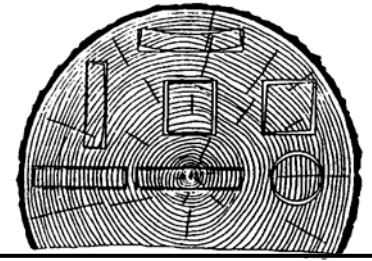


Units of Measure and Conversion Factors for Forest Products



Bulletin #7103

Knowledge of the common units of wood measurement is important to people who are involved in marketing forest products. These units of measurement provide a common basis of communication and understanding between buyer and seller. If you are familiar with these units, you will have a better understanding of the terms of forest products sales agreements and may be able to negotiate higher prices for your timber.

The International 1/4-Inch Log Rule is the standard for measuring sawlogs in Maine. Other authorized systems of measurement may be used if both buyer and seller agree. The following tables are based on the commonly-used International Rule.

The volume of a standing tree, or of a sawlog, is estimated with tree scales or log rules. These can be printed on a stick for direct measurement, or you can find the volume in tables. The rules provide an estimate of the number of board feet of sawed lumber that can be manufactured from the tree or log after allowing for losses in slabs, edgings and sawdust.

Tree Volume Measurement

To estimate the board foot content of standing trees:

1. Measure DBH (Diameter Breast Height—diameter of the tree 4½ feet above the ground)
2. Estimate the number of 16-foot logs to a six-inch top diameter.
3. Find the board foot content in Table 1.

Log Volume Measurement

To estimate the board foot content of sawlogs:

1. Measure the average diameter (inside bark) on the small end to the nearest inch.
2. Measure the length of the log. (*Note:* Log lengths are standardized. A 10-foot log must be at least 10 feet 3 inches long. If it is any shorter, it is called 8 feet. This is similar for other lengths.)

Find the board foot contents in Table 2 on page two.

Table 1: Tree Scale
(Based upon the International 1/4" Rule)

DBH inches	Number of 16-Foot Logs — to 6" Top						
	1	1½	2	2½	3	3½	4
8	20	28	35				
10	36	48	59	66	73		
12	56	74	92	106	120	128	137
14	78	105	132	153	174	187	200
16	106	143	180	210	241	263	285
18	136	184	233	274	314	344	374
20	171	234	296	348	401	440	480
22	211	290	368	434	500	552	603
24	251	346	441	523	605	664	723
26	299	414	528	626	725	801	877
28	347	482	616	733	850	938	1027
30	403	560	718	854	991	1094	1198

Table 2: International 1/4" Log Rule

If you are familiar with standard units, you may be able to negotiate higher prices for your timber.

Diameter (small end inside bark) in Inches	Length of Log in Feet						
	8	10	12	14	16	18	20
4		5	5	5	5	5	10
5	5	5	10	10	10	15	15
6	10	10	15	15	20	25	25
7	10	15	20	25	30	35	40
8	15	20	25	35	40	45	50
9	20	30	35	45	50	60	70
10	30	35	45	55	65	75	85
11	35	45	55	70	80	95	105
12	45	55	70	85	95	110	125
13	55	70	85	100	115	135	150
14	65	80	100	115	135	155	175
15	75	95	115	135	160	180	205
16	85	110	130	155	180	205	235
17	95	125	150	180	205	235	265
18	110	140	170	200	230	265	300
19	125	155	190	225	260	300	335
20	135	175	210	250	290	330	370
21	155	195	235	285	320	365	410
22	170	215	260	305	355	405	455
23	185	235	285	335	390	445	495
24	205	255	310	370	425	485	545
25	220	280	340	400	460	525	590
26	240	305	370	435	500	570	640
27	260	330	400	470	540	615	690
28	280	355	430	510	585	665	745
29	305	385	465	545	630	715	800
30	325	410	495	585	675	765	860



Pulpwood

Pulpwood is usually sold by the cord or by weight.

The Cord

A standard rough cord is generally accepted as equivalent to a pile of closely stacked wood four feet high, four feet deep and eight feet long. It contains 128 cubic feet of wood, bark and air. (See Table 3.) The solid wood content of a cord of pulpwood is variable, depending upon

1. the average diameter of the pieces,

2. tightness of piling,
3. size and number of knots and branch stubs,
4. taper and crookedness of the pieces,
5. bark rubbed off—common in springtime, and
6. shrinkage or compaction of the pile due to time or transportation.

The volumes in the Table 3 are averages commonly used for conversion factors.

Table 3

Solid Wood Content of a Standard Cord	
1 standard cord (4' x 4' x 8')	= 128 cubic feet of wood, bark and air spaces
1 standard cord of pulpwood, rough	= 85 cubic feet of solid wood (softwood)
1 standard cord of pulpwood, peeled	= 95 cubic feet of solid wood (softwood)
1 standard cord of pulpwood, rough	= 80 cubic feet of solid wood (hardwood)
1 standard cord of pulpwood, peeled	= 90 cubic feet of solid wood (hardwood)
1.8 to 2.2 cord	= 1000 board feet
When green rough pulpwood is purchased by weight, the following weight-volume equivalents are generally accepted: 3400-5100 pounds = 1 cord (hardwood) 2900-4700 pounds = 1 cord (softwood)	

Note: These conversion factors are handy for making estimates. In Maine, it is illegal to convert from one system of measurement to another for the basis of payment.

Firewood

Firewood, like pulpwood, is usually sold by the cord or by weight. A standard rough cord of firewood consisting of round 4-foot sticks fitting into a 4' x 4' x 8' space will "shrink" if cut to a shorter length, split and then re-piled. Maine law provides for scaling of firewood-length wood, either round or split, on a "thrown in" basis. A thrown cord of 12" or 16" wood will occupy 180 cubic feet; 24" wood will require 195 cubic feet to contain a cord.

Table 4

Approximate Stacked Volume of a Cord of Wood, Cut and Split		
Length	Approximate Cubic Feet	Approximate Percent Shrinkage from 128 Cubic Feet
48"	128	0
24"	110-113	12
16"	103-107	16
12"	100-103	20

Table 5

Approximate Weight and Heating Value Per Cord (80 cubic feet) of Different Woods, Green and Air Dry (Approximately 20% Moisture Content)				
Wood	Weight in pounds		Available Heat, in Million BTUs ¹	Equivalent in Gallons of Fuel Oil ²
	Green	Air Dried	Air Dried	
Ash	3840	3440	20.0	204
Aspen	3440	2160	12.5	128
Beech, American	4320	3760	21.8	222
Birch, yellow	4560	3680	21.3	217
Maple, red	4000	3200	18.6	190
Maple, sugar	4480	3680	21.3	217
Oak, red	5120	3680	21.3	217
Oak, white	5040	3920	22.7	232
Pine, eastern white	2880	2080	12.0	123

¹50 to 60% efficiency of burning unit.

²70% efficiency of furnace.

* BTU (British Thermal Unit) is the quantity of heat required to raise the temperature of one pound of water one degree F.

Table 6

Variation of Heating Values of Wood Due to Moisture	
Percent of Moisture	Percent of Usable Heat
0% (oven dry)	103.4%
4	102.7
20 (air-dried hardwood)	100.0
40	96.5
80	89.7
100 (green hardwood)	85.0

Table 7

Approximate Number of Trees per Cord for Pulpwood and Firewood		
Tree diameter at 4 ¹ / ₂ Feet	Number of Trees	
	Hardwood	Spruce-fir
6"	32	22
7"	24	14
8"	15	10 ¹ / ₂
9"	12	8
10"	8	6
11"	7	5
12"	5	4
14"	3	3
16"	2	2+
18"	1 ¹ / ₂	2-
20"	1	1 ¹ / ₂

By the time trees have been processed into finished lumber, measurement can be relatively precise.

Table 8

Calculated Sawdust Weights in Pounds Per Cubic Foot at Moisture Contents									
Moisture Content Level		Species and Compaction Classes							
		White Pine			Red Oak			Red Maple	
Percent	Percent	Light	Shaken	Packed	Light	Shaken	Packed	Light	Shaken
Oven-Dry Basis	Green Basis	7.7	9.7	13.2	11.0	13.9	16.8	8.9	12.2
5	4.8	8.1	10.2	13.7	11.5	14.6	17.3	9.3	12.8
10	9.1	8.5	10.7	14.0	12.1	15.3	17.7	9.8	13.4
15	13.0	8.8	11.1	14.5	12.6	16.0	18.3	10.2	14.0
20	16.6	9.2	11.6	14.9	13.2	16.7	18.9	10.7	14.6
25	20.0	9.6	12.1	15.2	13.7	17.4	19.5	11.1	15.2
30	23.1	10.0	12.6	15.5	14.3	18.1	20.0	11.6	15.9
50	33.3	11.5	14.5	17.3	16.5	20.8	22.8	13.3	18.3
75	42.8	13.5	17.0	19.5	19.2	24.3	26.2	15.6	21.3
100	50.0	15.4	19.4	22.0	22.0	27.8	31.0	17.8	24.4
125	55.5	17.3	21.8	25.0	24.7	31.3	36.0	20.0	27.4
140	58.3	18.5	23.3	27.1	26.4	33.3	40.0	21.4	29.9

Lumber: Square Edge

The standard unit of measure for lumber is the board foot. It is equivalent to 1/12 of a cubic foot, such as a board 12 inches by 12 inches and one inch thick.

Board foot measurements refer to rough lumber. Surfaced lumber is tallied on the basis of width and thickness before surfacing.

To calculate the board footage of lumber, for each piece multiply the width in inches by the thickness by the length in feet, and divide by 12. (See Table 9.)

$$\text{Example: } \frac{6" \text{ wide} \times 2" \text{ thick} \times 16' \text{ long}}{12} = 16 \text{ board feet}$$

Table 9

Board Foot Measure Contained in Lumber						
Thickness and width in inches	Board foot content Board length in feet					
	6	8	10	12	14	16
1 x 2	1	1 ¹ / ₃	1 ² / ₃	2	2 ¹ / ₃	2 ² / ₃
1 x 3	1 ¹ / ₂	2	2 ¹ / ₂	3	3 ¹ / ₂	4
1 x 4	2	2 ² / ₃	3 ¹ / ₂	4	4 ² / ₃	5 ¹ / ₃
1 x 5	2 ¹ / ₂	3 ¹ / ₃	4 ¹ / ₆	5	5 ⁵ / ₆	5 ² / ₃
1 x 6	3	4	5	6	7	8
1 x 7	3 ¹ / ₂	4 ² / ₃	5 ⁵ / ₆	7	8 ¹ / ₆	9 ¹ / ₃
1 x 8	4	5 ¹ / ₃	6 ² / ₃	8	9 ¹ / ₃	10 ² / ₃
1 x 10	5	6 ² / ₃	8 ¹ / ₃	10	11 ² / ₃	13 ¹ / ₃
1 x 12	6	8	10	12	14	16
1 ¹ / ₄ x 4	2 ¹ / ₂	3 ¹ / ₃	4 ¹ / ₆	5	5 ⁵ / ₆	6 ² / ₃
1 ¹ / ₄ x 6	3 ³ / ₄	5	6 ¹ / ₄	7 ¹ / ₂	8 ³ / ₄	10
1 ¹ / ₄ x 8	5	6 ² / ₃	8 ¹ / ₃	10	11 ² / ₃	13 ¹ / ₃
1 ¹ / ₂ x 4	3	4	5	6	7	8
1 ¹ / ₂ x 6	4 ¹ / ₂	6	7 ¹ / ₂	9	10 ¹ / ₂	12
1 ¹ / ₂ x 8	6	8	10	12	14	16
2 x 4	4	5 ¹ / ₃	6 ² / ₃	8	9 ¹ / ₃	10 ² / ₃
2 x 6	6	8	10	12	14	16
2 x 8	8	10 ² / ₃	11 ¹ / ₃	16	18 ² / ₃	21 ¹ / ₃
2 x 10	10	13 ¹ / ₃	16 ² / ₃	20	23 ¹ / ₃	26 ² / ₃
2 x 12	12	16	20	24	28	32
2 ¹ / ₂ x 12	15	20	25	30	35	40
3 x 6	9	12	15	18	21	24
3 x 8	12	16	20	24	28	32
3 x 10	15	20	25	30	35	40
3 x 12	18	24	30	36	42	48
4 x 4	8	10 ² / ₃	13 ¹ / ₃	16	18 ² / ₃	21 ¹ / ₂
6 x 6	18	24	30	36	42	48

Table 10

Lumber Size Table						
Nominal and Minimum-dressed Sizes of Boards, Dimensions and Timbers (All Figures in Inches)						
Item	Thickness			Face Widths		
	Nominal	Minimum Dressed		Nominal	Minimum Dressed	
		Dry	Green		Dry	Green
Boards *				2	1 ¹ / ₂	1 ⁹ / ₁₆
				3	2 ¹ / ₂	1 ⁹ / ₁₆
				4	3 ¹ / ₂	3 ⁹ / ₁₆
				5	4 ¹ / ₂	4 ⁵ / ₈
	1	3/4	25/32	6	5 ¹ / ₂	5 ⁵ / ₈
				7	6 ¹ / ₂	6 ⁵ / ₈
	1 ¹ / ₄	1	1 ¹ / ₃₂	8	7 ¹ / ₄	7 ¹ / ₂
				9	8 ¹ / ₄	8 ¹ / ₂
	1 ¹ / ₂	1 ¹ / ₄	1 ⁹ / ₃₂	10	9 ¹ / ₄	9 ¹ / ₂
				11	10 ¹ / ₄	10 ¹ / ₂
				12	11 ¹ / ₄	11 ¹ / ₂
				14	12 ¹ / ₄	13 ¹ / ₂
			16	15 ¹ / ₄	15 ¹ / ₂	
Dimension				2	1 ¹ / ₂	1 ⁹ / ₁₆
				3	2 ¹ / ₂	2 ⁹ / ₁₆
				4	3 ¹ / ₂	3 ⁹ / ₁₆
	2	1 ¹ / ₂	1 ⁹ / ₁₆	5	4 ¹ / ₂	4 ⁵ / ₈
	2 ¹ / ₂	2	2 ¹ / ₁₆	6	5 ¹ / ₂	5 ⁵ / ₈
	3	2 ¹ / ₂	2 ⁹ / ₁₆	8	7 ¹ / ₄	7 ¹ / ₂
	3 ¹ / ₂	3	3 ¹ / ₁₆	10	9 ¹ / ₄	9 ¹ / ₂
				12	11 ¹ / ₄	11 ¹ / ₂
			14	13 ¹ / ₄	13 ¹ / ₂	
			16	15 ¹ / ₄	15 ¹ / ₂	
Dimension				2	1 ¹ / ₂	1 ⁹ / ₁₆
				3	2 ¹ / ₂	2 ⁹ / ₁₆
				4	3 ¹ / ₂	3 ⁹ / ₁₆
				5	4 ¹ / ₂	4 ⁵ / ₈
	4	3 ¹ / ₂	3 ⁹ / ₁₆	6	5 ¹ / ₂	5 ⁵ / ₈
	4 ¹ / ₂	4	4 ¹ / ₁₆	8	7 ¹ / ₄	7 ¹ / ₂
				10	9 ¹ / ₄	9 ¹ / ₂
				12	11 ¹ / ₄	11 ¹ / ₂
				14		13 ¹ / ₂
			16		15 ¹ / ₂	
			5 & Wider		1/2 off	

*Boards less than the minimum thickness for one-inch nominal but 5/8 inch or greater thickness dry (11/16 inch green) may be regarded as American Standard Lumber, but such boards shall be marked to show the size and condition of seasoning at the time of dressing. They shall also be distinguished from one-inch boards on invoices and certificates.

Note: Dry Sizes apply to lumber that has been seasoned or dried to a moisture content of 19 percent or less. Green sizes apply to lumber having moisture content in excess of 19 percent.

When you measure the volume of a standing tree, you are in fact only estimating.

Summary

This is a general introduction to the measurement of forest products. It is by no means complete or comprehensive. While the information should prove useful, you may find instances where the numbers appear to be wrong. This is what happens when reams of specific information are condensed into a few pages.

Bear in mind that wood products literally grow on trees and trees are quite variable. When you measure the volume of a standing tree, you are in fact only estimating. The same holds true, to a lesser degree, when you

scale logs or cordwood. Then there is the human factor: if two expert scalers were to measure the same load of logs at the same place on the same day, I would expect them to come up with different totals. Their answers would probably be close, but not identical.

By the time trees have been processed into finished lumber, the wood has been reduced to a rather uniform product, so measurement can be relatively precise. Quality—grades of lumber—may vary, however.

Suggested References

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