merchantable volume and value. With hardwood timber and logs, the quality often is a more important determinant of value than the mere volume. A purchaser of logs must be adept at recognizing the tree quality of the raw material and adjust the price accordingly. Some logs may have a high enough quality to enable their use for veneer. Such logs generally command a premium price, and the differences between volumes determined by the different log rules become especially important.

Buyers of timber and logs often prefer the Doyle Rule, since we have seen that this rule underestimates the board footage (compared to the International 1/4-Inch Rule) for logs less than 30 inches in diameter. However, sawmillers justifiably argue that the milling costs for small-diameter logs are much higher, and thus they should have a reduced value. The Doyle Rule compensates the sawmiller by underscaling the smaller logs.

The important thing for you to remember is that different log rules exist, and the buying or selling of stumpage or logs should be based upon open agreement as to the log rule to be used. Any of the three rules discussed here can serve as a useful method for scaling logs, as long as both the buyer and seller recognize and agree to its use. Prices can easily be adjusted to reflect the log rule being used.

Conclusion

When selling standing timber or logs, you should expect to receive the fair market price for your product, no more and no less. Bargains often come at considerable expense, including poor logging jobs, site degradation, or perhaps default on the part of the purchaser. You will have the best chance of receiving the fair market price if you use a sealed, competitive bid process and receive as many bids as possible from reliable purchasers. Your Virginia Department of Forestry county forester, consulting foresters, and industrial landowner assistance foresters can provide you with assistance in this important process.