Some figures and text in this booklet are borrowed from the *National Forest Log Scaling Handbook*, FSH 2409.11, 1969.

BASIC MEASUREMENTS

How To Measure Lengths

Satisfactory devices for length measurements include scale sticks, tapes, numbered markers on scaling platforms, or mill decks. The method used depends on the type of scaling being performed.

Use the following length measuring techniques:

For stump cuts, measure lengths from a point at which the scaling cylinder emerges. For other cuts, make length measurements from the short side.

Determine all log lengths by measuring the shortest length between the applicable points at the log ends. Logs with sweep and crook are particularly difficult to measure. Figures 1a, 1b, 1c, and 1d illustrate length measurements.

Special Trim Provision

When authorized by the Regional Forester, timber sale contracts may provide other provisions relating to trim such as a requirement that logs be scaled to the next lower foot.

Log Diameters

Scaling requires accurate measurement of log diameters. Common tools used to measure diameters are scale sticks, steel tapes, and sliding calipers. The scale stick is the primary tool used to obtain the diameter of log ends. The steel tape is versatile and is particularly useful for obtaining diameters which cannot be measured with the scale stick, such as recessed logs on a truck. Calipers are useful in measuring diameters at points along the log other than at the ends.

1. Measure log diameters inside the bark at the small end of the log.

2. Measure through the true center of the log, not the center of the log as shown by the growth rings and pith.

3. In measuring, avoid abnormal bumps and depressions if possible; otherwise, measure as though such conditions do not exist (fig. 3).

4. Where possible, read the scale stick directly from the end of the log, not obliquely from the side.

5. Take a pair of diameter measurements at right angles to each other. Measure the short axis first, then take the second measurement at right angles to the first measurement. This is an important technique.

6. Take diameter measurements to the nearest inch. Round exact ½-inch measurements before averaging. Round up when it is one of a pair to be averaged. When both of a pair to be averaged fall on ½-inch marks, round one up and one down. If the average diameter is on a ½-inch; for example 23½ inches, round down for the final scaling diameter; that is to 23 inches.

Thus in figure 2, measurement "A" is read as 24

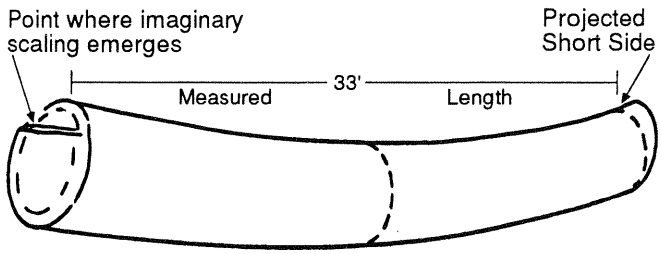

Figure 1a

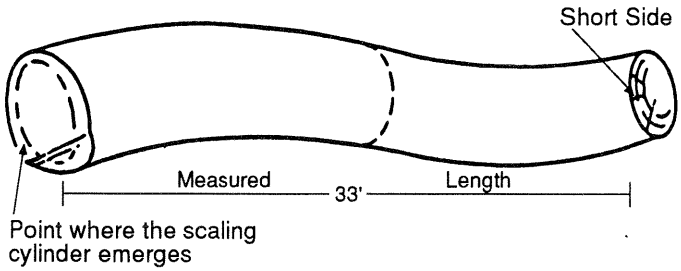

Figure 1b

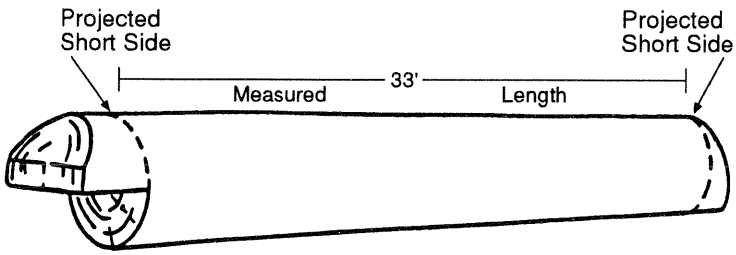

Figure 1c

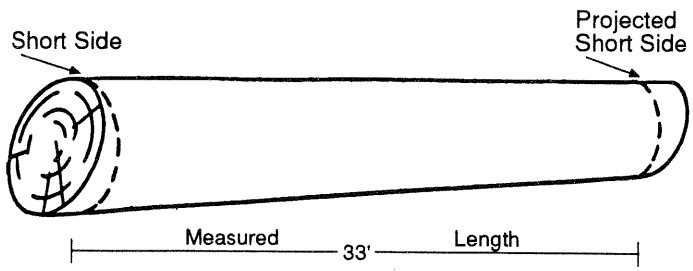

Figure 1d

Diagonal cutting or undercuts larger than normal industry practice are usually signs of poor bucking.

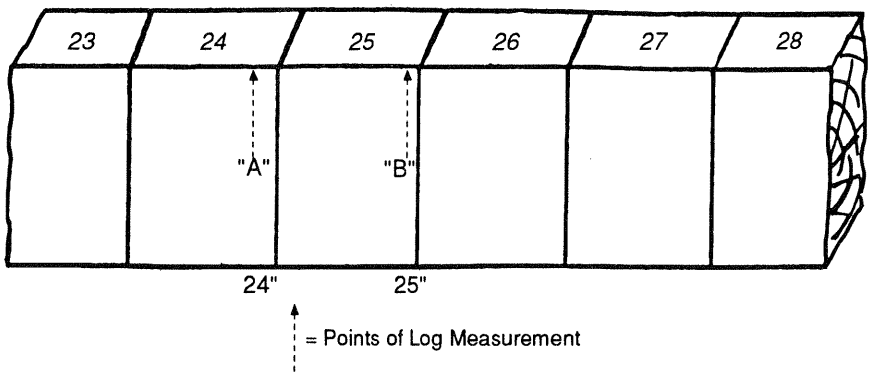

Figure 2 - Diameter measurements.

inches and measurement "B" as 25 inches. The average, (A + B) ÷ 2, is 24½ inches. The one-half inch is dropped to a scaling diameter of 24 inches. Note, however, that had measurement "A" and/or measurement "B" coincided with the ½-inch mark, the measurement would have resulted in a final scaling diameter 1 inch larger, or 25 inches.

7. Trees or pieces presented for scaling, which have not been bucked to separate material meeting minimum piece standards from material not meeting minimum piece standards due to diameter, shall be scaled as though such bucking had been done.

The diameter measurement is exactly that specified in the contract and not a diameter class. For example, a contract which lists the minimum diameter as 6 inches will be considered to be 6.0 inches. Take a single measurement across the short axis of the log. After establishing the assumed bucking point, determine diameters by the systematic method described in items 1-6.

Diameter Determination of Crotched and Irregularly Shaped Logs

When diameters cannot be measured accurately on log ends due to abnormalities, measure the smallest average diameter above or below the abnormality and project the log taper to determine the diameter. If calipers are not available, use a scale stick at this measurement point, remembering to allow for bark thickness.

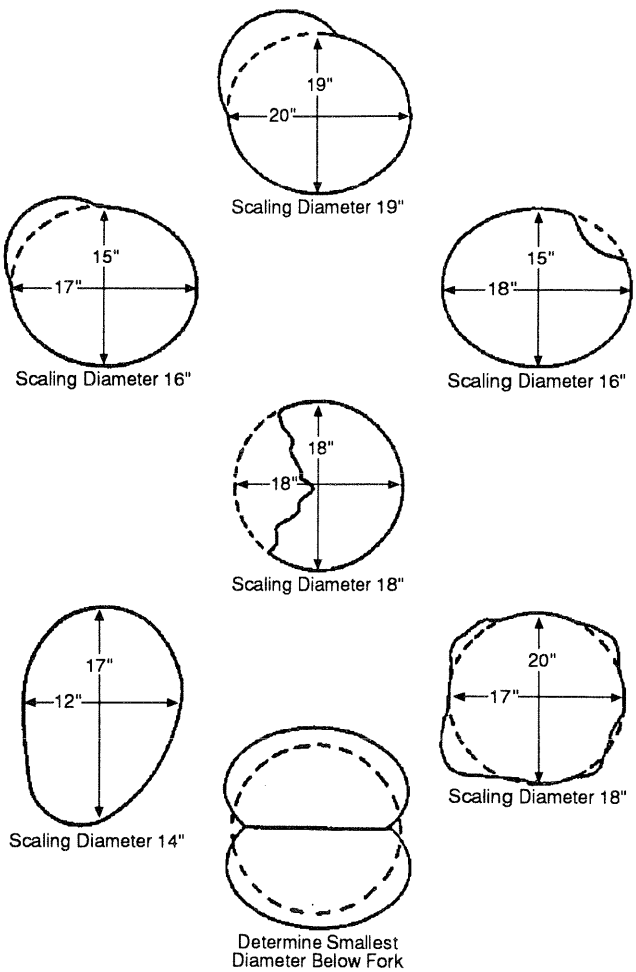

Figure 3 - How to measure logs with abnormal conditions and average the diameters.

DEFECT-DEDUCTION METHODS

The following defect-deduction methods are approved for Forest Service scaling:

1. Squared-defect method
2. Pie cut method
3. Length-deduction method
4. Diameter-deduction method

In applying any of the above methods, the loss will be those portions of the boards from the scaling cylinder which must be trimmed off because of defect, provided that the remainder of each board has at least the minimum length of 4 feet.

All methods must be used with judgement and skill. Knowledge of how defects actually cut out must be obtained from periodic mill visits. No formula, method, or rule will take the place of judgement in scaling. More than one defect-deduction method may be used in scaling one log. Good practice is to check one method of deduction against another for the same defect. Do not use rules of thumb.

If defect calculations end in a fraction of ½ or more, raise the defect to the next whole number. If the fraction is less than ½ , reduce the defect to the next lower whole number.

Squared-Defect Method[1]

Defects showing in one or both ends can often be treated as if sawn out in squares or rectangles. This deduction method is called the squared-defect method. It is generally the most accurate method of scaling interior defects.

For the Scribner Decimal C rule, the method may be stated by the following formula:

$$X = \frac{W'' \times H'' \times L'}{15}$$

In the preceding formula, W" and H" represent end dimensions of the defect in inches plus an allowance (ordinarily 1 inch for each dimension) for waste, L' is the length of the defect in feet, and X is the contents of the defect in board feet after 20% is deducted for saw kerf. X is raised or lowered to the nearest 10.

Example: A 16-foot log 21 inches in diameter has a gross volume of 300 board feet. The large end shows a spot of heart rot 5 inches square. The rot is estimated to go into the log 4 feet. Stated in terms of the formula above:

$$\frac{6 \times 6 \times 4}{15} = \frac{144}{15} = 9.6 \text{ board feet.}$$

Rounded to the nearest 10, the amount deductible for defect is 10 board feet. Subtracted from the gross scale of 300, the net scale is 290 board feet (29 Decimal).

Scalers find it difficult and time consuming to use this formula in ordinary scaling. As a result, rules of thumb or rough estimates have often been used. Such rules of thumb and estimates are largely unnecessary. Forest Service scalers should use the shortcut procedure with its simplified defect calculation.

Shortcut Procedure

For the Scribner Decimal C rule, the Shortcut Procedure for determining the squared-defect deduction may be stated by the following formula:

X = W x H to the next higher 10 x $^{L}/_{16}$ to nearest 10.

Defect dimensions used are identical to those which would be used in the preceding more complicated formula; however, the use of a divisor of 16 rather than 15 greatly simplifies computations for even-foot multiples of defect. Rounding the product of defect height times width to the next higher 10 effectively cancels the effect of the difference in divisors for defects up to and including 12 by 12 inches.

The procedure is particularly applicable to small rectangular defects such as checks and pitch seams.

In applying the Shortcut Procedure, remember the four easy steps:

1. Measure both height and width of the defect, including the 1-inch allowance for waste.
2. Multiply these two measurements, round off to the 10 next above, and drop the last zero. Raise results of multiplications that end in zero to the 10 next above. For example, 10 x 11 = 110, raise to 120 and drop the zero for 12.
3. This is the deduction if the defect extended through a 16-foot log.
4. Estimate the length of the defect in terms of 16 feet. If the estimate is 8 feet, take $^{8}/_{16}$ or ½ the originally calculated defect. If 4 feet, deduct ¼ of the 16-foot calculation. If the defect extends about 6 feet, use $^{6}/_{16}$ or ⅜.

The following corrections should be made for larger defects:

1. Add 10 board feet to the product of W x H for defects squaring 13 to 16 inches, inclusive.
2. Add 20 board feet to the product of W x H for defects squaring 17 to 21 inches, inclusive.

Employing the same example as for the more complex squared-defect method formula:

6 x 6 = 36 to the next higher 10 = 40

40 x $^{4}/_{16}$ or $^{40}/_{4}$ = 10 board feet (1 Decimal)

Application of Squared-Defect Method

A good scaler acquires techniques for measuring defects in the ends of logs. Take measurements in pairs, each at right angles to the other as in diameter measurements. If defect is irregular more than one pair of measurements may be needed.

To allow for loss of sound material surrounding a defect, always measure end defects for "squaring out" and add an extra inch of loss in each dimension.

Consider lumber of even lengths only unless, as in some hardwood scaling, lumber of odd length is normally considered merchantable.

When the deduction indicated by the squared-defect method results in greater volume deduction than the log scale of the portion affected, use the length-deduction method.

[1]Originally termed the (Forest Service) Standard Rule.

Logs With Defect Showing on One End Only

If only one end of a log shows defect, check surface indications to determine how far it extends into the log. Surface indications for interior rot include conks, scars, catfaces, seams, or rotten knots. Look carefully for these on both ends and sides of a log. If a defect is found on one end, try to locate its source. Look the sides over thoroughly. If defect is found on a side, observe both ends carefully. The length of stump rot can often be determined by swells in the log, but not all swells mean rot. Breakage sometimes is an indication of weakness caused by interior rot. Examine the point of breakage for this possibility. When exterior indications are lacking, judgment alone must determine its length.

After the extent of the defect has been determined and the squared-defect method judged applicable, use the Shortcut Procedure. Following are examples of defect calculation using the Scribner Decimal C rule.

Example 1: A 16-foot log 21 inches in diameter has a gross scale of 300 board feet. Defect at one end measures 6 by 9 inches and is estimated to extend halfway into the log.

Adding 1 inch to each dimension for waste
7 x 10 = 70 to the next higher 10 = 80
80 x 9/16 or 8 9/2 = 40
The deduction is 40 or 4 Decimal and net scale is 26 or 260 board feet.

Example 2: A 20-foot log 36 inches in diameter has a gross scale of 1,150 board feet. Defect at one end measures 13 by 15 inches and is estimated to extend 8 feet into the log.

Adding 1 inch to each dimension for waste
14 x 16 = 224 to the next higher 10 = 230
Add 10 (size between 13 and 16 inches)
240 x 9/16 or 24 0/2 = 120
The deduction is 120 or 12 Decimal and net scale is 103 to 1,030 board feet.

Example 3: A 14-foot log 21 inches in diameter has a gross scale of 270 board feet. Defect in one end measures 8 by 10 inches and extends 6 feet into the log.

Adding 1 inch to each dimension for waste.
9 x 11 = 99 to the next higher 10 = 100
100 x 9/16 or 38 to the nearest 10 = 40
The deduction is 40 or 4 Decimal and net scale is 23 or 230 board feet.

When a defect shows at one end only of a log and is estimated to extend to a point within less than minimum lumber length of the other end, use the full length of the log as the defect length in making deduction.

Logs With Same Defect Showing on Both Ends

Make careful examination of the log to determine if defects are connecting. If the defect is found to extend through the log and the square-defect method is applicable, use the Shortcut Procedure to determine the deduction. The average diameter of the defect will be used in making the deduction in 16-foot or longer logs.

Following are examples of defect calculation using the Scribner Decimal C rule and a 20-foot maximum scaling length.

1. For logs 8 to 14 feet in length, defect dimensions will be taken at large end of defect.

Example: A 14-foot log 21 inches in diameter has a gross scale of 270 board feet. End defects measure 8 by 10 inches and 4 by 6 inches.

Adding 1 inch for waste
9 x 11 = 99 to the next higher 10 = 100
100 x 14/16 = 88 to the nearest 10 = 90
The deduction is 90 or 9 Decimal and net scale is 18 or 180 board feet.

2. For logs 16 feet in length, the average of the defect dimensions for both ends of the log will be used.

Example: A 16-foot log 21 inches in diameter has a gross scale of 300 board feet. End defects measure 8 by 10 inches and 4 by 6 inches.

Add 1 inch for waste
$\frac{9+5}{2} = 7$ (H)
$\frac{11+7}{2} = 9$ (W)
7 x 9 = 63 to the next higher 10 = 70
70 x 16/16 = 70 to the next higher 10 = 80
The deduction is 80 or 8 Decimal and net scale is 22 or 220 board feet.

Pie Cut Method

Where the defect is deep and V-shaped it can be enclosed in a sector of a circle. The deduction bears the same relation to the total scale as the sector bears to the circle. Estimates of 1/8, 1/4, 1/3, 1/2, or 2/3 are used. The deduction is the amount determined by the fraction of the scaling cylinder affected, times the scale of a log the same length as the defect and the same diameter as the log being scaled.

Example: A 16-foot log 20 inches in diameter has a gross scale of 280 board feet. A lightning scar running the entire length of the log has been burned out (fig. 4). It can be enclosed in a sector (pie cut) equaling 1/4 of the circumference. The deduction is 1/4 of 280, which is 70 or 7 Decimal, and the net scale is 21 or 210 board feet.

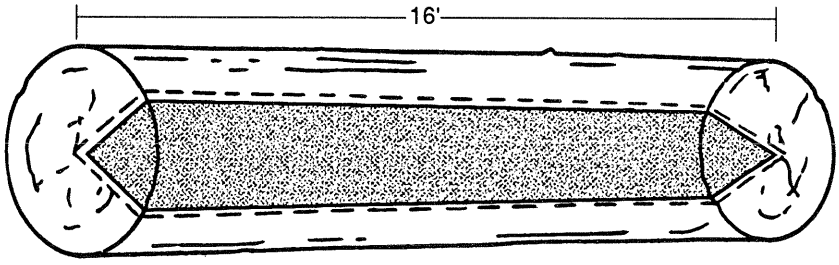

Figure 4 - Pie cut method (deep lightning scar affecting 1/4 of log).

This deduction method usually applies well to catfaces,

fire scars, grubworm holes, and rotten knots. It is applicable when the defect affects two-thirds or less of the scaling cylinder. To help determine the correct fraction to use, mark off the affected portion with a piece of keel. Remember to extend the defect the full length of the log if the sound portion would be less than minimum merchantable lumber length.

Length-Deduction Method

This method is useful to deduct for defects which can be confined to a portion of the log length. Use this method when the squared-defect deduction method equals or exceeds the scale of the affected log length. Use the scaling cylinder diameter to determine the scale of the affected log length. Such defects may include sweep, crook, fire scar, knot clusters, large burls and pitch spangles, breaks, crotch, massed pitch, and rot.

Example: In a 16-foot log, 16 inches in diameter, scaling 160 board feet, with rot 12 inches in diameter affecting 4 feet of the log, the squared-defect deduction would be 50 board feet. As this deduction exceeds a 4-foot cut, or 40 board feet, use a length cut.

In use, this method is often combined with the pie cut method. For example, a deduction for a defect which affects one-half the scaling cylinder for 4 feet is equivalent to a 2-foot length cut.

Diameter-Deduction Method

A diameter cut means reducing the original diameter and scaling cylinder of a log. This method is used in deductions for sap rot, weather checks (when deductible), shallow catfaces, perimeter rings, and knots when they cause a loss of merchantable material.

Example: A log with sap rot measures 20 inches in diameter. The rotten sapwood is 1 inch thick on each side. Reduce the gross diameter of 20 inches by 2 inches for a net diameter of 18 inches. Net scale is that of an 18-inch log. (Show the difference between that net scale and the gross scale in the defect column.)