

Forest Measurements

Tree Measurements for Cruising

Trees are measured to determine the volume and growth of both the individual tree, and the entire forest stand. The data taken from tree measurements can determine the health of the forest and help in determining the value of its wood.

Diameter: If you were to cut a tree down, and measure the average distance across the cut, you would come up with its diameter. Since we cannot cut down every tree we want to measure, it is far easier to use a *diameter tape*. Diameter tape is wrapped around the *circumference* of the tree at 4½ feet above the ground, the standard point of measurement for tree volume computations. This is called the **Diameter at Breast Height (DBH)** and is much easier than measuring the diameter at the base of the tree.



Since wrapping a regular measuring tape around the tree will only get us the circumference, you would want to make sure to use a specially calibrated diameter tape. This tape uses the formula of $Circumference = \pi \times \text{diameter}$, so that you don't have to do it! This makes every inch of diameter appear to be 3.14 inches long on your diameter tape! Most diameter tapes also have a standard tape measure on the reverse side, so be sure to use the correct side.

Diameter measurements are often used to determine the type of product for which a tree may be used. Minimum diameters vary from product to product and from mill to mill, but some general rules apply in Florida for some products. Diameters are usually tallied to the nearest inch. Round up when the measurement is .6 or more, and round down when less than .6.

Class	Pulpwood	Chip-N-Saw ¹	Saw Timber ¹	Poles ²	Veneer Logs
Use	Paper, wood by-products	Small lumber	Large lumber	Utility poles	Plywood
DBH	> 4.6"	> 8.6"	> 11.6"	Varies	> 14"
Top diameter	2 – 4"	5 – 6"	8"	6"	8"
Time to grow	8-15 years	12-20 years	20-30+ years	18+ years	25+ years

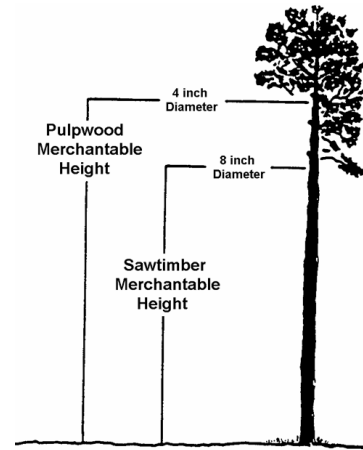
¹ Straight log at least 16 feet long with no forks, large branches or diseases.

² Long, straight, nearly perfect stem.

We will be using an instrument called the Biltmore stick to measure diameter at breast height.

Tree Height: Foresters use a couple of different types of instruments to measure tree height. These include the Biltmore stick, the hagameter, the clinometer, or one of several instruments that use lasers to get more accurate readings. We will be using the Biltmore stick.

There is a difference between *total tree height* and *merchantable tree height*. The total tree height is the height to the top of the needles. The merchantable tree height is the upper limit of useable wood for a given product on a tree stem. A tree's diameter gets smaller toward the top of the tree, this is known as taper. Pulpwood height is measured to a 4 inch minimum at the top of the tree. So, in this case, you would measure the tree's height up to where it tapers to around 4 inches in diameter. For other wood classes, you would measure to a larger diameter, usually an 8 inch top.



Heights are often measured in units larger than the standard foot. Pulpwood is often measured in $5 \frac{1}{3}$ foot sticks (16' minimum), and sawtimber is measured in 16 foot logs. After the first full log, these products can be measured to the half-log. Always round down when measuring heights.

How to use the Biltmore Stick:

To measure Diameter at Breast Height (DBH)

Step 1: Hold the Biltmore Stick horizontally 25 inches from the eye and at $4 \frac{1}{2}$ above the ground.

Step 2: Line up the left side of the stick with the left side of the tree trunk.

Step 3: Without moving your eye, look at the right side of the trunk and read the measurement. DBH is measured in inches.

Step 4: Record DBH

To measure the Height of the Tree

Step 1: Pace one chain away from the tree.

Step 2: Hold the Biltmore stick vertically 25 inches from the eye.

Step 3: Without moving your eye, line the bottom of the stick up with the base of the tree and then look up and measure the merchantable height of the tree. Merchantable height is measured in 16' logs.

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Tree Measurements for Cruising Practice

Directions: Using a Biltmore stick, measure the 5 pre-numbered trees for DBH and Merchantable Height. Record your answers on the chart below.

	DBH (inches)	Merchantable Height (16'logs)
Tree 1	_____	_____
Tree 2	_____	_____
Tree 3	_____	_____
Tree 4	_____	_____
Tree 5	_____	_____

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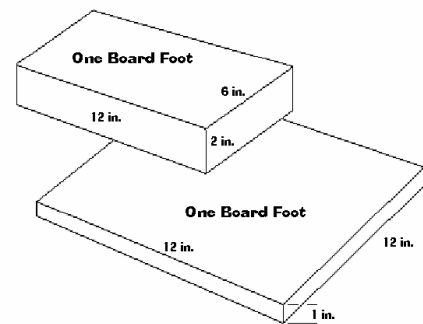
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Volume Determination: Once the trees are measured for diameter and merchantable height, the tree volumes can be computed using volume tables. Volume tables vary by product, species, geographic location, date, and user preference. To use a volume table, find where the tree's DBH intersects with its merchantable height, this will give you the merchantable volume of the tree. Below are examples of a pulpwood volume table and a sawtimber volume table.

Pulpwood is generally measured by the **cord** or by weight. A cord of wood is a stack of round wood that measures four feet high, four feet wide and eight feet long, and contains 128 cubic feet. But since that stack also contains air space and bark, a conversion factor of 90 cubic feet of solid wood per cord is used for standing timber. Once you add up all of the cubic foot values of all the pulpwood trees to give you your total volume, divide this number by 90 to get the number of cords of pulpwood. One cord of pine pulpwood is equivalent to 5,400 pounds, or 2.7 tons.

Sawtimber is measured in *board feet*, generally thousands of board feet (MBF), or by weight. A **board foot** is a unit of measure containing 144 cubic inches of solid wood.

Examples of a board foot include a piece of wood 12 inches by 12 inches by one inch thick; or a board six inches wide, 12 inches long, and two inches thick; or an 18 inch long 2" x 4". One thousand board feet of pine sawtimber is equivalent to 15,000 pounds, or 7.5 tons.



How to Timber Cruise for Wood Volume

Step 1: Record the DBH and Merchantable Height for each tree.

Step 2: Determine if you are measuring pulpwood or sawtimber and use the corresponding charts to determine volume.

Step 3: Record the volume for each tree on the chart.

Step 4: Add up the volume column and record total volume.

Step 5: If you measured sawtimber, then you will need to convert to MBF by moving the decimal point three places to the left. If pulpwood, skip this step.

Step 6: This spot represents $\frac{1}{4}$ acre, convert to per acre volume by multiplying total volume by 4. Answer will be MBF per acre for sawtimber and cords per acre for pulpwood.

Pulpwood Volume Table (cubic-foot volume, second growth Southern Pine) Number of 16-Foot Logs							
DBH	0.5	1	1.5	2	2.5	3	3.5
5"	0.8	1.3	1.8	2.2			
6"	1.4	2.4	3.2	4.0	4.7		
7"	2.0	3.4	4.6	5.7	6.7	7.7	
8"	2.6	4.4	5.9	7.3	8.7	9.9	11.1
9"	3.2	5.4	7.3	9.0	10.6	12.2	13.7
10"	3.8	6.4	8.6	10.7	12.6	14.5	16.3
11"	4.4	7.4	10.0	12.5	14.7	16.9	18.9

Gross Tree Volume Table Scribner Log Rule, Form Class 78 Volume (Board Feet) by Number of Usable 16-foot Logs							
DBH	1	1 ½	2	2 ½	3	3 ½	4
10"	28	36	44	48	52		
11"	38	47	60	67	74		
12"	47	61	75	85	95	100	106
13"	58	76	94	107	120	128	136
14"	69	92	114	130	146	156	166
15"	82	109	136	157	178	192	206
16"	95	127	159	185	211	229	247
17"	109	146	184	215	246	268	289
18"	123	166	209	244	280	306	331
19"	140	190	240	281	322	352	382
20"	157	214	270	317	364	398	432
21"	176	240	304	358	411	450	490
22"	194	266	338	398	458	504	549
23"	214	294	374	441	508	558	607
24"	234	322	409	484	558	611	665

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Timber Cruising for Wood Volume Lab Activity

Timber Cruising for Wood Volume

Directions: Using a Biltmore stick, the student will measure ten pre-numbered trees for total board foot volume. The student will record DBH computed to the nearest inch and merchantable height of each tree, rounded down to the nearest ½ log.

The minimum diameters and log lengths will be:

SAWTIMBER:

DBH-----10 inches

Top Diameter-----8 inches

Height-----16 feet (one log)

PULPWOOD:

DBH-----5 inches

Top Diameter-----4 inches

Height-----12 feet

	DBH (inches)	Merchantable Height (16'logs)	Volume (Board Feet)
Tree 1	_____	_____	_____
Tree 2	_____	_____	_____
Tree 3	_____	_____	_____
Tree 4	_____	_____	_____
Tree 5	_____	_____	_____
Tree 6	_____	_____	_____
Tree 7	_____	_____	_____
Tree 8	_____	_____	_____
Tree 9	_____	_____	_____
Tree 10	_____	_____	_____
		Total Volume	_____

Convert to MBF if Sawtimber: _____

This spot represents ¼ acre, convert to per acre volume: _____

Answer(MBF for Sawtimber, cords per acre for pulpwood): _____