



**FOREST SERVICE HANDBOOK
PACIFIC SOUTHWEST REGION (R5)
VALLEJO, CALIFORNIA
FSH 2409.12 - TIMBER CRUISING
HANDBOOK
CHAPTER 10 - PRINCIPLES OF
MEASURING TREES**

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13 - TREE MEASURING INSTRUMENTS

13.1 - Diameter Measuring Instruments

13.13 - Dendrometers

13.13a - Optical Fork (Relaskop, Tele-relaskop)

The Spiegel-Relaskop is an angle gauge that uses the Bitterlich angle method of forest sampling (also known as horizontal point sampling and variable plot sampling) to determine basal area in square feet per acre. Use the Spiegel-Relaskop to directly measure tree diameters to any height that stem visibility allows.

To measure diameter with an American Scale Relaskop:

Use the 75.6 Basal Area Factor (BAF) located approximately in the middle of the fifth white bar to the right of "0" on the scale (see ex. 01, or the diagram in the Timber Cruise Reference Guide, form R5-2400-28a, for approximate location).

Attach measuring tape to the center of the tree and while viewing through the relaskop, back away until the tree is centered and touching between "0" on left side of the scale and the middle of the fifth white bar to the right. At this point, the distance in feet away from the tree equals the diameter (at the point of sighting) in inches. For example, a 24.3 foot distance equates to a 24.3 inch diameter. The relaskop adjusts for slope when measuring diameters at any height above the ground. When measuring a diameter, take two measurements at right angles (90 degrees) to each other. Use the relaskop for abnormal diameters by shooting above or below DBH and adjusting for taper.

Two additionally approved diameter measuring instruments are the prism and laser.

1. Prism. Use a quality ground prism and a measuring tape to measure diameters. Consider slope correction to accurately determine diameters. Measure from center of tree to a point where the measured tree appears borderline through the prism. Divide that distance by the Plot Radius Factor (PRF) for the Basal Area Factor (BAF) used.

Example:

BAF=20

PRF to center of tree=1.944

Borderline Distance=35 feet as viewed through prism

$35/1.944=18.004$

diameter=18 inches

Average two diameter measurements taken at right angles (90 degrees) to each other. This accounts for trees that are not round. As the BAF increases, the distance required to make any given tree borderline decreases.

See section 35.21a of the parent text for the method to correct for slope using a prism.

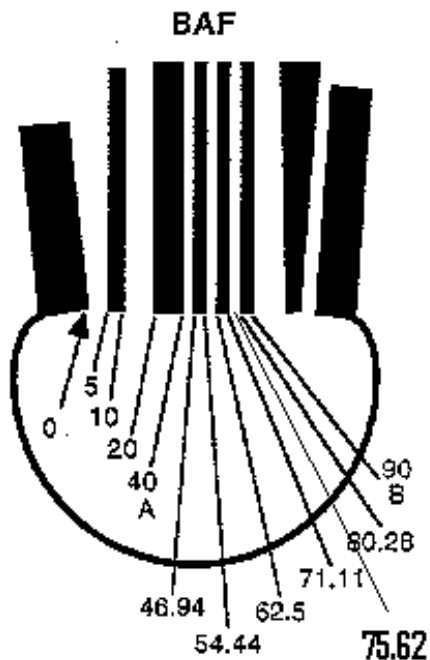
2. Tree Laser. This instrument may be used to measure tree stem diameters at any point if the device was designed to measure diameters. Few tree lasers are designed to measure stem diameters.

The recommended method to measure Diameter at Breast Height (DBH) is the Diameter Tape (D-tape). When a tree laser device must be used, average two measurements taken at right angles to each other in order to compensate for the out of round shape found in some trees.

Use a tripod or monopod (staff) when determining diameters with a tree laser.

13.13a - Exhibit 01

Lower Part of American Scale Enlarged to Show Identification of Graduations. (75.6 Basal Area Factor (BAF) lies in the middle of the white bar to the left of "b.") (Illustration is also shown in the Timber Cruise Reference Guide, form R5-2400-28a.)



RELASKOP

Value of Relaskop Bar Widths

Distance To tree (feet)	Width from "A" to "B" (feet)	Width Value Of each bar (inches)
33	1	2
66	2	4
99	3	6
132	4	8

13.2 - Height Measuring Instruments

All R5 volume tables presently in use are total-height volume tables. Measure total height between the forest floor on the uphill side of the tree and the tree tip.

13.28 - Laser Measuring Devices

Lasers are now available and may be used in measuring heights.

14 - MEASURING THE TREE

14.1 - Measuring Tree Diameter

14.12c - Trees Growing Together

An additional method which may be used to determine DBH on trees growing together is to use a relaskop, prism, laser, or similar instrument to measure the diameter. If necessary, due to bole abnormalities, measure above DBH and adjust for taper (see sec. 14.12d).

14.12d, 2. - Trees With Abnormalities at 4.5 Feet

When more direct methods of measuring diameter are not possible, apply the following taper guidelines:

1. Forest westside incense-cedar, use a taper of 3 inches per 8 feet of length;
2. For eastside incense-cedar, use a taper of 4 inches per 8 feet of length;
3. For all other species, use a taper of 2 inches per 8 feet of length. For example, the average of two diameters taken at 16.5 feet on a Douglas-fir would need to be increased (moving down the log) by 3 inches to give the correct DBH:
(16.5 feet-4.5 feet DBH=12/8×2 inches taper=3 inches)

14.2 - Measuring Tree Heights

14.21 - Baseline Distance

When using the percent scale on a clinometer or relaskop, measure 50, 100, 150, 200 feet, or any distance away from the tree, depending on its height. If 57 feet, multiply the reading by .57; 100 feet, read scale direct; 150 feet, multiply by 1.5; 225 feet, multiply by 2.25. Where feasible, measure tree heights from a distance that at least equals the tree height. Vertical measurements should not exceed 45 degrees.

If using topographic scale in measuring tree heights, distances from the tree are multiples of 66 feet (one chain). For example, 33 feet, divide by two; 66 feet, read scale direct; 99 feet, multiply by 1.5; 132 feet, multiply by two.

Use a calculator or slope table to convert slope distance to horizontal distance.

14.25 - Trees Having a Broken or Missing Top

Trees that have produced one or more new leaders from a broken top will be measured differently depending on the size of the base of the single or dominant leader. Compare the diameter of the base of the leader with the diameter at the top of the main bole. If the leader is about equal to or larger than the main bole, use the height of the dominate leader for the height of the tree. If the base of the leader is obviously less in diameter, determine the height averaging three similar species with approximately the same DBH and the same crown position.