

**CHAPTER**



**MEASURING  
TREE HEIGHTS**



# Measuring Tree Heights

After diameter, the height of a tree is the next most important measurement. Knowing the estimated height helps landowners and managers understand how well a forest is growing or for what forest products an individual tree might be used. In general, there are three common tree height measurements: total height, merchantable height, and height to live crown.

Total tree height is the height of the tree from the base to the uppermost branches. We do not measure to the end of the topmost needles/leaves. This is the preferred tree height measurement for making forest management decisions. Total tree height can be difficult to determine on older pine trees that have a flattened top and for many hardwood species.

Merchantable tree height is defined as the height of the usable portion of a tree that will be sold in a commercial logging operation. It is measured from the base to some upper stem diameter limit as specified by a mill. Merchantable tree height is more difficult to assess and takes more practice than total tree height measurements.

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Height to live crown is the height from the base to the point on the tree where branching begins. If there are individual branches lower on the tree, imagine where they might be to fill in the gaps. Once those gaps are filled in, the base of the filled-in crown is the point at which you would measure (figure 8.1).

## HEIGHT MEASUREMENT INSTRUMENTS

Because tree height is difficult to measure directly, instruments used to estimate tree height have been developed. These instruments include hypsometers and clinometers. In this section you will learn how tree height is measured using various forestry tools. See video 8.1, *Helpful Hints for Measuring Tree Height*, on the Alabama Extension website at [www.aces.edu/go/ForestInventoryBasics](http://www.aces.edu/go/ForestInventoryBasics).

## MERRITT HYPSONETER

A Merritt hypsometer is a scale that is usually printed on a cruiser stick, on the opposite side of a Biltmore stick, and can be used to estimate tree heights in merchantable log or half-log lengths. Merchantable logs in standing trees commonly are measured in the southern United States

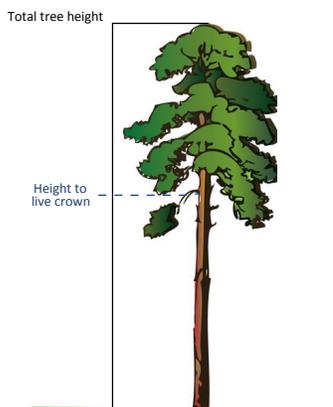


Figure 8.1. Example of where total tree height and height to live crown may be measured on a standing tree.

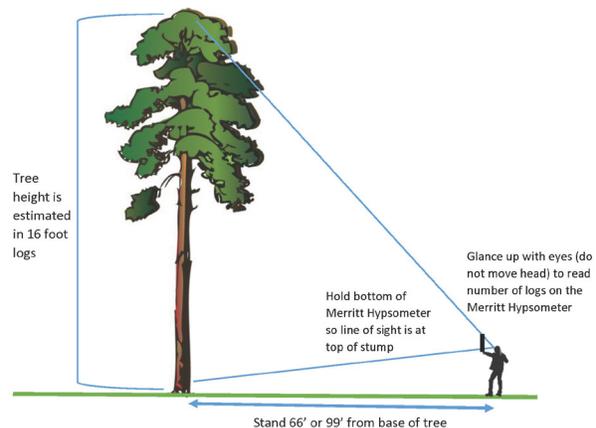


Figure 8.2. How to use a Merritt hypsometer.



Clinometers are commonly used to measure tree heights.

in 16.3-foot lengths. Therefore, markings on a Merritt hypsometer are in 16-foot log and 8-foot half log lengths.

To use a Merritt hypsometer, stand either 66 or 99 feet away from the tree as specified on the hypsometer and hold the stick out in front of you 25 inches from your eyes (figure 8.2). Hold the stick vertically, with the base of the stick level with the tree base. Looking up the stick, you can note the estimated number of logs in the tree. To estimate tree height in feet multiply the number of logs by 16 feet per log. Note that the Merritt hypsometer is good for log estimates but not reliable for precise tree height estimations.

## CLINOMETER

Clinometers are commonly used for tree height estimations. They have two scales: a percent scale (height can be read directly at 100 feet and is usually on the left side of the scale) and a topographic scale (height can be read directly at 66 feet and is usually on the right side of the scale). Using a clinometer accurately takes practice, but the process is easy if you remember a few basic guidelines:

- Always take height measurements at a distance greater than you think the tree is tall. We often use 50, 66 or 100 feet as this distance.
- To adjust a clinometer reading from any distance, divide your distance from the tree by the scale you are using. If you are using the topo side, divide the distance by 66. If you are using the percent side, divide by 100 and then multiply that number



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by the measured height reading of the tree. See examples on this page.

- Be sure to always stand perpendicular to the lean of a tree.
- If the tree is on a slope, try to position yourself so that your eye level is above the base of the tree.

When using a clinometer the reading below eye level will be negative (figure 8.3). Don't be confused about having to add a negative. The negative reading to the base of the tree implies that the base is below eye level, and the two parts of the height must be added together.

Examples of clinometer calculations:

1. You are measuring a tree from which you are standing 50 feet away. Your eye level is above the base of the tree. You get a reading of 80 to the top of the tree using the percent side of your clinometer. You then get a reading of minus 6 to the base of the tree. You would then estimate the height of that tree to be the following:

$$(50 \div 100) \times (80 + 6) = 43 \text{ feet tall}$$

2. You are measuring a tree from which you are standing 100 feet away and are above the base of the tree. You get a reading of 80 using the percent side of your clinometer to the top of the tree and a reading of minus 6 to the bottom of the tree. The height of that tree would be the following:

$$(100 \div 100) \times (80 + 6) = 86 \text{ feet tall}$$

3. You are below the base of the tree from example 2, and the reading is plus 6. The height of that tree would be the following:

## YOUR TURN

1. You are measuring a tree from which you are standing 100 feet away. Your eye level is above the base of the tree. You get a reading of 72 to the top of the tree using the percent side of your clinometer. You then get a reading of minus 10 to the base of the tree. What do you estimate the height of that tree to be in feet?
2. You are measuring a tree from which you are standing 66 feet away. Your eye level is above the base of the tree. You get a reading of 89 using the percent side of your clinometer to the top of the tree and a reading of minus 8 to the bottom of the tree. What do you estimate the height of that tree to be in feet?
3. You are measuring a tree from which you are standing 100 feet away. Your eye level is above the base of the tree. You get a reading of 89 using the percent of your clinometer to the top of the tree and a reading of minus 8 to the bottom of the tree. What do you estimate the height of that tree to be in feet?
4. You are measuring a tree from which you are standing 66 feet away. Your eye level is above the base of the tree. You get a reading of 47 using the top side of your clinometer to the top of the tree and a reading of minus 3 to the bottom of the tree. What do you estimate the height of that tree to be in feet?
5. You are measuring a tree from which you are standing 75 feet away. Your eye level is above the base of the tree. You get a reading of 53 using the percent side of your clinometer to the top of the tree and a reading of minus 6 to the bottom of the tree. What do you estimate the height of that tree to be in feet?

## ANSWERS

1.  $(100 \div 100) \times (72 + 10) = (1) \times (82) = 82 \text{ feet tall}$
2.  $(66 \div 100) \times (89 + 8) = (0.66) \times (97) = 64 \text{ feet tall}$
3.  $(100 \div 100) \times (89 + 8) = (1) \times (97) = 97 \text{ feet tall}$
4.  $(66 \div 66) \times (47 + 3) = (1) \times (50) = 50 \text{ feet tall}$
5.  $(75 \div 100) \times (53 + 6) = (0.75) \times (59) = 44 \text{ feet tall}$

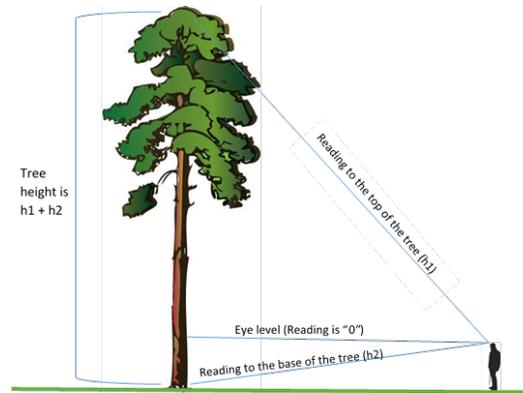


Figure 8.3. How to use a clinometer.

$$(100 \div 100) \times (80 - 6) = 74 \text{ feet tall}$$

## HEIGHT CLASSES

When measuring tree heights, the tool you use determines the precision with which you measure. Clinometers are used for more precise measurements while Merritt hypsometers are used for rough estimates in either half log or log increments.

There are times when you may need to convert more precise 1-foot height measurements to the nearest 5 or 10 feet. In forestry these are called height classes; that is, all trees within a range of heights fall into a given class. Appendix A details height class ranges for 5-foot-class and 10-foot-class ranges.

Example: You measure a tree and it is 66 feet tall, but you need to know which 5-foot height class it falls within. Looking in appendix A, you see that trees measuring between 62.6 and 67.5 are in the 65-foot class. If you wanted to know which 10-foot class the tree was in, you would look in appendix A and see that trees that are 66 to 75 feet tall are in the 70-foot height class. Ten-foot height classes are most common, so it helps to remember that heights that end in 5 round down.