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Forest Service Handbook 2409.11a – National Forest Cubic Scaling Handbook

Chapter 30 – Measuring Methods for Other Wood Products

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Approved by: Christopher French, Deputy Chief National Forest System.

Date approved: May 28, 2024

Responsible Staff: Forest Management, Rangelands Management, and Vegetation Ecology (FMRMVE)

Digest: Following is an explanation of the changes throughout the directive by section.

Section 31.5: Adds scaling deck volume using survey methods and tools.

Section 35.2: Adds section of pile volume estimation

Section 36: Updates weight scale section. Adds reference to FSH 2409.12, sec 80.

Section 37: Adds Load Count scaling method.

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The procedures for scaling fiber, cedar products, and other non-sawtimber products are outlined in this chapter. The merchantability factor for cull log determination does not apply to these products. In addition, the merchantability specifications used for these products must be included on the scaler information form.

Regional Foresters may specify the use of methods of measurement, other than cubic scaling individual logs, if better adapted to local conditions, providing the method is capable of converting the measurement used into cubic foot volumes. These alternate methods for scaling may include weighing, counting, or some other method, which may result in lower measurement cost. Regardless of the method used, it is necessary to determine the cubic foot volume.

31 - Decked Volume

31.1 - Measurement Procedure

Length and height measurements may be obtained from one or both sides of the deck.

31.2 - Length of Deck

1. **Length**. The length of a deck shall be measured to the nearest 0.1 foot.

2. **Decks with Sloping Ends**. When a deck of roundwood drops off in height at one or both ends to form a sloping end, the length measurement shall be taken:

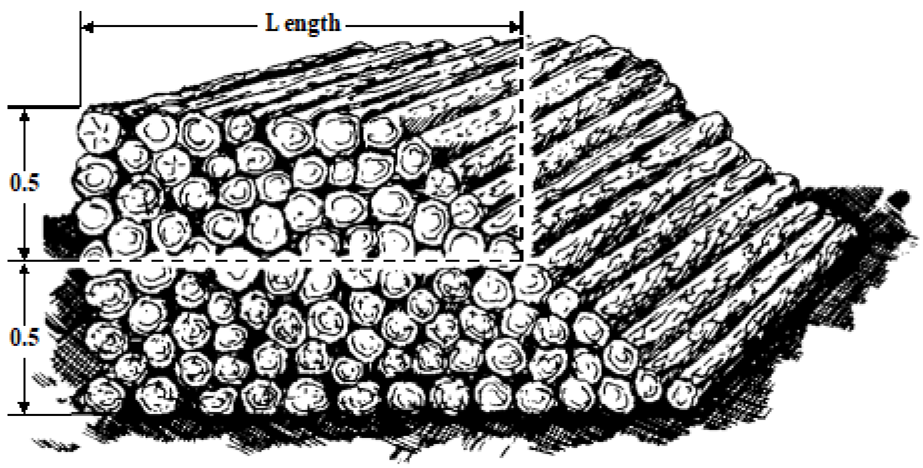
   a. To a point where half the height of the deck intercepts the line of the slope; see exhibits 01 or 02 for an example; or

   b. At the points that describe the maximum length of the deck; see exhibit 03 for an example.

3. **Decks on Hillsides or Slopes**. On hillsides or slopes, the length of a deck shall be measured parallel to the slope of the ground or deck (ex. 04).

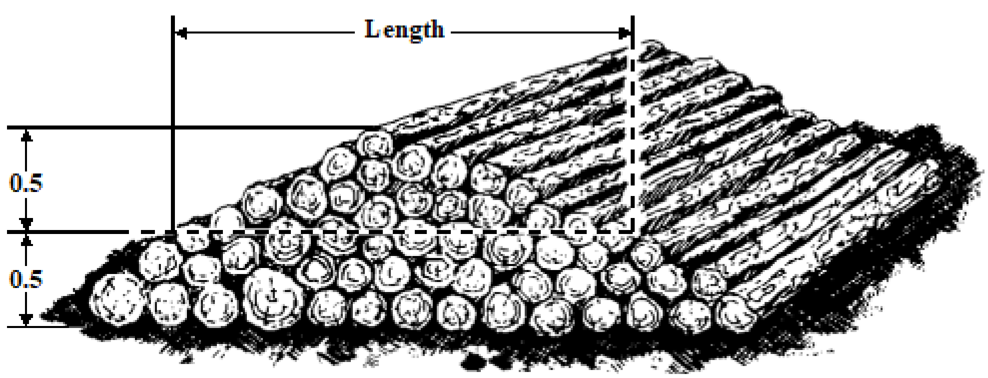
31.2 - Exhibit 01

Length of Deck with One Sloping End



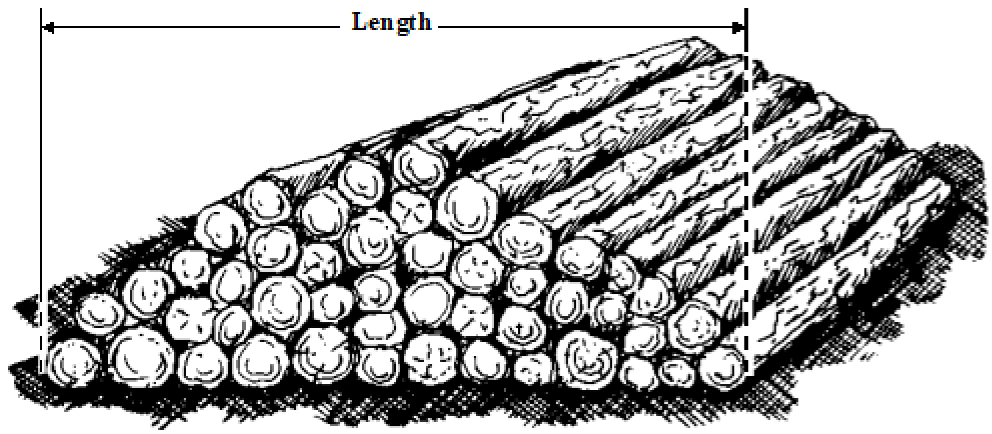
31.2 - Exhibit 02

Length of Deck with Both Ends Sloping



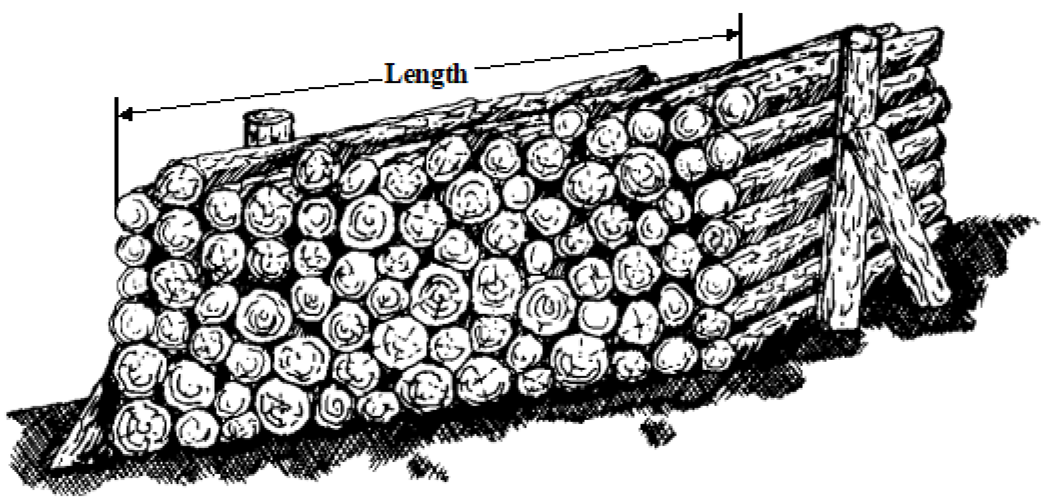
31.2 - Exhibit 03

Length of Deck Measured at Points that Define the Maximum Length



31.2 - Exhibit 04

Length of Deck Parallel to Slope of Ground



31.3 - Height of Deck

1. **Height**. Height shall be measured at equal intervals along the deck and recorded in feet and tenth of feet (ex. 01).

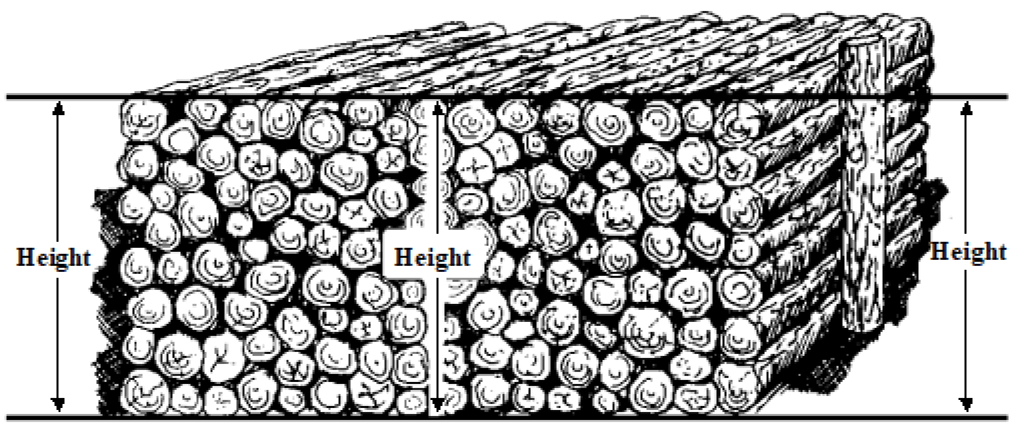
2. **Decks with Irregular Height**. The height of decks with irregular height shall be taken at equal intervals along the deck to obtain the average height of the deck. The more irregular the height, the more measurements shall be taken (ex. 02).

3. **Decks on Hillsides or Slopes**. On hillsides or slopes, make height measurements perpendicular to the length measurement of the deck (ex. 03 and ex. 04).

4. **Relation to Type of Length Measurement**. Height measurements must be related to the type of length measurement employed. If total length of the deck is measured, heights must be taken throughout the full length of the deck (ex. 05 and ex 06). When the length of the deck has been estimated at less than full length, take height measurements as displayed in exhibit 07.

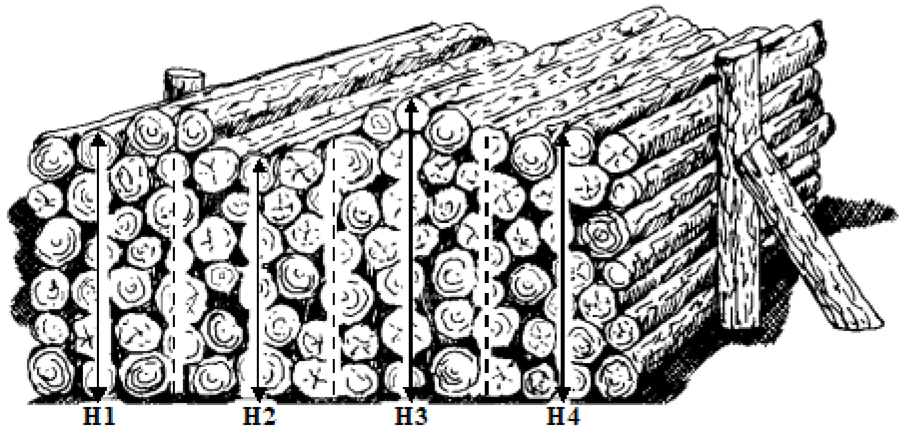
31.3 - Exhibit 01

Regular Height of Deck



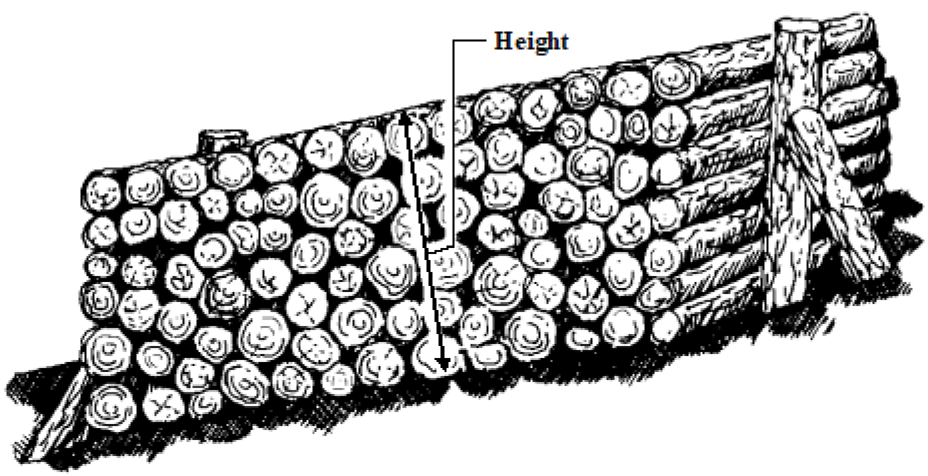
31.3 - Exhibit 02

Irregular Height of Deck



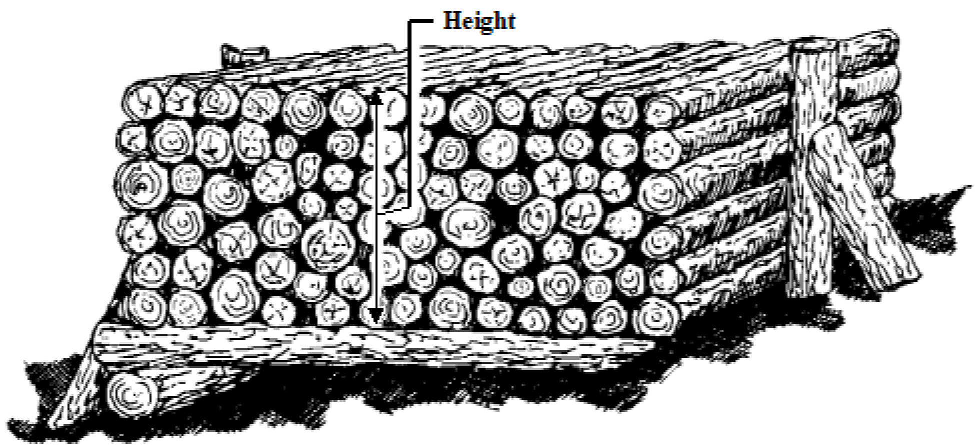
31.3 - Exhibit 03

Height of Deck (on Ground) on Slope



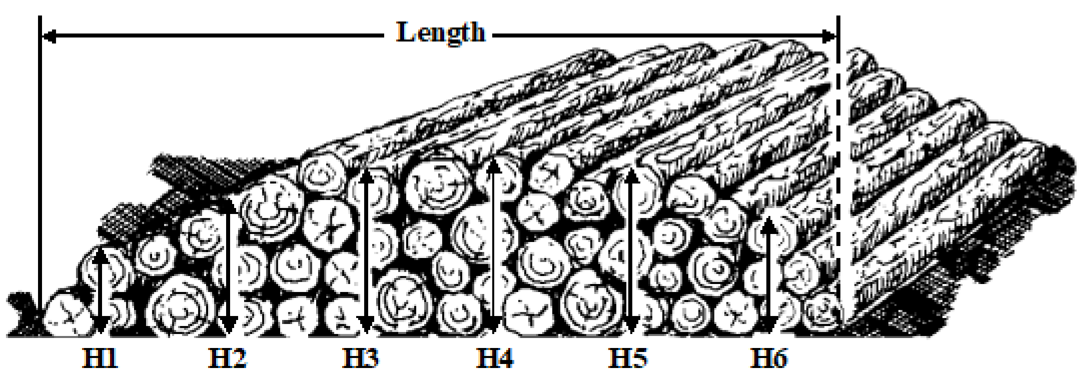
31.3 - Exhibit 04

Height of Deck (supported) on Slope



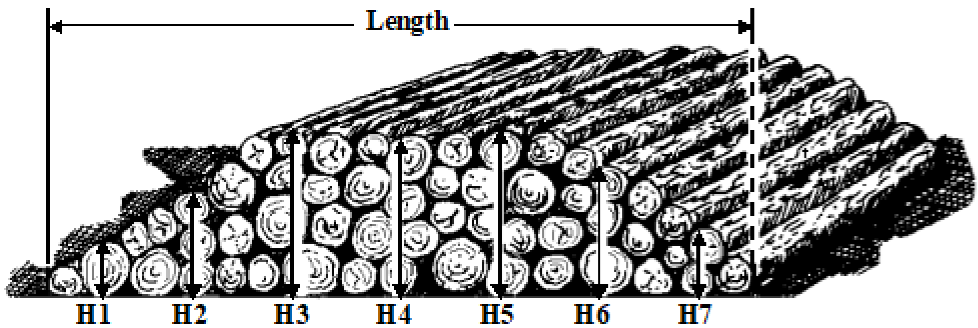
31.3 - Exhibit 05

Height of Deck with Total Length and Uneven Sloping Ends



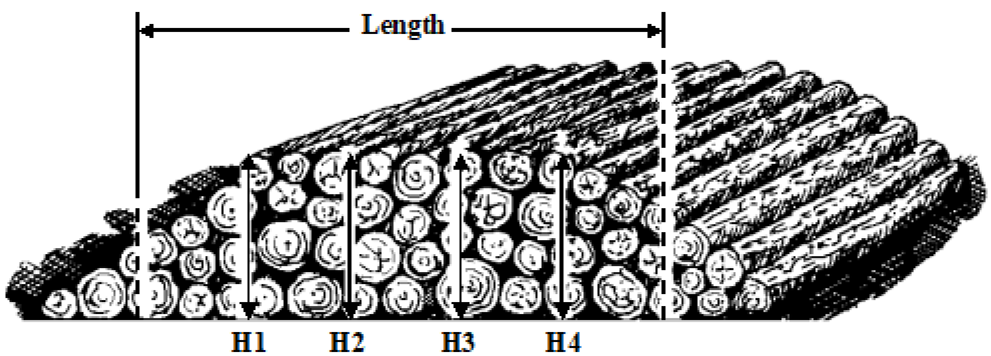
31.3 - Exhibit 06

Height of Deck with Total Length and Even Sloping Ends



31.3 - Exhibit 07

Height of Deck with Length Estimated at Less Than Total, with Sloping Ends



31.4 - Width of Deck

The width of a deck is the length of the material and should be measured to the nearest 0.1 foot.

31.41 - Uneven Widths

When the deck contains random lengths, an average of the width of the deck must be determined for the recorded width of the deck.

31.5 - Methods using Surveying Techniques

Deck dimensions may be measured using surveying techniques to obtain the square foot area of the deck face, multiplied by the average log length (ft) to obtain the cubic foot decked, where:

$ft^3 = A \times W$
A = area of deck face in square feet
W = width of deck in feet and tenths of feet

31.6 - Cubic Feet Calculation

Cubic volume of decked material shall be calculated with the use of the following formula:

$ft^3 = L \times H \times W$
L = length of deck in feet and tenths of feet
H = height of deck in feet and tenths of feet
W = width of deck in feet and tenths of feet

Decked wood is normally sold by solid cubic content. For example, 128 ft^3 of decked wood = 72.5 ft^3 of solid wood.

Solid wood content is calculated using conversion factors. Such conversion factors vary depending on length, diameter classes, bark thickness, piling standards, settling, and other factors. Conversion factors should be derived from samples in which the decked wood content and solid wood content have been compared under the required set of circumstances. Chapter 60, appendix 10 has estimates of solid wood for some types of products. Use local factors if they better reflect wood content. All conversion factors need to be approved by the Regional Forester before use.

32 - Linear Measurements

Linear measurement involves the measurement of length only. Posts, piling, fence poles, converter poles, telephone and power poles, hop poles, stulls, mine timbers, and lagging may be sold by the linear foot.

Timber sale contracts should specify the minimum merchantable length and diameter(s) of sticks for each product. If higher prices are charged for products cut from larger material, the contract should also set maximum lengths and diameters for each price category. For cedar poles and other products, the dimensions of material planned for each product should be specified.

Wherever necessary, similar specifications should cover the amount and kinds of defect admissible in products sold by the linear foot and the character of the material considered merchantable for the purpose. This is especially important for valuable products like telephone and power poles, which often require the best grades of timber. Use Forest Service specifications when available (FSH 2409.12, sec 10). Otherwise, use current commercial specifications of associations of local pole dealers or other associations.

33 - Combined Linear and Diameter Measurements

Sometimes top diameter, as well as lengths, affect the market value of products like telephone and power poles and stulls. Where this happens:

1. Use a schedule of stumpage rates for the various lengths and sizes.

2. Measure the diameter(s) of each piece.

3. Average diameters to the nearest inch unless otherwise agreed.

4. Number every piece and record it, either in a scale book or data collection application, as with sawlogs.

34 - Piece Count

Some products, such as ties, poles, posts, lagging, and Christmas trees, are sold by the piece.

Count ties sold by the piece. Ties are also counted in sales where their cubic foot content is specified in the contract. Where ties are scaled, follow the instructions for scaling (ch. 20). Count poles, posts, lagging, Christmas trees, and similar products, when sold by the piece.

Contract requirements should conform to local market specifications of products concerned. Designate clearly, by special contract provisions, the maximum and minimum piece sizes to be

counted rather than scaled. Include specifications as to defect or class of material necessary to establish precisely what timber is merchantable for those products.

35 - Chip and Pile Volume

35.1 - Chip Volume

The cubic volume of chips on loaded chip trucks and railroad cars can be determined by measuring width, height, and length (W x H x L), preferably after settling. The volume of chips can also be determined from weight by establishing a weight/volume ratio through sampling. The weight will vary by chips of different species, wood density, specific gravity, and moisture content.

The cubic volume of chip piles can be determined by an average (W x H x L).

Extremely large stockpiles of chips may be computed by plane table surveys or by ground surveys designed for computing stockpile cross-sections or may be estimated by photogrammetric methods.

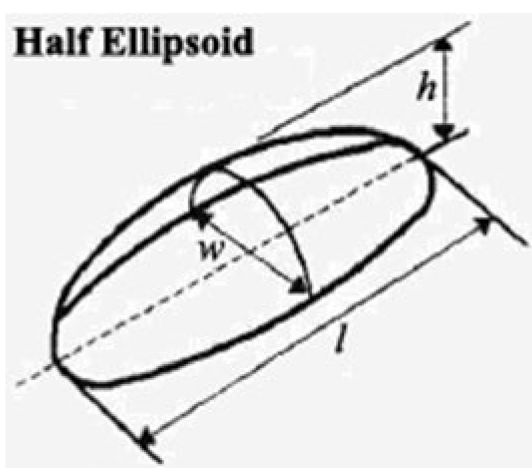
35.2 - Pile Volume

The cubic volume of harvesting residue piles may be determined using a generalized half ellipsoid shape by measuring width (w), height (h) and length (l) (Ex. 01) where:

$$V = \frac{(\pi \times w \times h \times l)}{6}$$

35.2 - Exhibit 01

Generalized Half Ellipsoid Shape of a Pile



Reduce the gross pile volume using an estimate of the percentage of the pile occupied by soil

36 - Weight

Selling forest products by the ton, or 100 percent weight scaling, differs from traditional log scaling where individual logs are measured for size and a Log Rule is used to determine a board or cubic foot product volume. One hundred percent weight scaling can be used to sell forest products when reliable weight factors can be obtained and facilities with approved weight scales are available. One hundred percent weight scaling has the same standards for load accountability (FSH 2409.15, sec. 25) and weight scale certification (FSH 2409.15, sec. 26; and FS-2400-6 and FS-2400-13 timber sale contracts) as traditional log scaling. One hundred percent weight scaling requires every load of material removed from a sale area be accounted for and weighed for payment.

Multiple products and species with different rates are expected to be sorted and hauled on separate loads (FSH 2409.15, sec. 24.51). However, for sales where multiple species will be hauled on a load, the expected percentage of species each load will contain is determined from the cruise data. Each load hauled will be expected to have this species mix.

A weight to gross cubic volume factor is necessary to determine:

1. The initial tonnage of material being offered based on timber cruise data.

2. The initial pricing for material being offered.

3. The volume of material removed for reporting purposes.

The procedures for developing and documenting weight to volume factors can be found in FSH 2409.12, chapter 80. When developing weight ratios, the following may be considered:

1. Moisture content of product being weighed (green to dry).

2. Wood density (product position in tree).

3. Product size (small logs have a larger percentage of juvenile wood), hence a lower specific gravity and more weight per cubic foot.

Weigh National Forest System products for payment purposes on State certified scales meeting the requirements of the National Institute of Standards and Technology (NIST), Handbook 44, U.S. Department of Commerce, Office of Weights and Measure. This Handbook is available in electronic format and may be retrieved from the NIST WWW/Internet homepage at http://www.nist.gov.

36.1 - Converting to CCF

Material can be sold by the ton or by cubic feet using conversion factors. To convert the weight to cubic foot volumes, use the same weight factors applied during the timber cruise processing.

Total weight / (weight/cubic foot ratio) = total cubic foot volume

37 - Load Count

Selling forest products by the load differs from 100 percent weight scaling as all loads hauled during a given month are counted and expanded by a predetermined quantity to determine payment. This scaling method is appropriate for very low value material where Total Weight scaling is not feasible for reasons such as cost, lack of certified scales, unstable weight factors resulting from deteriorating timber, or lack of approved weight factors (FSH 2409.15, sec. 24.52).

May use weighted average values (based on cruise data) or list separate values for each product.

1. Weighted average basis:

    a. The expected percentage of products each load will contain is determined from the cruise data.

    b. All products and species will have the same average contract price.

2. Separate prices for each product:

    a. Products shall be sorted for hauling. Loads cannot contain more than one product.

    b. Species are offered at an average contract rate.

One conversion factor (CCF/load or Ton/load) will be included in the contract at the time of offer for each initial truck configuration for weighted average counts. Contract can be modified to add additional conversion factors if truck configurations change or change the existing conversion factor with supporting documentation of the rationale and source for the change in rate. Alternate truck configurations must be requested by the Purchaser and approved in advance by the Contracting Officer (FSH 2409.15, sec 24.52).

38 - Fiber Scaling

Fiber scaling determines the wood content that, as a minimum, is suitable for the production of usable pulp chips. When scaling fiber logs, determine lengths and diameters using the same

method as for sawlogs or veneer logs and record the results in accordance with the guidelines outlined in section 21.

38.1 - Defects in Fiber Logs

Fiber defect is any unsound wood that is stringy, crumbles, or crushes when rolled in the hand, or that lacks the fibrous element that is basic in the development of specific items manufactured from wood chips. Other deductible defects in fiber logs are:

1. Voids (sec. 38.41);
2. Soft Rots (sec. 38.42);
3. Char (sec. 38.43); and
4. Massed Pitch (sec. 38.44).

38.2 - Basic Defect Deduction Procedures

Use the following basic defect deduction procedures for scaling fiber logs when using any of the defect deduction methods described in section 38.3:

1. Record any single occurring defect only when that defect meets a minimum volume of 0.2 cubic feet before rounding.
2. Record the defect volume to the nearest 0.1 cubic foot. For example, 0.23 is recorded as 0.2, 1.78 is recorded as 1.8; and 3.55 is recorded as 3.6.
3. Use four decimal places for unrounded figures when calculating manually. Use computer precision in software applications.
4. Use a maximum segment length of 20 feet.
5. Consider the extent of the defect length in 1-foot multiples.
6. Consider the defect shape (cylinder, cone) in determining average defect length.
7. Make segment length deductions when logs are not 90 percent debarkable.
8. Make segment length deductions when char penetrates the wood fiber.

38.3 - Defect Deduction Methods for Fiber Logs

Each of the following deduction methods may be used in combination with a percentage for scaling fiber logs:

1. Squared area (sec. 38.31);

2. Circular area (sec. 38.32);

3. Length deduction (sec. 38.33); and

4. Diameter deduction (sec. 38.34).

More than one defect deduction method may be used in scaling a log.

38.31 - Squared Area Deduction Method

1. Square or rectangular shaped defects occurring in one or both log ends may be deducted by using the squared area deduction method.

2. When multiple squared area defects occur on log end(s), it is not required to take secondary defect dimensions at right angles to the primary (largest) defect.

3. For irregular shaped defects, the dimensions of the square or rectangle should balance the unsound wood with usable fiber. This is known as the give and take procedure (sec. 38.32, ex. 01).

4. Calculate defect volume treated as squares or rectangles as shown in section 22.31.

38.32 - Circular Area Deduction Method

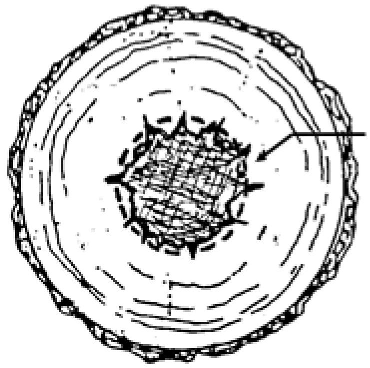
1. A defect that is determined to be circular in shape may be deducted by using the circular area deduction method.

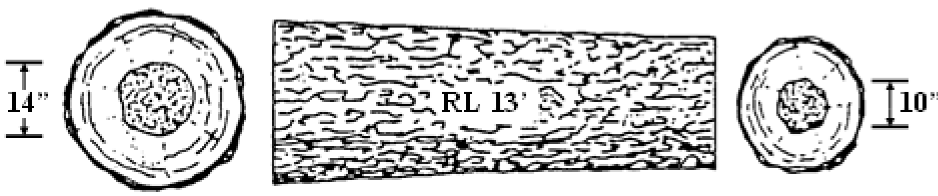
2. The give and take procedure can be used when determining defect dimensions (ex. 01).

3. The Smalian formula must be used to calculate defect volume (sec. 11.1).

38.32 - Exhibit 01

Calculating Circular Defect





Given:

D = Defect diameter large end = 14 inches
d = Defect diameter small end = 10 inches
RL = Recorded length

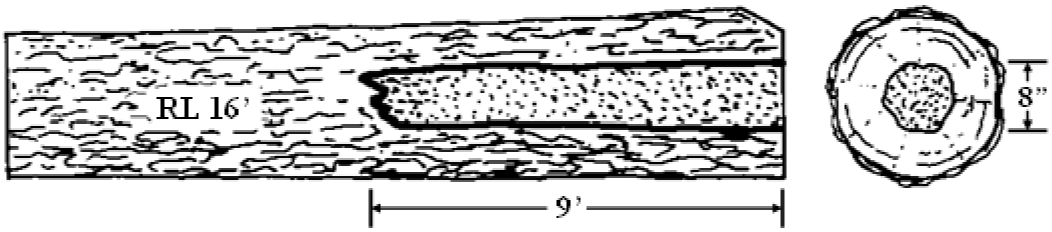
Defect volume (ft^3) $= 0.002727\ (D^2 + d^2)\ RL$
$= 0.002727\ (14^2 + 10^2)\ 13$
$= 0.002727\ (196 + 100)\ 13$
$= 0.002727 \times 296 \times 13$
$= 0.002727 \times 3848$
$= 10.5\ ft^3$

Alternatively, the defect volume of 10.5 ft^3 can be found in chapter 60, appendix 2, for a defect length of 13 feet, with a small end defect diameter of 10 inches and 4 inches of taper in the defect.

If the defect does not go through the whole log, use the length of the defect (ex. 02).

38.32 - Exhibit 02

Calculating Circular Defect



Defect volume (ft³) $= 0.002727 (D^2 + d^2) RL$

$= 0.002727 (8^2 + 8^2) 9$

$= 0.002727 (64 + 64) 9$

$= 0.002727 \times 128 \times 9$

$= 0.002727 \times 1152$

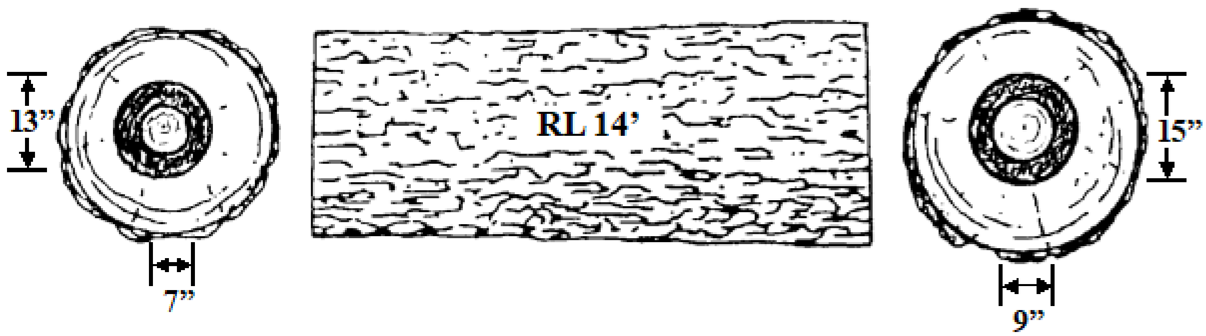
$= 3.1 ft^3$

Alternatively, the defect volume of 3.1 ft^3 can be found in chapter 60, appendix 2, for a defect length of 9 feet, with a small end defect diameter of 8 inches and no taper in the defect.

For ring rot defect, the defect volume is the difference between the volume of the outer core defect and the volume of the inner chipable core (ex. 03).

38.32 - Exhibit 03

Calculating Ring Rot Defect



Given:

Recorded length = 14 feet

Rot diameters:

Outer:

Large end = 15 inches
Small end = 13 inches

Inner:

Large end = 9 inches
Small end = 7 inches

Defect and core volumes:

Outer (13" with 2" taper, 14' long)
= 0.002727 ($D^2 + d^2$) RL
= 0.002727 ($15^2 + 13^2$) 14
= 15.0 ft^3

Inner (7" with 2" taper, 14' long)
= 0.002727 ($D^2 + d^2$) RL
= 0.002727 ($9^2 + 7^2$) 14
= 5.0 ft^3

Defect volume (ft^3) = outer core volume - inner core volume

= 15.0 - 5.0
= 10.0 ft^3

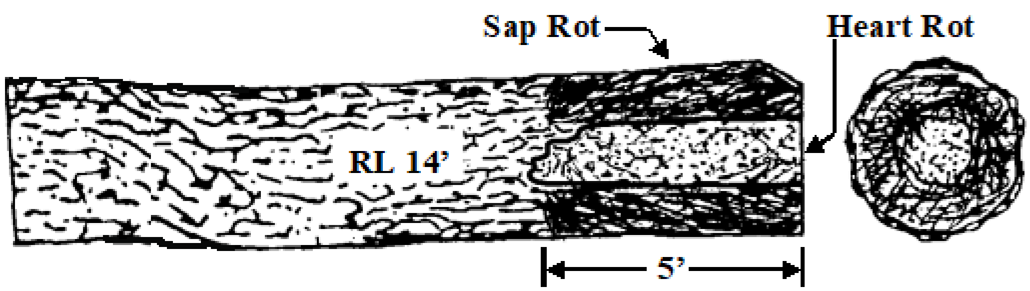
38.33 - Length Deduction Method

Use the length deduction method when unsound wood affects a portion of the segment length. See section 22.32 for further direction on using this method.

In exhibit 01, the deduction is used for unsound wood in the heart and sapwood areas due to soft rot.

38.33 - Exhibit 01

Calculating Defect Using Length Deduction Method



Given:

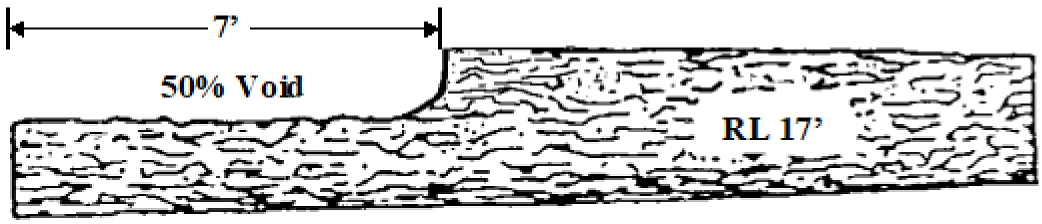
Recorded length = 14 feet
Gross segment volume = 27.6 ft^3
Length cut = 5 feet

$$\begin{aligned} \textit{Defect volume } (ft^3) &= \frac{\textit{defect length}}{\textit{segment length}} \; x \textit{ gross segment volume} \\ &= \frac{5}{14} \; x \; 27.6 \\ &= 0.3571 \; x \; 27.6 \\ &= 9.9 \; ft^3 \end{aligned}$$

This example uses a length deduction with percent. Estimate the percentage of log end affected in whole percents and the extent of defect in 1-foot multiples. See section 22.33.

38.33 - Exhibit 02

Calculating Defect Using Length with Percent Deduction



Given:

Recorded length = 17 feet
Gross segment volume = 33.6 ft^3
Defect affecting one-half of 7 feet

$$Defect\ volume\ (ft^3) = \frac{defect\ length}{segment\ length}\ x\ percent\ end\ area\ affected\ x\ gross\ segment\ volume$$

$$= \frac{7}{17}\ x\ 0.5\ x\ 33.6$$

$$= 0.4118\ x\ 0.5\ x\ 33.6$$

$$= 0.2059\ x\ 33.6$$

$$= 6.9\ ft^3$$

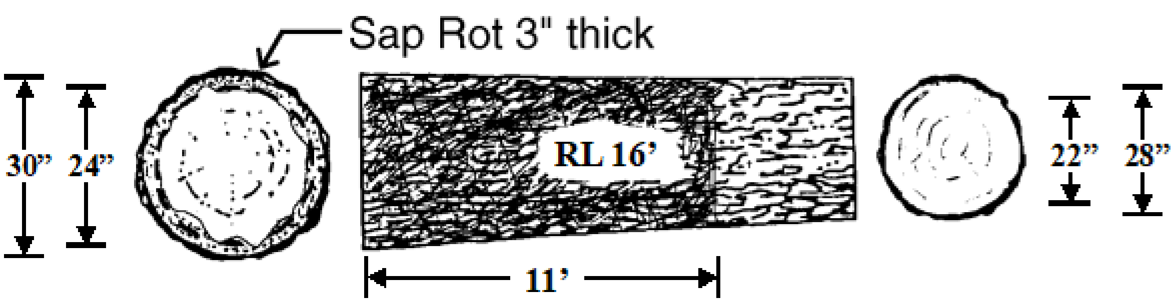
38.34 - Diameter Deduction Method

1. Use the diameter deduction method for perimeter defects such as sap rot.

2. Reduce the original diameter of the segment according to the extent of defect to obtain net volume. The defect volume is the difference between the gross and net volume (sec. 22.34).

38.34 - Exhibit 01

Calculating Defect Using the Diameter Deduction Method



Given:

Recorded length = 16 feet
Small end diameter = 28 inches
Large end diameter = 30 inches
Average thickness of rot = 3 inches

To find the deduction:

Reduce both end diameters by 6 inches (3 inches x 2)
Reduced small end diameter = 22 inches
Reduced large end diameter = 24 inches
Gross segment volume = 73.5 ft^3
$= 0.002727\ (D^2 + d^2)\ RL$
$= 0.002727\ (30^2 + 28^2)\ 16$
$= 73.5\ ft^3$

Adjusted segment volume = 46.2 ft^3
$= 0.002727\ (D^2 + d^2)\ RL$
$= 0.002727\ (24^2 + 22^2)\ 16$
$= 46.2\ ft^3$

$$Defect\ volume\ (ft^3) = \frac{defect\ length}{segment\ length}\ x\ (gross\ segment\ volume - adjusted\ segment\ volume)$$
$$= \frac{11}{16}\ x\ (73.5 - 46.2)$$
$$= 0.6875\ x\ 27.3$$
$$= 18.8\ ft^3$$

38.4 - Deduction Methods for Common Types of Defects

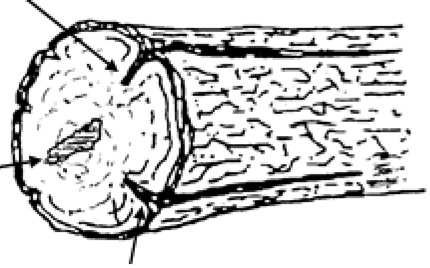
Use the guidelines in sections 38.41 through 38.46, as applicable, in determining the appropriate defect deduction methods to use for common types of fiber defects.

38.41 - Voids

When wood fiber is missing or absent within a log, the defect is called void. Gouges, slabs, stump pull, open catface, and bark seams are examples of void. Exhibit 01 illustrates how to calculate defect volume for void defects.

38.41 - Exhibit 01

Calculating Defect Volume for Voids



Defect volume: *Multiply the width, height, and length. As both width and height are in inches, divide by 144 to convert square inches into square feet. When multiplying by length in feet, the answer will be in cubic feet.*

Stump pull = $\frac{W\,x\,H\,x\,L}{144} = \frac{4\,x\,12\,x\,3}{144} = \frac{144}{144} = 1.0\,ft^3$

Bark seam # 1=$\frac{W\,x\,H\,x\,L}{144} = \frac{2\,x\,9\,x\,7}{144} = \frac{126}{144} = 0.9\,ft^3$

Bark seam # 2= $\frac{W\,x\,H\,x\,L}{144} = \frac{3\,x\,8\,x\,6}{144} = \frac{144}{144} = 1.0\,ft^3$

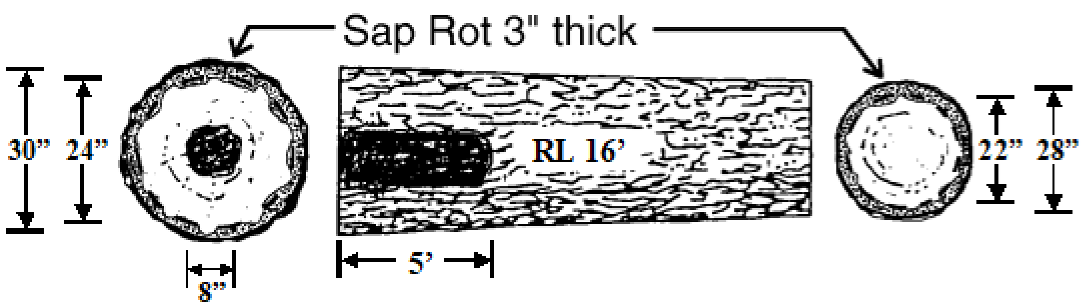
Total defect volume (ft^3) = 1.0 + .9 + 1.0 = 2.9 ft^3

38.42 - Soft Rots

There are various forms of rot, such as conk rot, heart rot, sap rot, stump (butt) rot, and rot associated with rotten knots. Exhibit 01 illustrates how to calculate defect volume for soft rot defects.

38.42 - Exhibit 01

Calculating Defect Volume for Soft Rots



Given:

Recorded length = 16 feet
Small end diameter = 28 inches
Large end diameter = 30 inches

Defect deduction:

Heart rot:

$$\begin{aligned} \text{Defect volume } (ft^3) &= 0.002727\,(D^2 + d^2)\,L \\ &= 0.002727\,(8^2 + 8^2)\,5 \\ &= 0.002727\,(64 + 64)\,5 \\ &= 0.002727 \times 128 \times 5 \\ &= 0.002727 \times 640 \\ &= 1.7\ ft^3 \end{aligned}$$

Alternatively, the defect volume of 1.7 ft^3 can be found in chapter 60, appendix 2, for a defect length of 5 feet, with a small end defect diameter of 8 inches and no taper in the defect.

38.42 - Exhibit 01--Continued

Calculating Defect Volume for Soft Rots

Sap rot:

Reduce both end diameters by 6 inches (3 inches x 2), or measure sound core.
Reduced small end diameter = 22 inches
Reduced large end diameter = 24 inches
Gross segment volume = 73.5 ft^3
$= 0.002727 (D^2 + d^2) RL$
$= 0.002727 (30^2 + 28^2) 16$
$= 73.5 ft^3$

Adjusted segment volume = 46.2 ft^3
$= 0.002727 (D^2 + d^2) RL$
$= 0.002727 (24^2 + 22^2) 16$
$= 73.5 ft^3$

Defect volume(ft^3) = gross segment volume - adjusted segment volume
= 73.5 - 46.2 = 27.3 ft^3

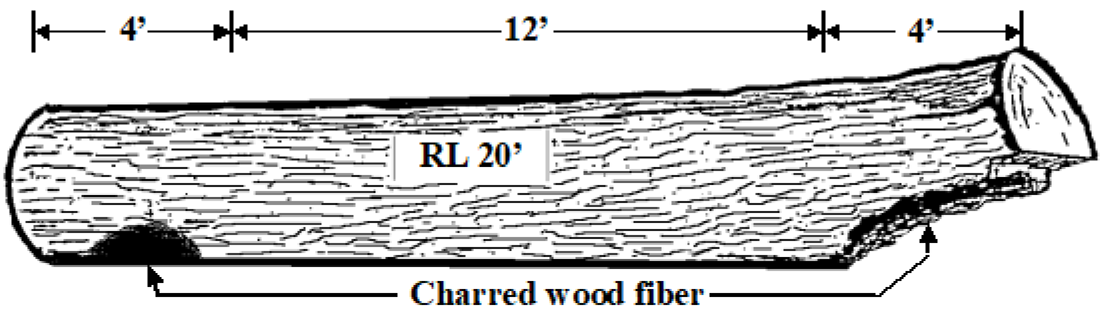
Total defect volume(ft^3) = 1.7 + 27.3 = 29.0 ft^3

38.43 - Char

Any char present in the wood fiber causes the entire length affected to be unusable. The remaining portion must meet contract minimum specifications for length, or the segment is cull. Exhibit 01 illustrates how to calculate defect volume for charred logs. A portion of the log in the exhibit is unusable due to charred wood fiber. Use the length deduction method to determine the defect volume.

38.43 - Exhibit 01

Log with Char



Given:

Gross segment volume = 48.2 ft^3
Defect length = 8 feet

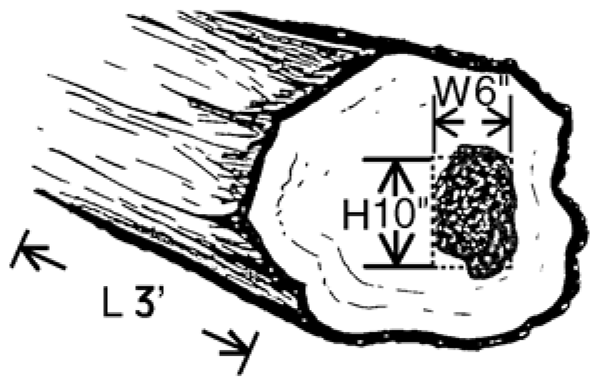
$$Defect\ volume\ (ft^3) = \frac{defect\ length}{segment\ length}\ x\ gross\ segment\ volume$$
$$= \frac{8}{20}\ x\ 48.2$$
$$= 0.4\ x\ 48.2$$
$$= 19.3\ ft^3$$

38.44 - Massed Pitch

Consider massed pitch to be the same type of defect as a void and deduct for the length affected.

38.44 - Exhibit 01

Calculating Defect Volume for Massed Pitch



Defect volume (ft^3) = $\frac{W\ x\ H\ x\ L}{144} = \frac{6\ x\ 10\ x\ 3}{144} = \frac{180}{144} = 1.25\ or\ 1.3\ ft^3\ (rounded)$

38.45 - Multiple Defects

When a log or segment contains multiple defects, use a combination of any or all of the acceptable defect deduction methods for fiber scaling.

38.46 - Debarkability

A log segment shall be considered debarkable if it would not create a safety hazard, would not fall apart when subjected to the mechanical debarking process, and is 90 percent debarkable. The remaining section of the log must contain a length that meets minimum contract specifications, or the entire log segment is cull.

38.46a - Shatter

Exhibit 01 illustrates how to calculate defect volume for shatter defects. Due to presence of shatter, 7 feet of the large end segment would fall apart, and may be a safety hazard when subjected to the debarking process. Use the length deduction method to determine the defect volume.

38.46a - Exhibit 01

Log with Shatter

Given:

Large end segment gross volume = 48.4 ft^3
Defect length = 7 feet

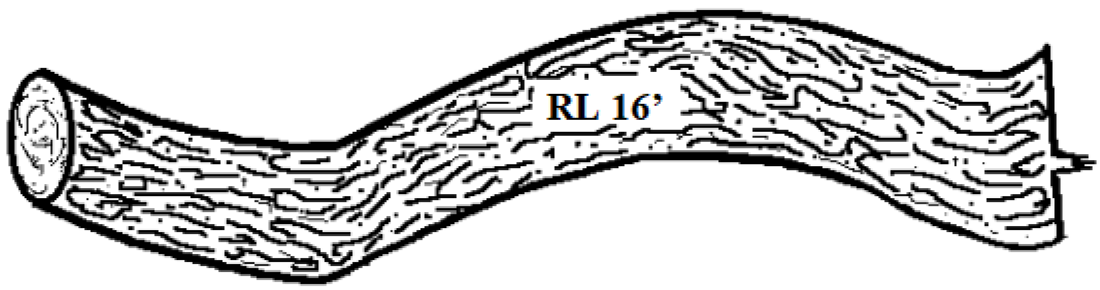
$$Defect\ volume\ (ft^3) = \frac{defect\ length}{segment\ length}\ x\ gross\ segment\ volume$$
$$= \frac{7}{16}\ x\ 48.4$$
$$= 0.4375\ x\ 48.4$$
$$= 21.2\ ft^3$$

38.46b - Severe Crook

Exhibit 01 illustrates how to calculate defect volume for severe crook defects. Due to severe crook, this log would be considered less than 90% debarkable and should be culled. In addition, this log would be considered a safety hazard if debarked.

38.46b - Exhibit 01

Log with Severe Crook



Given:

Gross segment volume = 25.3 ft^3
Defect length = 16 feet

$$Defect\ volume\ (ft^3) = \frac{defect\ length}{segment\ length}\ x\ gross\ segment\ volume$$
$$= \frac{16}{16}\ x\ 25.3$$
$$= 1.0\ x\ 25.3$$
$$= 25.3\ ft^3$$

39 - Cedar Product Log Scaling

Cedar product log scaling determines wood content that is suitable for the manufacture of fence posts, rails, shakes, shingles, or related products. Most of these products are produced from wood obtained from the outer shell of a log that has interior rot, although other types of defects may cause the log to be classified as a cedar product log. The species most commonly utilized is western redcedar. When scaling cedar product logs, determine lengths and diameters using the same method as for sawlogs or veneer logs and record the results in accordance with the guidelines outlined in section 21.

39.1 - Defects in Cedar Product Logs

Cedar product logs do not meet the minimum merchantability specifications for sawlogs (sec. 22.5). Deductible defects in cedar product logs are those defects that reduce the log volume that is suitable for the manufacture of fence posts, rails, shakes, shingles, and similar products. Interior rot is the most common and extensive type of defect in cedar product logs. Even early stages of decay are associated with volume loss and require careful examination when identifying rot defects. Other deductible cedar product log defects are:

1. Voids (including flutes and bark seams);
2. Rot;
3. Crook;
4. Shatter;
5. Excessive butt flare; and
6. Burls, large knots, and knot clusters.

39.2 - Basic Defect Deduction Procedures

1. Use the following basic defect deduction procedures for scaling cedar product logs when using any of the defect deduction methods described in section 38.3:

    a. Record any single occurring defect only when that defect meets a minimum volume of 0.2 cubic feet before rounding.

    b. Record defect volume to the nearest 0.1 cubic foot. For example, 0.23 is recorded as 0.2, 1.78 is recorded as 1.8, and 3.55 is recorded as 3.6.

    c. Use four decimal places for unrounded figures when calculating manually. Use computer precision in software applications.

d. Consider the following in determining a defect:

(1) A sound outer shell thickness of 3.5 inches or greater must be present in logs or portions of logs.

(2) A minimum of 3.5 inches of suitable material must be present between rings of rot.

(3) In order to be usable, an end area must contain suitable material of at least 3.5 inches by 6.0 inches.

(4) A minimum product recovery of 6 feet in length.

(5) A minimum replaceable sound core of 8.0 inches.

(6) A minimum log merchantability of 20 percent per segment.

(7) The extent of defect length in 2-foot multiples.

(8) Defect shape (cylinder, cone).

2. When appropriate, deduct interior rots using the circular area deduction method.

3. Do not deduct heart checks, straight splits, and minor surface checking.

39.3 - Defect Deduction Methods for Cedar Product Logs

Each of the following deduction methods may be used in combination with a percentage for scaling cedar product logs:

1. Squared area;

2. Circular area;

3. Length deduction; and

4. Diameter deduction.

More than one defect deduction method may be used in scaling a log.

39.31 - Squared Area Deduction Method

For direction on how to use the squared area deduction method, see section 38.31.

39.32 - Circular Area Deduction Method

For direction on how to use the circular area deduction method, see section 38.32. Exhibit 01 illustrates how to calculate circular defect in cedar product logs using this method. Note that the log in exhibit 01 has an outer shell thickness of sound wood that is greater than the minimum 3.5 inches.

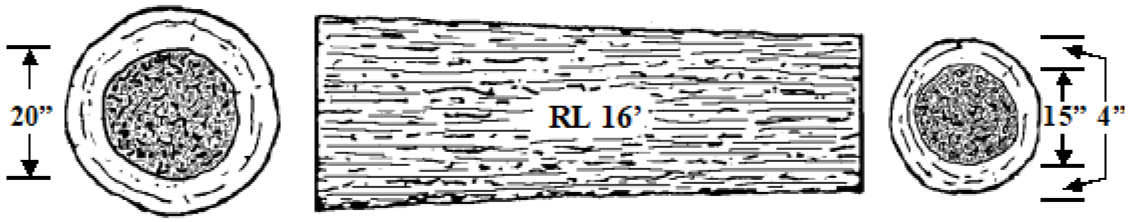
Alternatively, the defect volume of 27.3 ft^3 can be found in chapter 60, appendix 2, for a defect length of 16 feet, with a small end defect diameter of 15 inches and 5 inches of taper in the defect.

A log that has multiple rings must have 3.5 inches of sound wood between the rings, in order for the material between the rings to be considered usable. For multiple ring rot defects, the defect volume is the difference between the volume of the outer ring defect and the volume of the inner sound core, when there is less than 3.5 inches of sound wood between the rings. If there is 3.5 inches or more of sound wood between the rings, then each ring rot defect is treated as a single ring of rot. For single ring rot defects, the defect volume is the difference between the volume of the outer ring defect and the volume of the inner sound core.

Exhibit 02 illustrates how to calculate multiple ring rot defects. In the exhibit, the sound wood between the rings is less than 3.5 inches on each side.

39.32 - Exhibit 01

Calculating Circular Defect



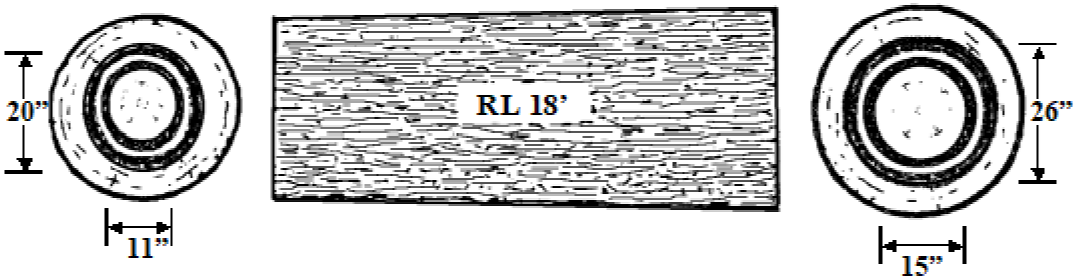
Given:

D = Defect diameter large end = 20 inches
d = Defect diameter small end = 15 inches
L = Defect length

Defect volume (ft^3) = 0.002727 ($D^2 + d^2$) L
= 0.002727 ($20^2 + 15^2$) 16
= 0.002727 (400 + 225) 16
= 0.002727 x 625 x 16
= 0.002727 x 10000
= 27.3 ft^3

39.32 - Exhibit 02

Calculating Multiple Ring Rot Defect



Given:

Recorded length = 18 feet

Rot diameters:

Outer:

Large end = 26 inches
Small end = 20 inches

Inner:

Large end = 15 inches
Small end = 11 inches

Defect and core volumes:

Outer (20" with 6" taper, 18' long)
$= 0.002727\ (D^2 + d^2)\ RL$
$= 0.002727\ (26^2 + 20^2)\ 18$
$= 52.8\ ft^3$

Inner (11" with 4" taper, 18' long)
$= 0.002727\ (D^2 + d^2)\ RL$
$= 0.002727\ (15^2 + 11^2)\ 18$
$= 17.0\ ft^3$

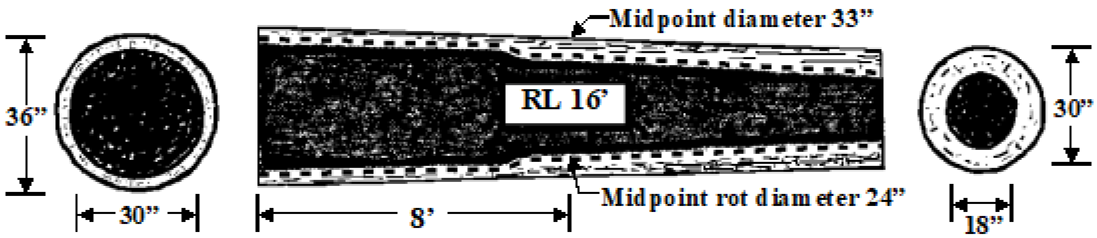
Defect volume (ft^3)= outer core volume - inner core volume
$= 52.8 - 17.0$
$= 35.8\ ft^3$

39.33 - Length Deduction Method

For direction on how to use the length deduction method, see sections 22.32 and 38.33. In exhibit 01, the deductions have been taken for loss due to heart rot. A length deduction is applied on the large end portion where the outer shell thickness is less than the required 3.5 inches. A circular area deduction has been applied on the small end portion where the outer shell thickness is 3.5 inches or more.

39.33 - Exhibit 01

Calculating Heart Rot Defect Using Length and Circular Area Deductions



Large end portion:
Given:

Recorded length = 16 feet
Gross segment volume
= 0.002727 ($D^2 + d^2$) RL
= 0.002727 ($36^2 + 302^2$) 16
= 95.8 ft^3

Length cut = 8 feet

$$Defect\ volume\ (ft^3) = \frac{defect\ length}{segment\ length}\ x\ gross\ segment\ volume$$
$$= \frac{8}{16}\ x\ 95.8$$
$$= 0.5\ x\ 95.8$$
$$= 47.9\ ft^3$$

Small end portion:
Given:

D = Defect diameter large end = 24 inches
d = Defect diameter small end = 18 inches
L = Defect length

Defect volume (ft^3) = 0.002727 ($D^2 + d^2$) L
= 0.002727 ($24^2 + 18^2$) 8
= 0.002727 (576 + 324) 8
= 0.002727 x 900 x 8
= 0.002727 x 7200
= 19.6 ft^3

39.33 - Exhibit 01--Continued

Calculating Heart Rot Defect Using Length and Circular Area Deductions

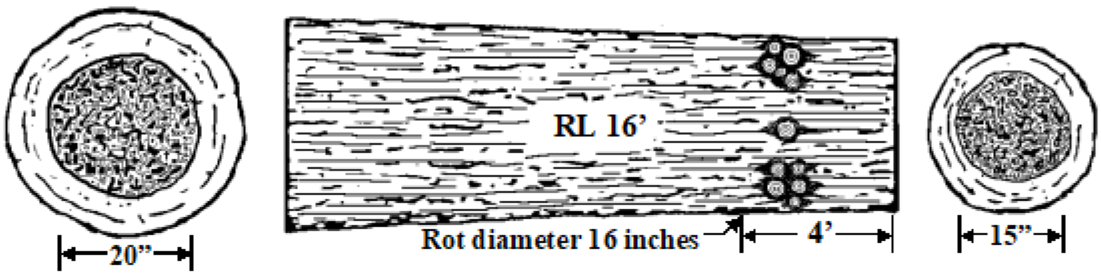
Alternatively, the defect volume of 19.6 ft^3 can be found in chapter 60, appendix 2, for a defect length of 8 feet, with a small end defect diameter of 18 inches and 6 inches of taper in the defect.

Total defect volume (ft^3) = 47.9 + 19.6 = 67.5 ft^3
Net volume = Gross segment volume – Total defect volume or 95.8 ft^3 – 67.5 ft^3 = 28.3 ft^3

In exhibit 02, the deductions have been taken for loss due to large knot clusters and heart rot. A length deduction has been applied on the small end portion since product recovery of 6 feet is not possible due to the large knots occurring all the way around this log about 3 feet from the small end. A circular area deduction has been applied to the remainder of the segment for loss due to heart rot.

39.33 - Exhibit 02

Calculating Defect Using Length and Circular Area Deductions for Knots



For the large end, given:

Recorded length = 16 feet
Gross segment volume = 57.3 ft^3
Length cut = 4 feet

$$\begin{aligned} Defect\ volume\ (ft^3) &= \frac{defect\ length}{segment\ length}\ x\ gross\ segment\ volume \\ &= \frac{4}{16}\ x\ 57.3 \\ &= 0.25\ x\ 57.3 \\ &= 14.3\ ft^3 \end{aligned}$$

For the small end, given:

D = Defect diameter large end = 20 inches
d = Defect diameter small end = 16 inches
L = Defect length = 12

$$\begin{aligned} Defect\ volume\ (ft^3) &= 0.002727\ (D^2 + d^2)\ L \\ &= 0.002727\ (20^2 + 16^2)\ 12 \\ &= 0.002727\ (400 + 256)\ 12 \\ &= 0.002727\ x\ 656\ x\ 12 \\ &= 0.002727\ x\ 7872 \\ &= 21.5\ ft^3 \end{aligned}$$

Alternatively, the defect volume of 21.5 ft^3 can be found in chapter 60, appendix 2, for a defect length of 12 feet, with a small end defect diameter of 16 inches and 4 inches of taper in the defect.

Total defect volume $(ft^3) = 14.3 + 21.5 = 35.8\ ft^3$

Net volume = Gross segment volume – Total defect volume or 57.3 ft^3 – 35.8 ft^3 **=** *21.5 ft^3*

39.34 - Diameter Deduction Method

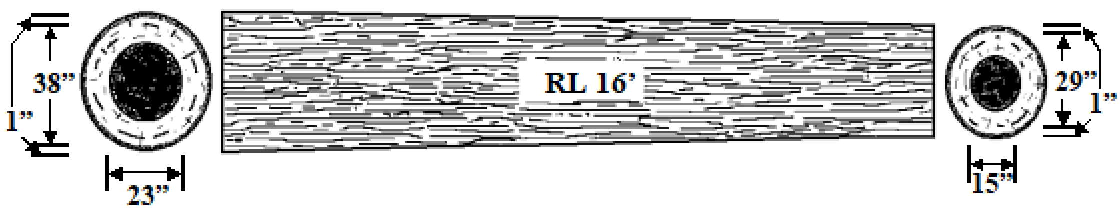
1. Use the diameter deduction method for perimeter defects such as sap rot. In exhibit 01, the deductions are for loss due to sap rot and heart rot.

2. Reduce the original diameter of the segment according to the extent of the sap rot. The sap rot defect volume is the difference between the gross and adjusted segment volume (sec. 22.34).

3. Use the circular area deduction method to determine the heart rot defect volume.

39.34 - Exhibit 01

Calculating Defect Using Diameter and Circular Area Deductions for Sap Rot



Given:

Recorded length = 16 feet
Small end diameter = 31 inches
Large end diameter = 40 inches
Average depth of sap rot = 1 inch

Sap rot defect deduction:

Reduce both end diameters by 2 inches (1 inch x 2)
Reduced small end diameter = 29 inches
Reduced large end diameter = 38 inches
Gross segment volume = 111.7 ft^3

$= 0.002727 (D^2 + d^2) RL$
$= 0.002727 (40^2 + 31^2) 16$
$= 111.7 ft^3$

Adjusted segment volume

$= 0.002727 (D^2 + d^2) RL$
$= 0.002727 (38^2 + 29^2) 16$
$= 99.7 ft^3$

$$\begin{aligned} \text{Defect volume } (ft^3) &= \text{gross segment volume} - \text{adjusted segment volume} \\ &= 111.7 - 99.7 \\ &= 12.0\ ft^3 \end{aligned}$$

Given:

D = Defect diameter large end = 23 inches
d = Defect diameter small end = 15 inches
L = Defect length

39.34 - Exhibit 01—Continued

Calculating Defect Using Diameter and Circular Area Deductions for Sap Rot

Heart rot defect deduction:

Defect volume (ft^3) $= 0.002727 (D^2 + d^2) L$
$= 0.002727 (23^2 + 15^2) 16$
$= 0.002727 (529 + 225) 16$
$= 0.002727 \times 754 \times 16$
$= 0.002727 \times 12064$
$= 32.9 ft^3$

Alternatively, the defect volume of 32.9 ft^3 can be found in chapter 60, appendix 2, for a defect length of 16 feet, with a small end defect diameter of 15 inches and 8 inches of taper in the defect.

Total defect volume (ft^3) $= 12.0 + 32.9 = 44.9 ft^3$
Net volume= Gross segment volume – Total defect volume or $111.7 ft^3 – 44.9 ft^3 = 66.8 ft^3$