National Forest Log Scaling Handbook

United States Department of Agriculture

Forest Service

FSH 2409.11
NATIONAL FOREST LOG SCALING HANDBOOK

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Approved: Gregory Smith
For Joel Holtrop
Deputy Chief

Date Approved: 04/20/06

Posting Instructions: Amendments are numbered consecutively by Handbook number and calendar year. Post by document; remove the entire document and replace it with this amendment. Retain this transmittal as the first page(s) of this document. The last amendment to this Handbook was Amendment No. 7.

New Document	2409.11-2006-1_transmittal	7 pages
	2409.11_contents	1 page
	2409.11_zero code	2 pages
	2409.11_10	30 pages
	2409.11_20	15 pages
	2409.11_30	76 pages
	2409.11_40	27 pages
	2409.11_50	6 pages
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	2409.11_70	6 pages
	2409.11_80	18 pages
	2409.11_appendix	66 pages
Superceded Documents(s) by Issuance Number and Effective Date	(Entire Handbook) Title page thru 247	263 Pages

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Digest:

10 - Corrects minor typographical and technical errors throughout the chapter. Substantive changes are as follows:

13 - Clarifies in paragraph 1 that the standard unit for saw timber scaling will be in cubic foot log scale, although board foot log scale is used under certain circumstances.

17.12 - Changes the caption in exhibit 02 to clarify direction to allow full trim in the length measurement and record in 2 foot multiples.

17.18 - Adds new direction and an exhibit for length measurements on forked logs.

17.2 - Clarifies scalers will notify the contracting officer when improper trim allowance is detected.

17.3 - Adds direction on how to record logs that are further reduced to the lower 2 foot multiple, but the diameter increases to the next diameter class, the increased diameter will be recorded as the proper scaling diameter.

17.33 - Adds a list of butt characteristics to assist in identifying butt cut logs.

20 - Corrects minor typographical and technical errors throughout the chapter. There are no changes to the substantive direction in this chapter.

30 - Corrects minor typographical and technical errors throughout the chapter. Substantive changes are as follows:

Digest-Continued:

33 - Establishes defect types and new deduction procedures for: Burls, Foreign Material, Pecky Rot, Pistol Butt Defect, Pitch Pockets, and Spiral Grain.

Slope of Grain, and Twist have been included in the Spiral Grain definition.

Barber Chair and Pull, Stump or Sliver has been included in the Breaks and Splits definition.

Bark Seam has been included in the Pitch Seam, Heart Check, Frost Crack definition.

Adds new direction and exhibits for crook defect deduction process.

Combines Knots, large and Knots, clusters into a single new defect type, Knots. Establishes new knot size limits and knot deduction guide.

Adds definition of massed pitch and clarification of when a deduction in necessary.

Adds clarification of scaling cylinder position when deducting for sweep.

Reformats and renumbers entire section to conform to FSH 2409.11a - Cubic Scaling Handbook, chapter 20.

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Digest-Continued:

40 - Corrects minor typographical and technical errors throughout the chapter. Substantive changes are as follows:

44 - Changes caption from Stump Scaling to Timber Trespass. Provides direction for measurements to be performed by certified scalers and cruisers and requires coordination with Law Enforcement staff prior to beginning field work.

44.1 - Changes caption from Timber Trespass to Stump Scaling.

44.2 - Changes caption from Scaling when Stump and other Direct Evidence is lacking to Stump Cruising.

44.3 - Established this code and recodes direction formerly at section 44.2 to this section.

51 - Changes caption to selection of scaling locations. Changes responsibility for selection of scaling locations from District Ranger to Contracting Officer. Also removes direction on selecting truck-scaling locations.

52 - Removes requirement for Forest Supervisor to develop additional safety specifications for scaling.

Digest-Continued:

53 - Removes the direction which discusses the need for the purchaser to keep government logs separate from private logs up to the point of scaling and for the use of distinctive marking between various sales.

54.1 - Changes the direction for team scaling from "discouraged" to "must not be used." Also removes direction Regional Forester to authorize team scaling in limited situations. Changes the responsibility for taking corrective action when scalers to not perform to standard from District Ranger to Contacting Officer.

54.2 - Removes direction on the benefits of mill visits and specific direction concerning various items to be observed while conducting a mill visit.

55.2 - 55.4 - Removes obsolete direction, which referenced out of date equipment, processes and procedures.

55.5 - Revises and recodes to section 55.2. Changes the responsibility for completing the Scaler Information Form from the Forest Service Representative to the Contracting Officer.

55.61 - Removes section on standard scaling forms.

55.62 - Recodes to section 55.3.

55.63 - Recodes to section 55.4. Removes significant amount of instruction, including exhibit's 01 and 02, on how to fill in scaling sheets. Stresses the use of field data recorders to record scaling information.

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Digest-Continued:

55.64 - 55.65 - Removes obsolete direction from handbook.

56.1 - Removes obsolete from handbook.

56.21 - Removes obsolete direction from handbook.

56.22 - Recodes to section 56.1.

56.3 - Removes obsolete direction from handbook.

60 - Corrects minor typographical and technical errors throughout the chapter. Substantive changes are as follows:

64 - Increases situations where Regional Foresters may deviate from established check scale standards.

65 - Revises to require minimum check scale record and summary information. Removes out-dated policy, procedures, and forms.

70 - Reformats chapter.

71 - Updates CFR reference.

80 - Corrects minor typographical and technical errors throughout the chapter. Substantive changes are as follows:

82 - Deletes previous documentation which was incomplete and adds reference to National Forest Cubic Scaling Handbook (FSH 2409.11a) for handbook direction.

Digest-Continued:

85 - Adds a cross reference on sample scaling to Forest Service Handbook 2409.11a, National Forest Cubic Scaling Handbook, chapter 50.

85.5 - Recodes to section 86.1.

85.6 - Recodes to section 86.2.

87.42 - Establishes new direction for Fiber Scaling.

Appendix - Renames exhibits from "Table" to "Appendix." Removes Table 1A, Table VIII, Table IX - Exhibit A, Table XIV. Adds Appendix 15 - Factors for Computing Scribner decimal C Volumes and Appendix 16 - Scribner Decimal C Recorded Length and Segment Lengths.

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01 - AUTHORITY

Timber use laws are cited in FSM 2400.

02 - OBJECTIVE

The objective of this handbook is to provide standard Service-wide procedures and instructions for scaling National Forest timber to be sold, for free use, for exchange, and in timber trespass cases.

03 - POLICY

The procedures provided in this handbook shall be used by all Regions and Forests when scaling timber for sales, free use, exchange, or in trespass cases.

04 - RESPONSIBILITY

04.1 - Director of Forest Management

The Director of Forest Management, Washington Office, is responsible for the maintenance of this handbook. Regional Foresters may propose revisions to the white pages at any time. These must be made in terms of specific wording, additions, or deletions.

04.2 - Regional Foresters

Regional Foresters are responsible for supplementing this handbook to accommodate particular Regional and sub-Regional conditions.

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11 - THEORY OF SCALING

Scaling is the determination of the gross and net volume of logs by the customary commercial units for the product involved; volume may be expressed in terms of board feet, cords, cubic feet, linear feet, or number of pieces. Scaling is not guessing; it is an art founded on applying specific rules in a consistent manner based on experienced judgment as to how serious certain external indicators of defect are in a specific locality.

The measuring standard used in scaling logs, called a log rule, is a table intended to show amounts of lumber which may be sawed from logs of different sizes under assumed conditions. At best, a log rule can only approximate salable manufactured volume because of constant changes in markets, machinery, manufacturing practices, and even the varying skill of individual sawyers. Thus a log rule is an arbitrary measure. Its application must not be varied according to the mill in which logs are sawed. The scaled volume of logs must be independent of variations in manufacture.

The difference between the volume of log scale and the actual volume of lumber sawed from the same logs is called “overrun” if the lumber tally exceeds log scale, or “underrun” if it is less.

There may generally be an overrun or an underrun when logs are scaled by a particular rule in a given locality and sawed by a mill. Basic assumptions in the log rules and assumptions in utilization practices cause overrun to vary with the size of the average log. Experience proves that this is true even for the International 1/4-Inch rule, although not to the same degree as for the Scribner Decimal C rule. This fact does not change scaling practice. Overrun (or underrun) is estimated in the process of appraising National Forest timber

for sale, and presumably by the purchaser in determining what prices he will bid. Overrun or underrun is not considered in log scaling, even though it is very important to any mill.

12 - GENERAL PRINCIPLES OF FOREST SERVICE SCALING

The scaler must be familiar with Forest Service and Regional policy on scaling contained in the Forest Service Manual (FSM 2440), instructions contained in this Handbook, and utilization and scaling specifications of the timber sale contract.

Forest Service scaling determines quantity rather than quality of the material. Unless the contract provides for payment on a gross scale basis, all defects affecting recovery of sound volumes are deducted. No consideration is given to lumber grade recovery.

13 - COMMERCIAL UNITS USED

1. National Forest timber is appraised, sold, and measured by customary commercial units for the products involved. Standard practice is to scale saw timber by a cubic foot log scale, although board foot is used in some Regions under certain circumstances, mining timbers by the piece or linear foot, telephone poles by the linear foot or the piece of stated length, piling by the linear foot, pulpwood by the solid cubic foot or cord, and fuel wood, shingle bolts, and similar material by the cord. Other units may be used when better adapted to local trade customs or local situations.

2. As a general rule, the measurement of National Forest timber is in the form in which the material leaves the woods rather than in the form of products. End-product measurement may only be used under special conditions approved by the Regional Forester.

Products, such as telephone poles and fence posts, are ordinarily finished for market at the stump, and are therefore usually measured or counted in their final form.

14 - AUTHORIZED LOG RULES

The Scribner Decimal C Log Rule, the International *-1/4-Inch log rule, or the Smalian cubic volume rule as used by the Forest Service are authorized under 36 CFR 223.3 for uniform scaling of sawtimber.

With the exception of the Smalian cubic volume rule, all specified rules are board-foot rules. Each board-foot rule is a table showing an arbitrary estimate of the amount of lumber a log of given length and diameter can produce. Inasmuch as the tables for each rule have a different base, the scale of identical logs will differ according to the rule used.

1. The Scribner Decimal C Rule. This is one standard rule for Forest Service saw log scaling. This rule rounds contents to the nearest 10 board feet. For example: Logs that according to the Scribner rule have volumes between 136 and 145 board feet are rounded to 140 board feet and shown as 14.

This rule is a diagram rule based on diagrams of circles. These diagrams (ex. 01) show in cross section the number of 1-inch boards the small end of a log will produce under assumed conditions.

14 - Exhibit 01
Diagram Showing the Number of 1-inch Boards That Can be Cut From a Specific Log

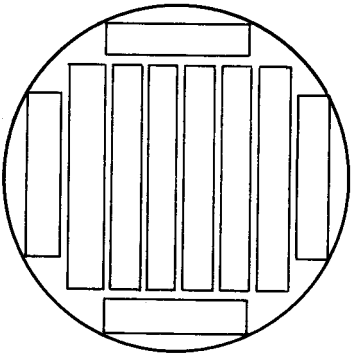

Table II in the appendix shows the Scribner Decimal C rule volume of even- and uneven-length logs from 4 to 20 feet.

The Scribner Decimal C rule is used unless the advertisement and timber sale contract specify the International 1/4-Inch rule, the Forest Service International 1/4-Inch Decimal rule, or the Cubic Volume rule.

2. The International 1/4-Inch Rule. This is another standard Forest Service rule, which probably gives a closer lumber-volume estimate than other log rules in common use. This rule measures logs to the nearest 5 board feet. As the name implies, it allows for a saw kerf of one-fourth inch. It is a rule based on a formula applied to each 4-foot section of the log, and assumes a taper of one-half inch in each 4 feet. For practical purposes, the scaling cylinder becomes a part of a cone (a frustrum) with a taper of 2 inches in 16 feet. This

rule generally results in a log scale relatively close to lumber tally when logs are sawed in a reasonably efficient mill. Table X in the appendix gives volumes for this rule.

3. The Smalian Cubic Volume Rule. This rule uses the Smalian Formula, which is an equation for finding the volume of the frustum of a paraboloid. It can be shown generally in the form:

$$V \quad \frac{A+a}{2} x\, L$$

Where V = Volume in cubic feet (ft^3)
A = Large-end cross-section area (ft^2)
a = Small-end cross-section area (ft^2)
L = Log Length (ft)

Table XIV in the appendix chapter gives cubic fiber content of round-wood.

15 - SPECIES IDENTIFICATION

Since logs of different species may differ in stumpage rates and scaling specifications, the scaler's ability to identify logs by species is extremely important, although the logs may be mud- or snow-covered, weathered, or debarked. Species identity is determined by bark characteristics, color, amount of sapwood and heartwood, presence of pitch, and size and distribution of knots.

Regional Foresters should develop Regional guidelines as needed to aid in species identification.

16 - PRODUCT OR PIECE SPECIFICATIONS

Forest Service timber sale contracts established estimated volumes, prices, and minimum tree and product or piece specifications. Contract provisions not only define tree and product or piece minimums, but also require the purchaser to vary log lengths to secure the greatest practicable utilization to the minimum top diameter specified in the contract. In entering the contract, purchaser agrees to pay for that material which equals or exceeds the contract minimums.

Contract terms also determine whether certain classes of material, which do not meet the specifications, may be removed at the rate of payment, if any, for this type of material. It is most important that the scaler adhere to the specifications in the contract. Regional Foresters may develop forms or procedures that will ensure that the scaler has the necessary contract information to properly scale any material required to be scaled which the purchaser may remove from the sale.

17 - LOG MEASUREMENTS

17.1 - Log Lengths

17.11 - Maximum Scaling Lengths

A maximum scaling length of 20 feet is standard for the western Regions and Alaska; 16 feet is standard for the eastern Regions. Variation from the above standards may be authorized by the Regional Forester by special instructions included in Regional supplements.

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The Scaler's Information Form must show maximum scaling length specified in the timber sale contract.

Unless otherwise specified, any further reference to maximum scaling length must be to the 20-foot standard. This may require the eastern Regions and the Alaska Region to issue special supplements.

17.12 - 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.

1. Use the following length measuring techniques.

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

2. 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 a, b, c, and d of exhibit 01 illustrate length measurements.

See "Breaks and Splits" in chapter 30, section 33 for measuring broken-end logs.

17.12 - Exhibit 01
Length Measures
Figure a.

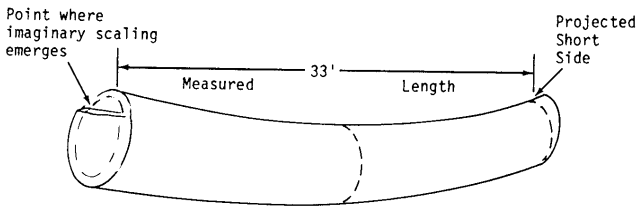


Figure b.

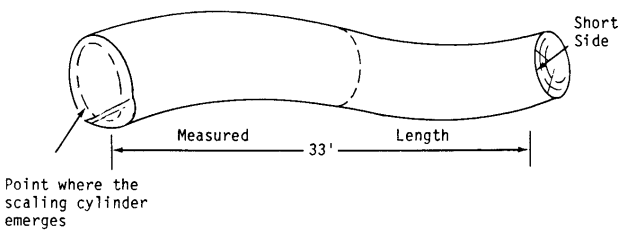
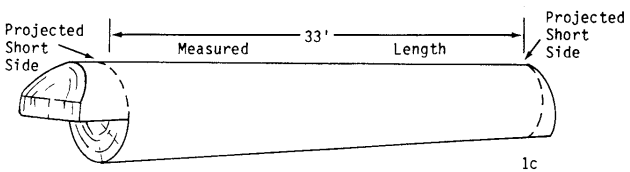


Figure c.



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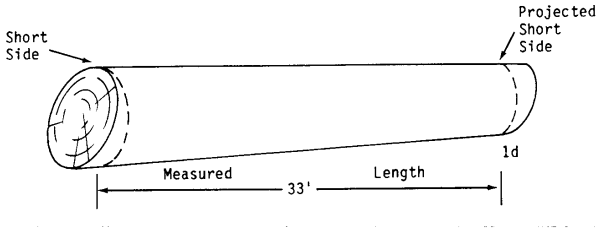
7.12 - Exhibit 01-Continued
Length Measures
Figure d.



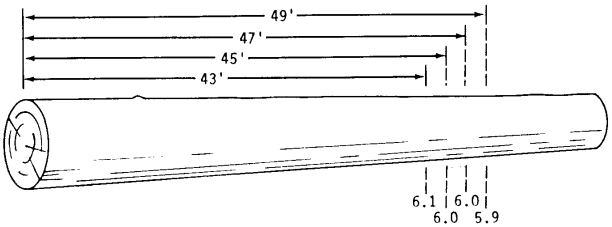
According to timber sale contract provision B6.82, Presentation for Scaling (FS-2400-6 - 4/04):

> "Trees or pieces presented for Scaling that 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."

Determine the measured length from the large end of the piece to the full extent of the minimum diameter specified in section A2 of the timber sale contract. The minimum diameter can be located with one measurement across the short axis of the log. Allow full trim in the length measurement and record length in even 2-foot multiples.

Exhibit 02 illustrates this:

17.12 - Exhibit 02
Scaling Pieces That Do Not Meet Minimum Piece Standards Due to Diameter



The measured length of this log would be 47 feet to the contract minimum diameter. Allowing for full trim and 2-foot multiples, record and scale it as a 44-foot multiple segment log (sec. 17.13).

Pieces presented for scaling with part of the length (less than the minimum length stated in section A2 of the contract) meeting the minimum diameter stated in section A2 of the contract shall be noted on the scale sheet and the Contracting Officer notified. These pieces will be recorded for payment only by written instruction of the Contracting Officer.

17.13 - Length in Long Logs

When logs exceed the maximum scaling length, scale them as two or more segments as nearly the same 2-foot length as practicable. When it is necessary to divide a log into unequal lengths, make the butt segment(s) the longest.

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Exhibit 01 illustrates a 30-foot log divided into one 16-foot segment (large end) and one 14-foot segment (small end).

17.13 - Exhibit 01
How to Divide a 30-foot Log

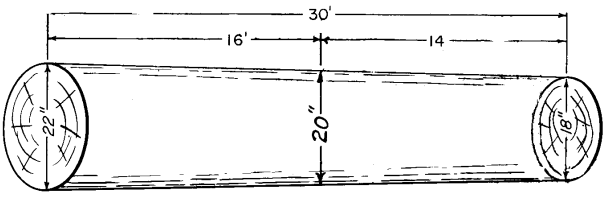
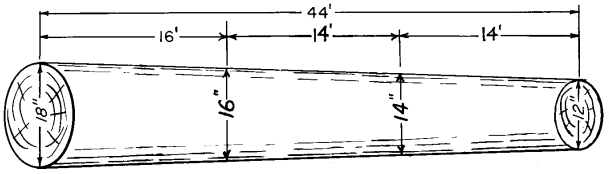


Exhibit 02 illustrates a 44-foot log divided into one 16-foot segment (large end) and two 14-foot segments.

17.13 - Exhibit 02
How to Divide a 44-foot Log



Tables IA and IB in the appendix chapter give the proper divisions of long logs for scaling purposes where maximum scaling lengths are 16 feet and 20 feet.

Table III in the appendix chapter shows the division of long logs and the Scribner Decimal C volumes for the applicable taper.

17.14 - Scaling 8 1/2-Foot Tie Logs

Scale tie logs cut 8 1/2 feet long (plus trim), up to and including 19 inches in diameter, as 8-foot logs. If diameters are 20 inches or larger, scale tie logs as 8 feet long plus one-half the difference between the scales of an 8-foot log and a 9-foot log. If half the difference is a fraction, use the next lower whole number.

Example: Scale a 14-inch tie log 8 1/2 feet long as an 8-foot log with 60 board feet; scale a 17-inch tie log as an 8-foot log with 90 board feet. Scale a 20-inch tie log as:

$$140 + \frac{(160 - 140)}{2} = 150 \text{ board feet (recorded as 15).}$$

Scale a 25-inch tie log as:

$$230 + \frac{(260 - 230)}{2} = 245 \text{ board feet (recorded as 24).}$$

17.15 - Scaling Odd-Length Logs

Scale stick volumes are given for even 2-foot lengths. In the absence of tables or a special scale stick, scale odd-length logs by interpolating volumes, rounding 0.5 up or down to the nearest even volume.

Example: For a 15-foot log, use the volume halfway between those of 14- and 16-foot logs; then round results like 10.5 and 22.5 to 10 and 22 and results like 7.5 and 51.5 to 8 and 52.

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17.16 - Scaling Short, Even-Length Logs

When scale sticks are not marked for 6-, 8-, and 10-foot lengths, use 1/2 the volume for double the length and round 0.5 to the nearest even volume or obtain the volume from volume tables II, X, XI of the appendix chapter.

17.17 - Log Volumes, Board Feet

Regional Foresters may develop Regional guidelines to provide uniformity of log scale volumes. These guidelines must be based on Table II, Interpolation, in the appendix chapter or even length factors depending upon their applicability.

17.18 - Length Determination of Forked Logs

When a forked log is presented for scaling record only those sections that meet the contract minimum piece specification. Do not record substandard forks or sections unless specified to do so on the Scaler's Information Form. Measure the length of any qualifying section or fork from the large end to the small end. Forking begins at the point of daylight. On the piece below the fork, allow full trim and record the length to the nearest lower, even, two-foot multiple. Record the remaining lengths to the nearest lower, even two-foot multiple (Figures a-d - ex. 01).

17.18 - Exhibit 01
Diagrams of Length Determination of Forked Logs

Figure a - Forked Log With Two Merchantable Forks

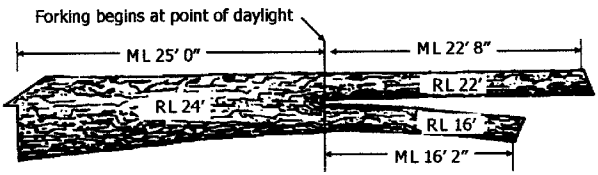


Figure b - Forked Log With One Substandard Fork

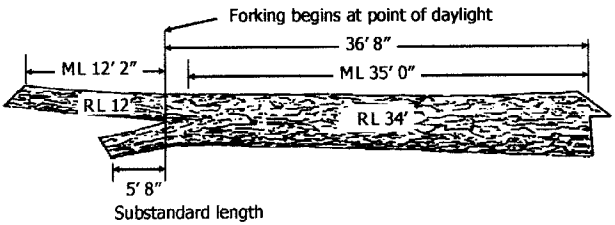
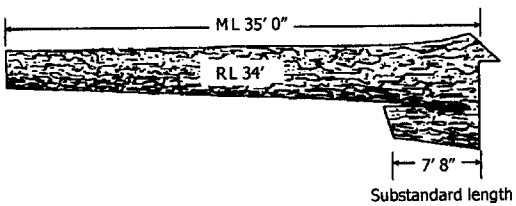


Figure c - Forked Log With A Substandard Fork at Butt End



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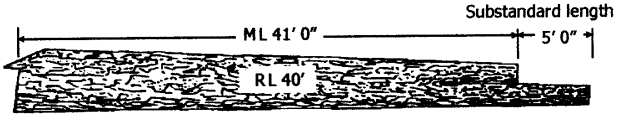
17.18 - Exhibit 01-Continued
Figure d - Forked Log With a Substandard Fork at Top End



17.2 - Trim Allowance

Logs are cut longer than standard lumber lengths because of the impossibility of bucking logs squarely and logging damage to log ends. This extra length is considered trim allowance and may vary between large and small timber, products to be sawed, and logging methods. Timber sale contracts list maximum allowances for trim in accordance with Regional standards. The Scaler's Information Form should be used to inform the scaler of variations from normal trim allowances.

Contract trim allowances are the permissive maximums. Regularly measure enough lengths to ensure proper observance of trim. The scaler is responsible for accurate length measurements on all logs scaled. Scale logs overrunning the trim allowance to the next 1-foot scaling length. For example, if 6 inches is the contract trim allowance for logs 8 to 20 feet in length, a log measuring 20 feet 10 inches is scaled as a 21; one measuring 24 feet 10 inches, as a 24; but one measuring 25 feet 2 inches, as a 25-foot log; 32 feet 0 inches, as a 31; or 32 feet 2 inches, as a 32; 41 feet 2 inches as a 41. It is difficult to measure log lengths to the nearest inch. Be sure there is actually an overtrim before scaling to the next 1-foot length. After the scaling

length and trim has been established, as above, divide logs into scaling segments in accordance with instructions in section 17.13 and tables IA and IB of the appendix chapter.

Special cut lengths should be taken care of by contract modification and, except for different specifications, should not be a scaling problem.

Scalers should notify the Contracting Officer of any improper trim they detect. The Contracting Officer should notify the purchaser and take necessary action to obtain contract compliance (sec. 17.5).

17.21 - 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.

17.3 - Log Diameters

Scaling requires accurate measurement of log diameters. Common tools used to measure diameters are scale sticks, steel tapes, and sliding calipers. The steel tape is the primary tool used to obtain the diameter of log ends in most regions, the scale stick is used to a lesser degree in other regions. 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 (sec. 17.31, ex. 01).

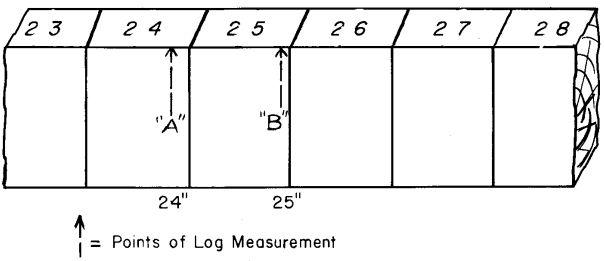
4. Where possible, read the scale stick directly from the end of the log, not obliquely from the side.

5. Take a pair of diameter measurements at right angles to each other. Measure the short axis first, and 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 1/2-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 2-inch marks, round one up and one down. If the average diameter is on a 1/2-inch; for example 23 1/2 inches, round down for the final scaling diameter; that is to 23 inches.

In Exhibit 01, measurement “A” is read as 24 inches and measurement “B” as 25 inches. The average, (A + B) ÷ 2, is 24 1/2 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 1/2-inch mark, the measurement would have resulted in a final scaling diameter 1 inch larger, or 25 inches.

17.3 - Exhibit 01
(4) Diameter Measurements (Coconino Scale Stick)



7. Trees or pieces presented for scaling that 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.

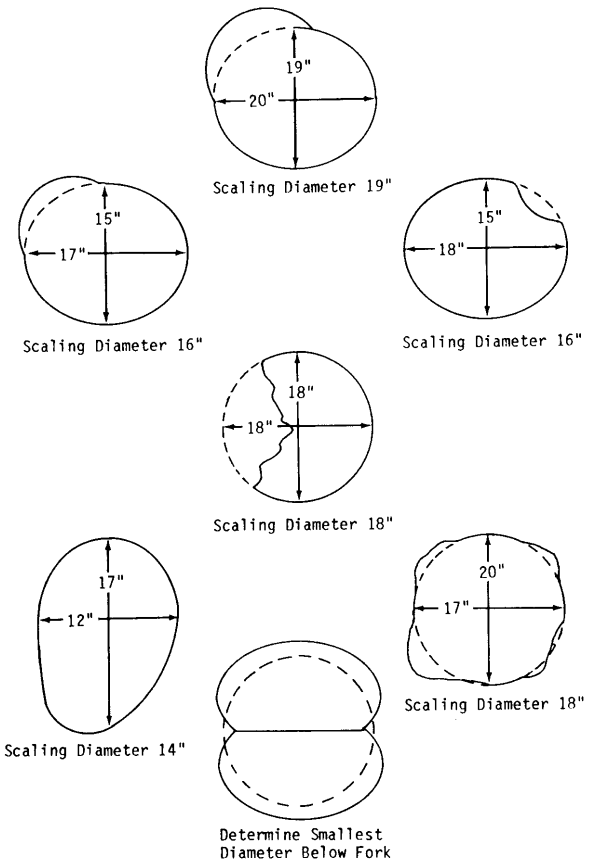
The diameter measurement is exactly that specified in the contract and not a diameter class. For example, a contract which lists the minimum diameter as 6 inches will be considered to be 6.0 inches. Take a single measurement across the short axis of the log. After establishing the assumed bucking point, determine diameters by the systematic method described in section 17.3, paragraphs 1-6.

Where a length is further reduced to the lower 2-foot multiple, and the diameter increases to the next diameter class, the increased diameter is recorded as the proper scaling diameter.

17.31 - 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 or steel tape at this measurement point, remembering to allow for bark thickness.

17.31 - Exhibit 01
How to Measure Logs With Abnormal Conditions and Average the Diameters



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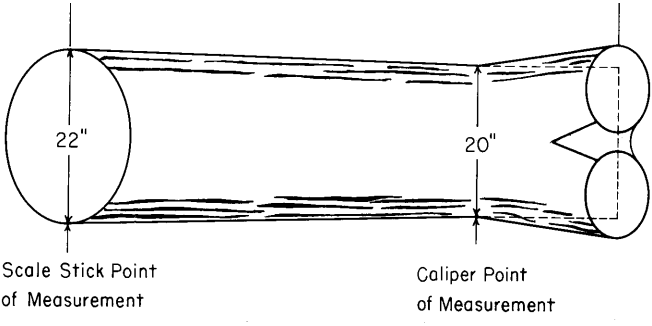
17.31 - Exhibit 02
Points of Measurement for Log With Crotch



Use the following methods to measure diameters of broken-end logs:

1. When the small end of a log other than a butt cut is broken, measure the large end. Reduce this measurement by the amount of estimated taper.

2. When the small end of a butt log is broken, lay the scale stick across the top of the small end. Read the measurement (inside bark) carefully.

3. When both ends of a log are broken, measure the same way as in paragraph 2.

17.32 - Diameter Determination for Caliper Scaling

Use average diameters in all types of scaling except caliper scaling in the woods. In this type of scaling, place the points of the calipers directly over the log. Be sure the points are on the widest portion on the sides. Measure inside the bark if the logs are scalped. If not, measure outside the bark and subtract twice the bark thickness. The same basic rules outlined in paragraphs 3, 5, and 6 of section 17.3 apply, except in caliper scaling in the woods. Keep the calipers snug without squeezing them. The recorded measurement is always taken from the inside bark diameter.

17.33 - Determining Butt Logs

There are several physical characteristics whose absence or presence can assist the scaler in determining whether or not a log is a butt-cut. Physical characteristics that are indicative of butt logs are:

Butt flare, flutes, absence of limbs, thicker bark, actual undercut, hinge, stump pull, and shear or circular saw marks left by mechanical fellers.

A paint mark showing on the side of a log is only an indicator and should not be used as the determining factor in identifying a log as a butt-cut. A log that has been long-butted will be considered a second-cut log.

17.4 - Taper in Long Logs

Scaling diameters of the butt segments are determined by apportioning the taper of the long log. Except for butt logs, taper is the difference between the two end diameters. For butt logs,
see section 17.43.

Taper is even when it can be apportioned in an equal amount to each segment such as 4-inch taper in a 2-segment log can be apportioned 2-inches to each segment, and uneven when it cannot.

17.41 - Distribution of Even Taper

Divide the taper by the number of segments, and add the taper per segment to the top diameter to obtain the diameter of the second segment. For a 3-segment log, add the taper per segment to the diameter of the middle segment. The resulting diameter should differ from the butt diameter by the taper per segment.

Exhibit 01 illustrates a 32-foot log with end measurements of 16 and 20 inches or 4 inches total taper. Scale it as one 16-foot segment with a diameter of 16 inches and one 16-foot segment with a diameter of 18 inches (the mid-diameter).

17.41 - Exhibit 01
How to Distribute Even Taper in a 32-foot Log

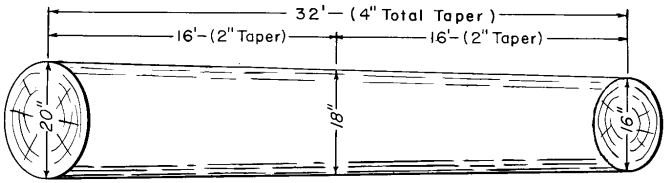


Exhibit 02 illustrates a 46-foot log with end measurements of 16 and 22 inches (6 inches total taper or 2 inches per segment). Scale it as one 14-foot segment with a diameter of 16 inches (2 inches taper); one 16-foot segment with a diameter of 18 inches (2 inches taper); one 16-foot segment with a diameter of 20 inches (2 inches taper).

17.41 - Exhibit 02
How to Distribute Even Taper in a 46-foot Log

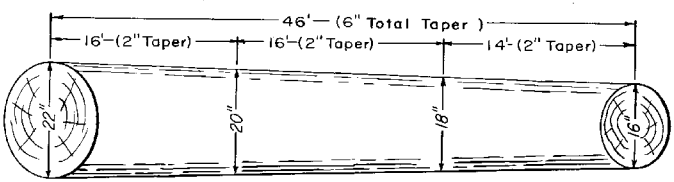


Table III in the appendix chapter shows Scribner Decimal C volumes of long logs, 22 to 48 feet, for various total tapers.

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17.42 - Distribution of Uneven Taper

Scale logs with taper in uneven amounts, by applying the excess taper to the top segment(s). Trees naturally grow with increased taper in top logs, as a check of taper tables or of actual taper measurements will demonstrate.

The rule of distribution of taper in long logs is as follows:

1. For two-segment logs with taper not divisible by 2, add an inch and divide by 2. This is the amount of taper assigned to the top segment.

2. For three-segment logs, raise total taper to a number divisible by 3 and divide. This is the amount of taper assigned to the top segment. Distribute the remainder of the taper as in a two-segment log.

Exhibit 01 illustrates a 32-foot log with end measurements of 16 and 19 inches (3 inches total taper). Scale it as one 16-foot segment with a diameter of 16 inches (2 inches of taper); one 16-foot segment with a diameter of 18 inches (1-inch taper to large end).

17.42 - Exhibit 01
How to Distribute Uneven Taper in a 32-foot

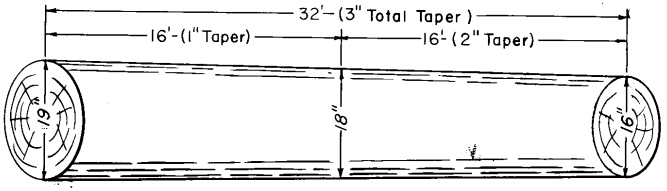
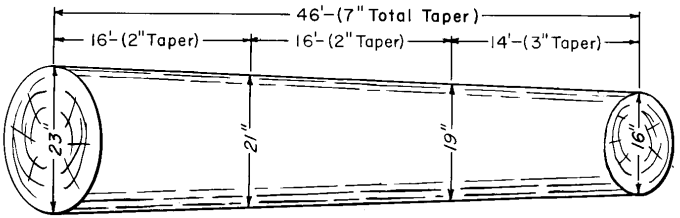


Exhibit 02 illustrates a 46-foot log with end measurements of 16 and 23 inches (7 inches total taper). Scale it as one 14-foot segment with a diameter of 16 inches (3 inches taper); one 16-foot segment with a diameter of 19 inches (2 inches taper); one 16-foot segment with a diameter of 21 inches (2 inches taper).

17.42 - Exhibit 02
How to Distribute Uneven Taper in a 46-foot Log



17.43 - Taper in Butt Logs

The taper in long logs which have the butt cut at one end cannot be determined in the same manner as other logs. Average taper can be determined by local studies conducted by species.

Uniform butt log tapers as determined by studies may be shown in the Long Log Table, Table III in the appendix chapter. Use of this table shall be in accordance with instructions issued by the Regional Forester. In the absence of authorized taper tables, scale on the basis of actual taper.

17.5 - Measurements for Contract Specifications

As described in section 16, the timber sale contract establishes the specifications for scaling the products. The Contracting Officer is responsible for determining whether or not the material presented for scaling is in accordance with the terms of the contract.

Occasionally, a purchaser may cut logs so that material in one product class is attached to material of another product class which may have a lower price, or may be removed free of charge. An example of this would be where a purchaser chooses to saw small diameter logs rather than buck, sort, and haul the smaller logs separately. That portion of the log, which meets or exceeds the contract minimums would be scaled and charged for in the appropriate product class. The smaller portion of the log would be charged for at the rate for the appropriate product or removed free of charge depending upon contract specifications.

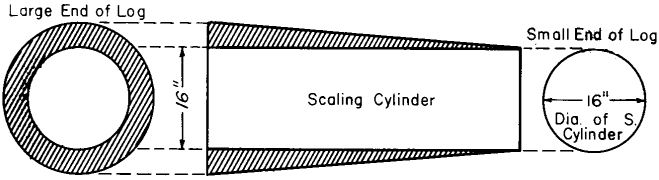
The scaler must be alert for operator actions, which are not within contract specifications and report these actions to the Contracting Officer. When losses due to stump pull, breakage and damage, exces-

sive trim, improper bucking, or poor top utilization begin to show up in scaling, the scaler must inform the Contracting Officer so that the latter may determine if administrative action is necessary. The scaler should not alter scaling practices until instructed to do so by the Contracting Officer (ch. 40, sec. 42).

18 - SCALING CYLINDER IN LOGS

The scaling cylinder for the Scribner Decimal C rule is an imaginary cylinder extending the scaling length of the log with a diameter equal to the measured or small end of the log (ex. 01). Volumes given by the rule are the gross board-foot contents of this cylinder.

18 - Exhibit 01
The Scaling Cylinder of a Log—Scribner Decimal C Rule



To visualize the scaling cylinder in a perfectly round log, picture the log in a giant lathe rotated against a knife until the entire log is peeled to the size of the small-end diameter. The cylinder of wood left is the scaling cylinder of that log. The part peeled off is outside the scaling cylinder. Make no deduction for defects in that portion of the log (ex. 02, figures a and b).

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18 - Exhibit 02
Figure a - Defect Both Inside and Outside the Scaling Cylinder

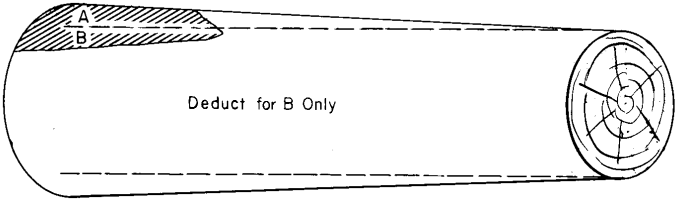
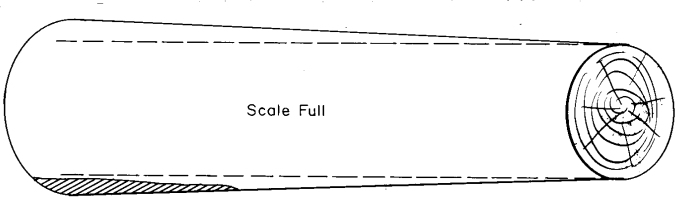


Figure b - Defect Outside the Scaling Cylinder



In the above illustrations, note that the scaling cylinder is independent of the pith center of the tree. A good scaler learns to "see" the scaling cylinder when he deducts for defect.

The Scribner Decimal C rule also incorporates an allowance for slab and edgings, considered for practical purposes to be 1 inch inside the surface of the scaling cylinder (fig. a). For this reason, no deduction should be made for minor surface defects or blemishes that can be eliminated in the slab or edgings.

For International 1/4-Inch log rule or Forest Service International 1/4-Inch Decimal log rule, refer to chapter 70, section 72.

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CHAPTER 20 - DEFECT-DEDUCTION METHODS

21 - GENERAL

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

a. Squared-defect method.

b. Pie cut method.

c. Length-deduction method.

d. Diameter-deduction method.

2. In applying any of the above methods, the loss is those portions of the boards (even feet in softwoods) 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 6 feet and a minimum width of 4 inches for softwoods. If the remainder of any board is shorter or narrower than these limits, the entire board must be considered lost, except as provided in chapter 70, sec. 73.

3. All methods must be used with judgment and skill. Knowledge of how defects actually cut out must be obtained from periodic mill visits. 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.

4. If defect calculations end in a fraction of 1/2 or more, raise the defect to the next whole number. If the fraction is less than 1/2, reduce the defect to the next lower whole number.

22 - SQUARED-DEFECT METHOD

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.[1] 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:

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

See chapter 70, section 75 and table XII in the appendix chapter for defect deductions applied with the International 1/4-Inch rule.

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 percent is deducted for saw kerf. X is raised or lowered to the nearest 10. Deductions for the various sizes of rectangular and squared defects as computed by the formula are shown in tables IV and V in the appendix chapter.

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

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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:

$$\frac{6x6x4}{15} = \frac{144}{15} = 9.6 \text{ board feet}$$

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 either a Coconino scale stick, or shortcut procedure with its simplified defect calculation.

22.1 - Coconino Scale Stick

Defect deductions for squares up to 30 inches are read directly from Coconino-style scale sticks for all log lengths. Defect deductions for odd or shorter lengths are determined by interpolation. Rectangular defects closely approaching squares are ordinarily converted to squares. This procedure is permissible in the smaller defects, since in the Shortcut Procedure for the Scribner Decimal C rule (sec. 22.2), the products of 6x8 and 7x7 would both be raised to 50 board feet and the products of 10x12 and 11x11 would both be raised to 130. The variance in the readings can be extended to 4 inches without an appreciable difference in volumes; for example, a 16x20 measurement can be read directly as an 18 x 18 square. Use of large rectangular measurements on both ends of a log, requiring

averaging, increases computations and can induce errors. A more practicable method is measuring these defects as a square using the larger dimension, then averaging, squaring, and making a fractional estimate.

Small rectangular defects, as for checks and pitch seams, can generally be readily figured using the shortcut procedure (sec. 22.2). Where larger rectangular defects are involved, such as 9 x 27, the 27 can be squared for the length of defect and this figure divided by 3, as 9 is a third of 27. Another example would be 13 x 26; square 26 for the length of defect and use half of this amount. There may be occasional answer variances of 10 and 20 board feet from the figures in table V (see appendix chapter). These differences can creep into the figures through the single and double steps of raising or lowering Scribner volumes to the nearest Decimal C figure.

Coconino-style scale sticks marked according to the Forest Service International 1/4-Inch Decimal rule are available.

22.2 - Shortcut Procedure

1. For the Scribner Decimal C rule, the shortcut procedure for determining the squared-defect deduction may be stated by the following formula:

$$X = W \times H \text{ to the next higher } 10 \times L/16 \text{ to nearest } 10.$$

The defect dimensions used in this formula are identical to those which would be used in the preceding more complicated formula (sec. 22); 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.

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

3. In applying the shortcut procedure, remember these four easy steps:

a. Measure both height and width of the defect, including the 1-inch allowance for waste.

b. 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.

c. This is the deduction if the defect extended through a 16-foot log.

d. Estimate the length of the defect in terms of 16 feet. If the estimate is 8 feet, take 8/16 or 1/2, the originally calculated defect. If the estimate is 4 feet, deduct 1/4 of the 16-foot calculation. If the defect extends about 6 feet, use 6/16 or 3/8. For a 20-foot length of defect, add 1/4 of the 16-foot calculation.

4. The following corrections should be made for larger defects:

a. Add 10 board feet to the product of W x H for defects squaring 13 to 16 inches, inclusive.

b. Add 20 board feet to the product of W x H for defects squaring 17 to 21 inches, inclusive.

Using the same example as for the formula in section 22:

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

$$40 \times \frac{4}{16} \quad \text{or} \quad \frac{4}{16} = 10 \text{ board feet (1 Decimal C)}$$

See chapter 70, section 75 for the shortcut procedure applicable to the International rule.

22.3 - Application of Squared-Defect Method

Scalers should acquire 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.

The squared-defect method is best adapted to not more than two defects in a log end. Applying this method separately to more than two defects may cause errors in the several computations required.

See chapter 70, section 75 for exceptions when using the International rule.

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22.4 - 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 rots 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 either a Coconino-style scale stick or the shortcut procedure. Following are several 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 8/16 or 80/2 = 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 8/16 or 240/2 = 120

(Read on Coconino stick 15 x 15 x 8' = 12).

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 6/16 or 38 to the nearest 10 = 40

(Read on Coconino stick 10 x 10 x 6' = 4).

The deduction is 40 or 4 Decimal and net scale is 23 or 230 board feet.

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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. In Western regions the minimum lumber length is 6 feet for softwoods and normally 4 feet for hardwoods.

22.5 - 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 squared-defect method is applicable, use either a Coconino-style scale stick or 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. (See ch. 70, sec. 75 for International rule).

1. For logs 8 to 14 feet in length, defect dimensions must be taken at large end of defect (in Western regions).

Example 1: 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

(Read on Coconino stick 10 x 10 x 14' = 9)

The deduction is 90 or 9 Decimal and net scale is 18 or 180 board feet.

2. For logs 16 to 20 feet in length, the average of the defect dimensions for both ends of the log must be used (in Western regions).

Example 2: A 20-foot log 21 inches in diameter has a gross scale of 380 board feet. End defects measure 8 by 10 inches and 4 by 6 inches. Add 1 inch for waste:

$$\frac{9+5}{2} = 7 \text{ (H)}$$

$$\frac{11+7}{2} = 9 \text{ (W)}$$

7 x 9 = 63 to the next higher 10 = 70

70 x 20/16 = 88 to the nearest 10 = 90

(Read on Coconino stick 8 x 8 x 20' = 9)

The deduction is 90 or 9 Decimal and net scale is 29 or 290 board feet.

3. For logs 22 feet and longer, treat each segment in the manner prescribed in paragraphs 1 and 2.

a. For logs 22 to 28 feet in length, average the defect dimension at both ends to obtain the size of the defect at midpoint and run the larger end of the defect dimension through each segment.

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Example 1: Defect extends through a 24-foot log that is scaled as two 12-foot segments. Defect, including waste allowance, measures 8 by 10 inches on the large end, 4 by 6 inches on the small end. The midpoint defect dimensions are 6 by 8 inches. For one segment, use 8 by 10 inches for deduction. For the other segment, use the midpoint size, 6 by 8 inches.

b. For 30-foot logs, use large defect dimensions for the 14-foot segment and average defect dimensions for the 16-foot segment. See items a and c.

c. For logs 32 to 40 feet in length, average the defect dimensions at both ends to obtain the size of the defect at midpoint and then use average widths and heights of the defect as computed for each segment.

The procedure may be simplified and the same or a comparable answer obtained by an alternate method. This modification provides for use of the midpoint dimensions as the average defect dimensions for each log, but do not use it on marginal logs.

Example 2: Heart check on both ends of a 32-foot log measures (including waste) 2 by 10 inches and 2 by 4 inches. The midpoint measurements are 2 by 7.

Usual Deduction Method

$$\frac{2+2}{2}=2 \qquad \frac{10+7}{2}=9$$

$$\frac{2+2}{2}=2 \qquad \frac{4+7}{2}=6$$

2 x 9 = 18 to the next higher 10 = 20 board feet deduction for butt log.

2 x 6 = 12 to the next higher 10 = 20 board feet deduction for the top log.

Alternate Method: Use midpoint measurement.

2 x 7 = 14 to the next higher 10 = 20 board feet for the average deduction or 40 for the 32-foot log.

Do not use the alternate method when one segment of a long log is a cull or where other indicators cast doubt as to the uniformity of the defect.

When the dimensions of end defects are averaged and the result is a fraction, round up to the next whole number, as (4 + 3) ÷ 2 = 4.

In regions where hardwoods comprise a significant part of the timber volume or where short logs are preponderant, Regional Foresters may prescribe different utilization standards and lengths for averaging defects.

23 - 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.

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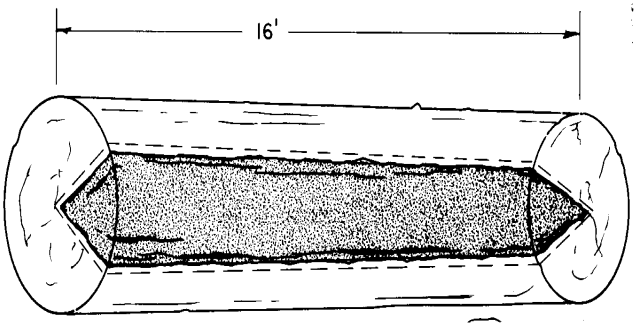
23 - Exhibit 01
Pie Cut Method (deep lightning scar affecting 1/4 of log)



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. 14). 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.

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.

24 - 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 (section 23). 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.

25 - 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.

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31 - GENERAL

A scaling defect is any unsound material or abnormal shape in a log that reduces its net volume. Defects are grouped in two common classes:

1. Natural Defects. Natural defects are those which exist in the log before the tree is felled. These may include all kinds of interior rot, rotten knots fire scars, catfaces, massed pitch, pitch rings and shake, pitch seams and checks, lightning scars, sweep, crook, massed grubworm holes, crotch, sap rot, weather checks (snags and windfalls), knot clusters, burls, and some types of large knots.

2. Logging Defects. Logging defects are those generally occurring after the tree is felled. They include mechanical defects, such as breakage, brooming, tractor damage, and loading damage. They also include other defects caused by poor logging practices, such as sap rot, weather checks, and damage caused by borers after trees have been cut.

Forest Service scaling considers deductions for all defects, natural and mechanical. All logs shall be scaled as presented, unless otherwise instructed by the Contracting Officer. The Contracting Officer must make the decision concerning permissive deductions for defects caused by the purchaser allowing logs to remain in the woods.

Some defects in logs are caused by abnormal delay in scaling due to the fault of the purchaser. Deductions made for sap rot, weather checks, or other defect resulting from abnormal delay in scaling are chargeable at contract rates. Therefore, these deductions must be separately identified.

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32 - DEFECT TYPES AND APPLICABLE DEDUCTION METHODS

Following is a tabulation of common types of defect and the defect-deduction method most applicable to each type. The types of defect and applicable procedures are discussed in section 33. Deduction methods are described in chapter 20.

32 - Exhibit 01
Tabulations of Defect

		Deduction Method			
Defect	Defect Symbol	Diameter	Length	Pie-cut	Squared-defect
Barber chair	BK		x	x	x
Bark seam	PS			x	x
Break, straight	BK		x	x	x
Break, other	BK		x		
Burl	BL		x	x	
Catface, shallow	CF	X			
Catface, deep	CF			x	
Check, heart	CH				x
Check, weather	WC	X			
Crack, frost	FC			x	x
Crook	CR		x		
Crotch	Y		x		x
Fire scar	FS		x	x	
Knots, large	K	X	x	x	x
Knot cluster	KC		x	x	
Knots, rotten	RK			x	x
Lightning scar	LS	X	x	x	x
Multiple defects	MD		x	x	x
Pitch, massed	MP		x	x	x
Pitch seam	PS				x
Pitch spangle, small	SF				x
Pitch spangle, large	SP		x		
Pull, stump or sliver	BK				x
Ring, pitch or shake	PR or SH	X			x
Ring, pitch or shake multiple	PR or SH		x		
Rot, conk	C		x	x	x
Rot, heart	R		x		x
Rot, sap	S	X			
Rot, stump	R		x		x
Stain[1]					
Sweep	SW		x	x	
Wormholes, massed large	WH	X	x	x	x

[1]Stain is not a defect by itself. If stain is accompanied by rot, refer to the appropriate rot. The common rots and fungi found in sawlogs are described in table IX in the appendix chapter.

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33 - DEFECT TYPES AND DEDUCTION PROCEDURES

Descriptions of common defect types, with applicable deduction procedures, follow in alphabetical order. The Scribner Decimal C rule is used in examples. The same general scaling practices apply to the International rule.

33.1 - Rots

33.1a - Rot, Conk

Sometimes this rot is called red ring or honeycomb rot. In eastern species, it is known as red rot. (Should not be confused with red rot of ponderosa pine-Polyporus anceps - see table IX, appendix chapter.) In incipient stages it is commonly referred to as "firm red heart." This defect varies in color from purple and light red in early stages to dark brown in mature stages. In the early stages the wood is only stained and requires no deduction. In later stages, the wood breaks down to form a honeycomb appearance. Patches of white substance called "white pocket" appear. These white pockets indicate that the wood is broken down and that a deduction is required.

Deductions for conk rot are particularly difficult. Any one of several methods may apply. Effects of the fungus appear to vary with species, soil, altitude, and climatic conditions. Mill visits and experience are essential for a scaler to interpret what conk indicators mean in the timber he is scaling. Record guides applicable to timber from specific areas.

Generally, the point of deepest penetration of conk rot is where a fruiting body or conk enters the log. Here the rot most commonly takes the shape of a crescent. Occasionally, it may be in the form of one or more full rings. These may roughly parallel growth rings.

When conk stain or conk rot shows in log ends, look with care for conks on the log. Use a spud to dig into swollen spots, punk knots, and black limbs. Size of conks is sometimes helpful in determining the extent of rot in some species. Recognize where conks have broken away from logs by punky, yellowish-brown material in the holes where the conks were attached.

Make deductions for white pocket (conk) using the squared-defect method if the defect occurs as a spot in one end. If 1/4 to 1/2 of one end is defective, make a pie-cut deduction of the scaling cylinder affected for the estimated length.

A good plan while on a mill visit is to make a rough chart guide such as that shown in exhibit A, appendix chapter, for conk rot deductions. Use such a chart only for areas and species where it is proved to be applicable by repeated mill visits. Note the average length of rot spread from the last visible indicator.

WARNING: The effects of conk rot are variable. Widespread or uniform use of one chart without essential local modifications and repeated checks could- result in erroneous scaling.

33.1b - Rot, Heart

Sometimes called center, circular, dry, or red, this rot is found in logs cut from any position in trees. In color it ranges from light brown in early stages to reddish brown in its advanced stage. Fruiting bodies are usually missing by the time the log is ready to scale. This decay is characterized as brittle, dry, crumbly, sometimes with cubical patches and usually with white felt like layers between the patches.

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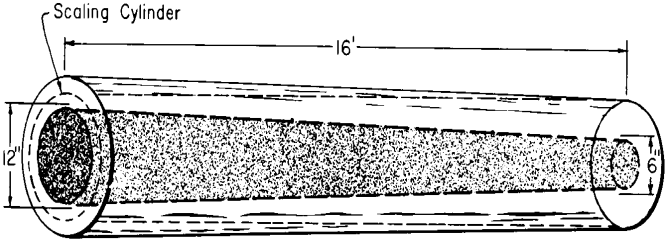
Use the full estimated length of heart rot because it does not taper like stump rot. Make deductions by the squared-defect method for most heart rot.

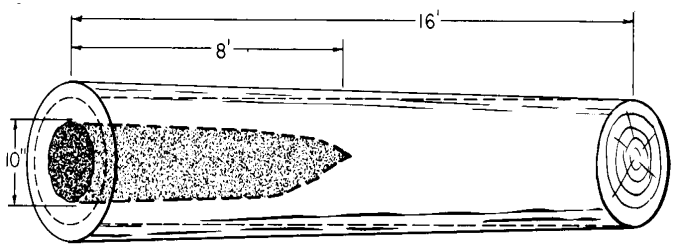
Example 1: Exhibit 01 illustrates a 16-foot log with a heart rot extending full length through the log. The defect including allowance for waste measures 12 by 12 inches on one end, 6 by 6 inches on the other. Average of these end dimensions is 9 by 9 inches. Using the squared-defect method (ch. 20, sec. 22.5), deduct as follows: 9 x 9 = 81 to the next 10 = 90 (9 Decimal).

33.1b - Exhibit 01
Example 1 - Heart Rot Both Ends - Squared-defect Method



Example 2: Exhibit 02 illustrates a 16-foot log with heart rot extending 8 feet into the log. The defect including waste allowance measures 10 by 10 inches on the end showing. The squared-defect method gives 10 x 10 = 100 to the next 10 = 110 (11 Decimal). Take 1/2 of 11 or a 6 deduction for this log.

33.1b - Exhibit 02
Example 2 - Heart Rot One End Only - Squared-defect Method



Use the length-deduction method where the diameter of heart rot equals or approaches the diameter of the scaling cylinder (sec. 24). Any regional variance from the instructions above should be based on a local guide developed during mill visits. Refer to Rot, Conk, and exhibit A, appendix chapter.

33.1c - Rot, Sap

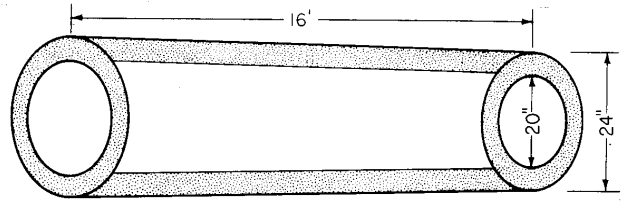
1. Sapwood on logs cut from dead trees, either snags or windfalls, often is in advanced stages of decay. If rotten sap extends over both the length and circumference of the log and the sapwood is still in place, the gross or outside diameter will be measured directly and the average diameter determined just as for green logs. When the rotten sapwood has sloughed away, the gross or outside diameter will be determined by measuring the sound wood within the sapwood and adding thereto the estimated thickness of the rotten sapwood.

To obtain net scale, determine the average diameter of the sound cylinder inside the rotten sapwood (or surface checks) and treat it as a special scaling cylinder, considering any other defects that may be

present. The difference between the gross scale of the outer scaling diameter and the net scale of the inner scaling diameter will be the deduction if no other defects are present.

Example: Exhibit 01 illustrates a 16-foot log, 24 inches in diameter at the small end, has a gross scale of 40. If the average thickness of rotten sapwood is 2 inches, the net scale of the log will be that of a 16-foot log 20 inches in diameter, or 28.

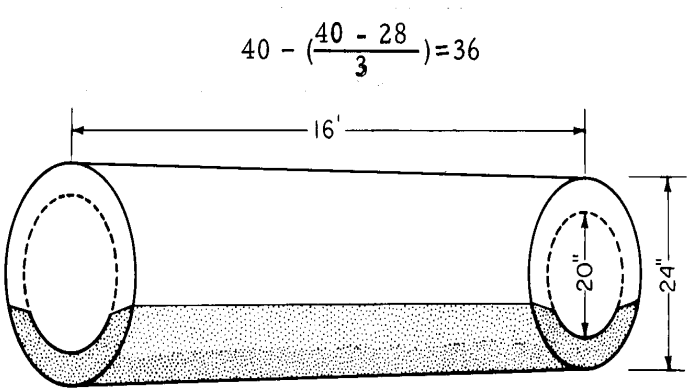
33.1c - Exhibit 01
Example 1 - Sap Rot - Diameter-deduction Method



2. When portions of the length or circumference of the sap are sound, the full log diameter including sap will be the scaling diameter and the defect deduction will be treated as follows:

Example: Exhibit 02 illustrates a 16-foot log, 24 inches in diameter at the small end, has a gross scale of 40. If the rotten sapwood is confined to the side which was lying on the ground and averaged 2 inches rotten sapwood for 1/3 the circumference for the full length of the log the net scale of the log would be 36, derived as:

33.1c - Exhibit 02
Example 2 - Sap Rot on One Side - Diameter-deduction Method



3. Examine logs with dead sapwood carefully. Rot may extend into the heart in the form of pockets. In fire-killed or down timber these pockets may be on one side only. This material should be looked over with care. Use the Hallin hammer or other type of spud to help determine the extent of rot. Deductions for these associated rots should usually be determined by the pie-cut method. See ch. 20, sec. 23.

4. Occasionally the top end of a sap-rotted log shows a deep rot penetration for a short length only. Make a length deduction for this portion and a diameter deduction for the remainder.

5. Check merchantability specifications of the timber sale contract (ch. 10, sec. 16). Some contracts may state that logs with the sapwood decayed will be scaled inside the sapwood. In such cases the sapwood, like the bark, in disregarded in scaling. Gross scale in such a case refers to the heartwood only. Other contracts may provide for scaling such logs "gross," in which case the gross scale is the only recorded volume.

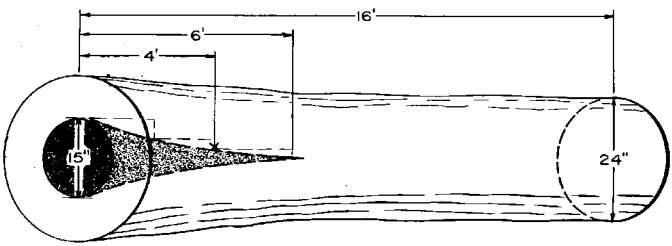
33.1d - Rot, Stump

Often called butt or ground rot, it is found only in the butt portion of trees as the name implies. Color varies from light brown to dark reddish brown. Swelling on the outside of a log may be an indication of defect length but not always so. Where swellings do indicate rot, decay seldom extends far beyond such swelling. The rot may be either blunt or conical. Splits on the side of a log, sometimes due to weakness caused by rot, aid in estimating decay length. Mill visits are the best way to find out whether the local stump rot is generally blunt or conical. It may be desirable to develop a local chart guide of the type shown by exhibit A in appendix chapter.

The length of penetration of stump rot seldom exceeds 16 feet and most commonly runs 2 to 8 feet. If mill visits show that the rot is generally blunt at the end, the amount of defect will be determined in the same manner as heart rot. If the rot is conical in shape, the amount of standard-length lumber which will be recovered along the taper of the rot must be considered. Use the squared-defect method unless the size of the defect is so large as to approach the diameter of the scaling cylinder and a length cut is indicated.

Example 1: Exhibit 01 illustrates a 16-foot, 24-inch log with stump rot averaging 14 inches in diameter. Visible swelling in the log indicates total length is 6 feet. Because of the cone shape of stump rot, all of the 6-foot portion is not lost. At the point where the rot penetrates deepest, the log will not produce longer than 10-foot lumber, but along the sides of the rot cone within the scaling cylinder, it should produce 12- and possibly some 14-foot lumber. Average the defect length. In this example use 4 feet as the average length. The squared-defect method (code 22.4) gives 15 x 15 = 225 + 10 raised to the next 10 = 240 (24 Decimal), the deduction if the defect extended 16 feet. The average length, however, is 4 feet, 1 the length of the log, or a deduction of 6.

33.1d - Exhibit 01
Example 1 - Stump Rot - Squared-defect Method



Example 2: Exhibit 02 illustrates a 16-foot, 18-inch log with stump rot averaging 16 inches in diameter. The size of this defect is so large as to approach the diameter of the scaling cylinder and calls for a length deduction. In the type of stump rot illustrated, a 4-foot-length cut should equal the loss from rot. The difference in scale between a log 12 feet in length and 18 inches in diameter and one 16 feet is 5, the proper deduction for this log.

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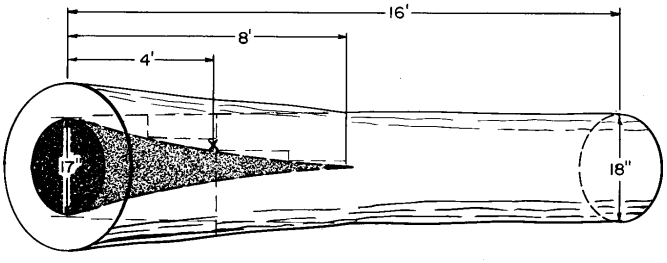
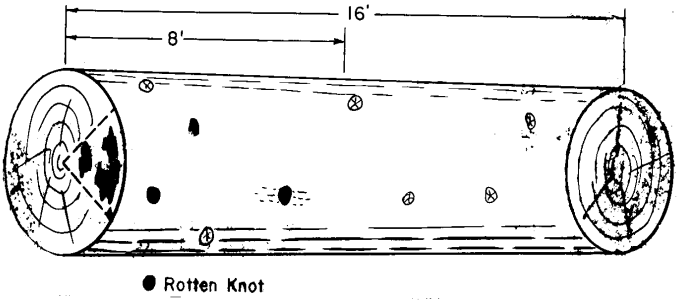
33.1d - Exhibit 02
Example 2 - Stump Rot - Length-deduction Method



33.1e - Knots, Rotten

In some species and areas, rotten knots indicate interior rot. Rot may follow the knot into the log, and then spread out one or both ways. The length of this spread varies with species, age, and locality. When rot shows on one or both ends, make deductions using the pie cut method for the length affected. Logs with rotten knots and no end indications are a challenge to any scaler. Visit local mills to establish a pattern for making deductions for this defect.

33.1e - Exhibit 01
Rot in Log End Caused by Rotten Knots—Pie-cut Method



33.1f - Pecky Rot

Pecky rot does not taper the same as other defects. The following rules apply to pecky rot in lieu of averaging defect dimensions (Squared Area Methods, sec. 22.31).

1. Arrangement of Pecky Rot.

Consider all pecky rot that is less than 2.0" apart as defect. Minimum recordable volume for any single pecky rot defect is 10 board feet, or 1 Dec C. A 1.0" x 2.0" peck extended through a 16' log will yield 1 Dec C defect. (Including 1" for waste; $\frac{2" \times 3" \times 16'}{15} = 6$ BF, or 1 Dec C).

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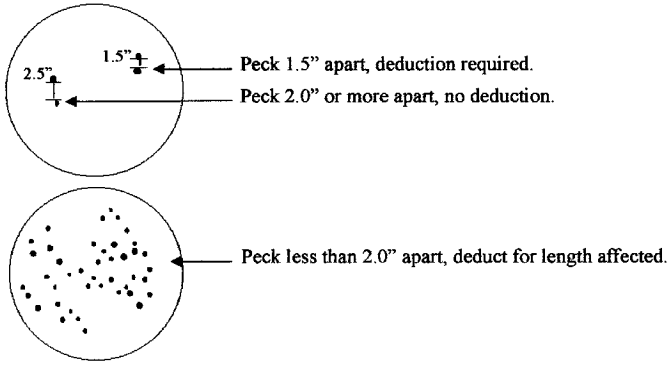
The following exhibit is an example of an arrangement of deductible pecky rot:

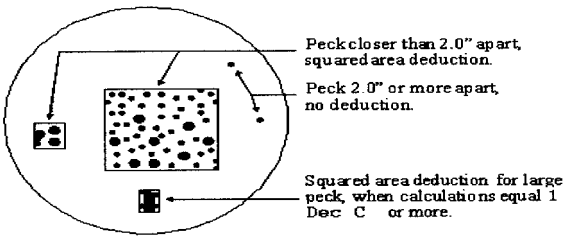
33.1f - Exhibit 01
Pecky Rot Arrangements



2. Defect Deduction Methods

The following exhibit is an example of Squared Area Method:

33.1f - Exhibit 02
Pecky Rot Squared Area Method

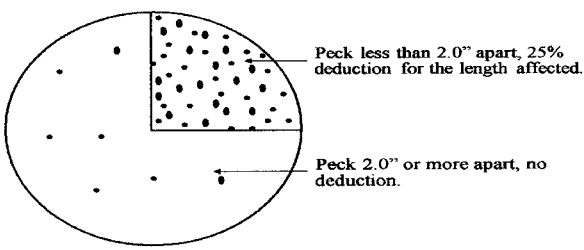


First, calculate largest squared area; taking each subsequent squared area at right angles.

When edges of squares result in squared areas closer than 2.0", use the give and take method to obtain squared area dimensions for the entire area affected by pecky rot.

Percent Deduction Method:

33.1f - Exhibit 03
Pecky Rot Percent Deduction Method



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3. Extent of Pecky Rot

In the absence of other indicators, use the following rules to determine extent of pecky rot.

Single Segment Logs

(1) When only one end contains pecky rot, calculate and extend the actual dimensions, including waste, of any deductible peck through one-half of the segment length in even, two foot multiple

For example:

33.1f - Exhibit 04
Figures a & b - Pecky Rot One End, Single Segment Log

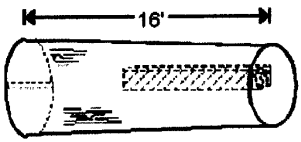


Figure a:
Butt Log
Extended defect dimensions (10" x 10") through one-half of segment (8').

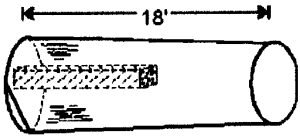


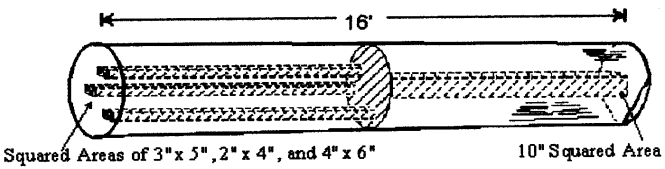
Figure b:
Second Cut
Extended defect dimensions (10" x 10") through one-half of segment (9') in even, two foot multiples, rounding whole.

(2) When both ends contain pecky rot and the defect on each end can be contained using one squared area dimension, calculate the average squared dimension and extend through the segment length.

(3) When both ends contain pecky rot and the defect dimensions on one or both ends result in two or more squared areas, extend each defect through one-half of the segment length.

For example:

33.1f - Exhibit 05
Pecky Rot Both Ends, Multiple Squared Areas, Single Segment Log



Extend defect dimensions, including waste, through half segment length (8').

Extend defect dimensions the segment through one-half the one- the segment length (8').

Two Segment Second Cut Logs

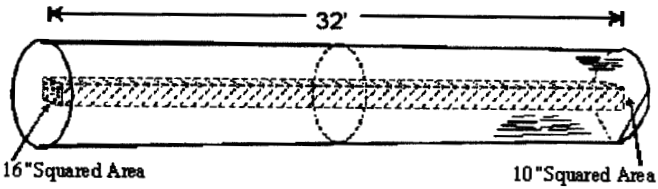
(1) When only the small end is affected by deductible peck, calculate and extend the actual dimensions, including waste, through the small end segment only.

(2) When only the large end is affected by deductible peck, calculate and extend the actual dimensions, including waste, through the large end segment only.

(3) When both ends contain pecky rot and the defect on each end can be contained using one squared area dimension, calculate the average squared dimension including waste, and extend through the length of each segment.

For example:

33.1f - Exhibit 06
Pecky Rot Both Ends, One Squared Area, Two Segment Second Cut Log

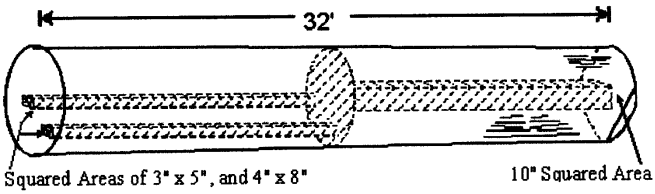


Extend averaged dimensions (17" x 17" on large end and 11" x 11" on small end, for an average of 14" at the mid - point)

(4) When both ends contain pecky rot and defect dimensions on one or both ends result in two or more squared areas, extend each defect through the length of the segment.

For example:

33.1f - Exhibit 07
Pecky Rot Both Ends, Multiple Squared Areas, Two Segment Second Cut Log



(5) Exception:

When in the scaler's judgment the pecky rot is clearing up or when the individual pecks are small and not expected to extend through the segment length, extend actual dimensions through one-half segment only.

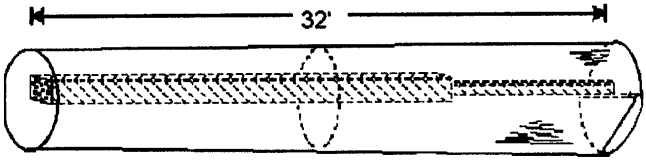
c. Two Segment Butt Logs

(1) Merchantable Butt Logs

(a) When both ends are affected by deductible peck, calculate and extend the actual dimensions including waste, of the small end deductible peck through the length of the small end segment and one-half the length of the butt (large) end segment. Extend the actual dimensions including waste of any deductible peck on the butt through the remaining one-half length of the butt (large) end segment.

For example:

33.1f - Exhibit 08
Pecky Rot Both Ends, Merchantable Two Segment Butt Log



Extend actual dimensions (10" x 10" on small end), plus waste, through the length of the small end segment (16'), and one-half the length of the butt (large) end segment (8'). Extend actual dimensions (4" x 5" on the butt end) plus waste, through on-half the length of the butt (large) end segment.

(b) When only the butt (large) end segment is affected by deductible peck, calculate and extend actual dimensions of any deductible peck through the length of the butt (large) end segment only.

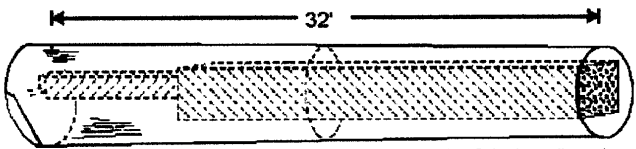
(2) Cull Segments, Butt Logs

(a) When the small end is affected by deductible peck, covering an area large enough to result in less than the contract minimum net scale recovery, cull the small end segment and one-half the length of the butt (large) end segment. Extend the actual dimensions, including waste, of any deductible peck showing on the butt through the remaining length (one-half) of the butt (large) end segment. To determine if the butt (large)

end segment is cull, compute the volume for each defect [include culled one-half butt (large) end segment], and then add them together. If the combined defect results in a net volume in the butt segment that is less than the contract minimum net scale recovery, cull the butt (large) end segment.

For example:

33.1f - Exhibit 09
Pecky Rot Both Ends (Cull Small End Segment), Two Segment Butt Log

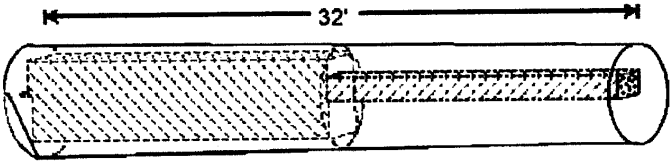


Cull small end segment (16') and one - half the length of the butt (large) end segment (8'). Extend actual dimensions (10" x 10" on butt end, plus waste), through the remaining length of the butt (large) end segment (8').

(b) When the large end segment is affected by deductible peck covering an area large enough to result in less than the contract minimum net scale recovery, cull the large end segment. Extend the actual dimensions, plus waste, of any deductible peck showing on the small end through the length of the segment.

For example:

33.1f - Exhibit 10
Pecky Rot Both Ends (cull large end segment), Two Segment Butt Log



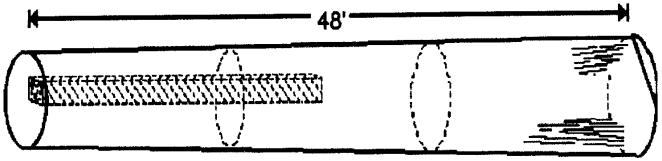
Cull butt (large) end segment (16'). Extend actual dimensions (10" x 10" on small end), plus waste, through small end segment (16').

d. Three Segment Second Cut Logs

(1) When only the small end is affected by deductible peck, calculate and extend the actual dimensions, plus waste, of any deductible peck through the length of the small end segment and one-half the length of the middle segment.

For example:

33.1f - Exhibit 11
Pecky Rot Small End Only,
Three Segment Second Cut Log



Extend actual dimensions (10"x 10" on small end), including waste, through the small end segment (16'), and one-half of middle segment (8').

(2) When only the large end is affected by deductible peck, calculate and extend the actual dimensions, plus waste, of any deductible peck through the length of the large end segment and one-half the length of the middle segment.

(3) When both ends are affected by deductible peck and the defect on each end can be contained using one squared area dimension, calculate the average squared dimension for each segment and extend through the length of each segment.

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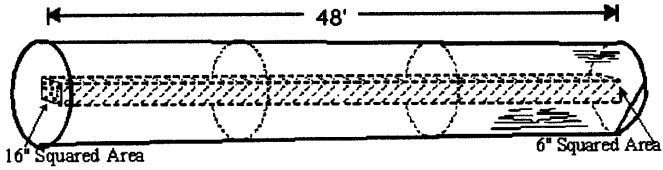
For example:

33.1f - Exhibit 12
Pecky Rot Both Ends, One Squared Area, Three Segment Second Cut Log



Average squared dimension for each segment and extend through the length of each segment.

(4) When both ends are affected by deductible peck and the defect on one or both ends results in two or more squared areas, calculate and extend the actual dimensions of each deductible squared area through the length of each end segment and one-half the length of the middle segment.

(5) Exception:

When in the scaler's judgment the pecky rot is clearing up or when the individual pecks are small and not expected to extend through the segment length, extend actual dimensions through one-half segment only.

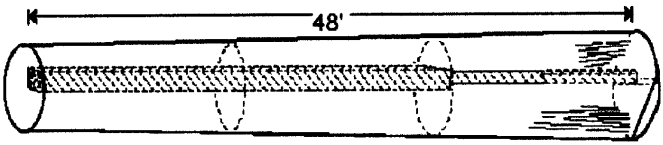
e. Three Segment Butt Logs

(1) Merchantable Butt Logs

(a) When both ends are affected by deductible peck, calculate and extend the actual dimensions, including waste, of any deductible peck on the small end through the length of the small end and middle segments. Extend the actual dimensions of any deductible peck on the butt through the remaining length of the butt (large) end segment.

For example:

33.1f - Exhibit 13
Pecky Rot Both Ends, Merchantable Three Segment Butt Log



Extend actual dimensions (10" x 10" on small end, plus waste) through the length of the small end segment (16') and middle segment (16'). Extend actual dimensions (4" x 5" on the butt end, plus waste) through the length of the butt (large) end segment (16').

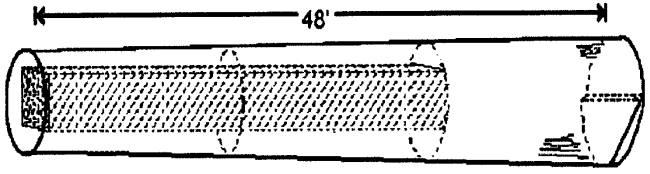
(b) When only the butt (large) end is affected by deductible peck, calculate and extend the actual dimensions, plus waste, of any deductible peck through the butt (large) end segment only.

(2) Cull Segments, Butt Logs

(a) When the small end is affected by deductible peck, covering an area large enough to result in less than the contract minimum net scale recovery, cull the small end segment and the middle segment.

For example:

33.1f - Exhibit 14
Pecky Rot Small End Only,
Three Segment Butt Log With Cull



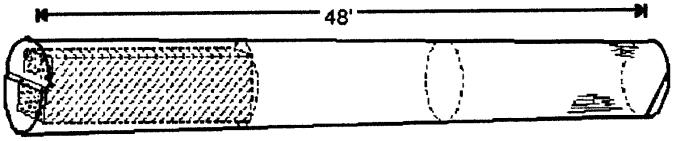
Cull small end segment (16'), middle segment (16'0).

Extend any other defects showing on the butt (large) end through the remaining length of the butt (large) end segment.

(b) When the butt (large) end is affected by deductible peck, covering an area large enough to result in less than the contract minimum net scale recovery, cull the large end segment only.

For example:

33.1f - Exhibit 15
Pecky Rot Large End Only,
Three Segment Butt Log With Cull



Cull butt (large) end segment (16').

(c) When both ends are affected by deductible peck, and the butt end has deductible peck covering an area large enough to result in less than the contract minimum net scale recovery, cull the large end segment only. Calculate and extend the actual dimnsions, plus waste, of any deductible peck on the small end through the length of the small end and middle segments.

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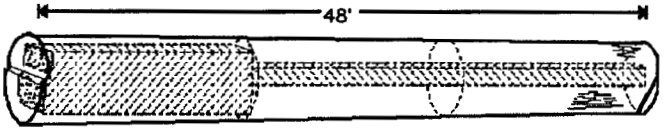
For example:

33.1f - Exhibit 16
Pecky Rot Both Ends, Three Segment Butt Log With Cull



Cull butt (large) end segment (16'). Extend actual dimensions (10" x 10" on small end), plus waste, through the length of the small end segment (16') and the middle segment (16').

33.2 - Voids

33.2a - Catface

Scars or wounds, often caused by falling objects scraping against a tree, are generally called catfaces. When shallow in depth and removable with the slab, they need no deduction. When they penetrate deeper into the log, use the pie-cut method.

For catfaces similar to sap rot, determine how much of the surface of the scaling cylinder is affected and apply a diameter cut.

Exhibit 01 illustrates a 16-foot log with a deep and partially grown-over catface. The defect is 10 feet long and is confined to a quarter section of the log. The diameter at the small end of the log is 17 inches. The gross scale of a 10-foot log, 17 inches in diameter, is 120 or 12 Decimal. The deduction for defect would be 1/4 of 12 or 3 Decimal.

33.2a - Exhibit 01
Catface - Pie-cut Method

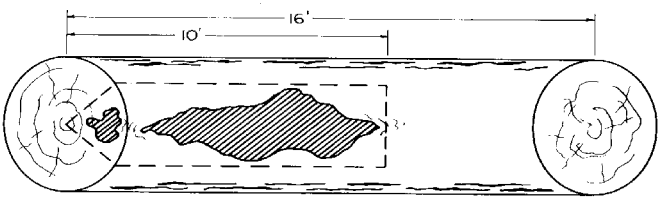
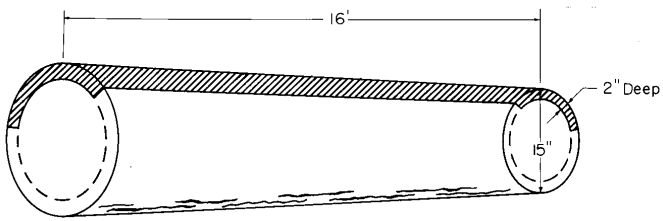


Exhibit 02 illustrates a 16-foot log with a catface extending the entire length. The catface is 2 inches deep and covers 1/3 the circumference. The small diameter of the log is 15 inches and the gross scale 140 or 14. The defect is determined by subtracting the scale of an 11-inch log (diameter of core) from the gross scale and dividing by 3. Example: (14-7) ÷ 3 = 2.

33.2a - Exhibit 02
Catface - Diameter-deduction Method



Watch for massed pitch, wormholes, and rot in conjunction with catface. If ants are present, they are usually an indication of a deep dry rot somewhere within the log.

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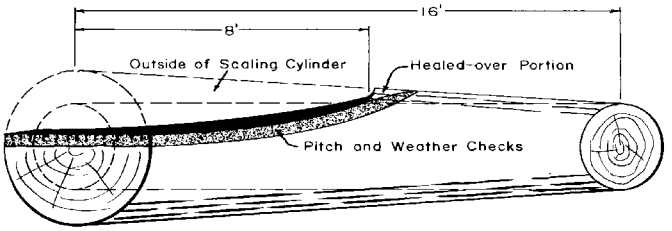
33.2b - Fire Scar

Fire scars are usually found only in butt logs, but occasionally extend into the second 16-foot log. In some species this defect may be accompanied by massed black or red pitch; sometimes by weather checks and wormholes or rot. Part of the scar at the top end may be healed over; consider possible defect here in measuring its length within the scaling cylinder. Mill visits will show how fire scars affect recovery of lumber from local species, timber of different ages, and scars of different ages. Fire scars may also be called catfaces. (See catface.)

Exhibit 01 illustrates a 16-foot log with fire scar extending 8 feet from the butt. Fire scars of this type always have a part of the defect outside the scaling cylinder (not deductible) and therefore appear more serious than they are actually.

Use a combination of pie cut and length of defect. First, estimate what part of the end of the scaling cylinder is affected, then what length is lost by defect. In the illustration half of the cross section of the scaling cylinder might be affected for 8 feet in length. Deduct 1/2 of the 8 feet or 4 feet in length. Net scale is that of a log 12 feet long.

33.2b - Exhibit 01
Fire Scar in Butt Log - Combination Pie and Length of Defect Method



33.2c - Lightning Scar

The spiral effect of lightning scars, sometimes with shatter, massed pitch, wormholes, and weather checks, presents a difficult scaling problem. The degree of spiral and volume loss varies. Give consideration to short-length lumber the log will produce.

The following alternate method may be used for the more difficult problems:

1. Determine degree of spiral over the entire log (as 1/4, 1/3, 1/2, 2/3). Consider recovery of short-length lumber and taper.

2. Obtain gross scale of the log.

3. Measure depth of scar. Include massed pitch and other defects if present.

4. Double the scar depth (for both sides, sec. A) and subtract from log diameter. This result is diameter of section B.

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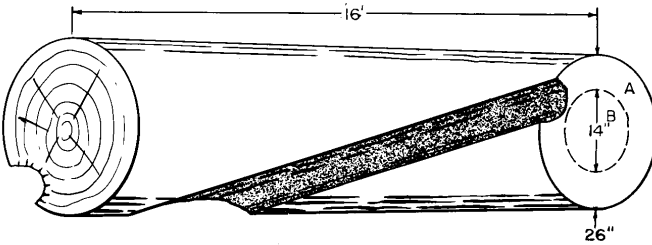
33.2c - Exhibit 01
Lightning-scar Deduction



5. Obtain volume of section B and subtract from gross volume of the log for the gross deduction if the entire collar, section A, were lost.

6. Judge how much of this collar is lost. If the spiral went 1/3 the way around the log, only 1/3 would be affected in some way. Short-length-lumber recovery might also reduce the amount lost.

7. Subtract net deduction from gross scale for net scale. Exhibit 12 illustrates a 16-foot by 26-inch log with lightning scar spiral of 1/3 and 6 inches in depth. When the above formula is applied to these figures, the results are:

a. Gross log scale of 16-foot by 26-inch log = 50

b. Depth of scar doubled = 6 plus 6 inches = 12

c. Diameter of unaffected section B = 26 minus 12 inches or 14

d. Volume of section B = (16 feet by 14 inches) = 11

e. Gross deduction = 50 minus 11 = 39

f. Scar affects 1/3 of this "collar" 1/3 of 39 = 13

g. If short-length-lumber recovery and taper allowance in that 1/3 is about 25 percent, reduce the amount of loss 25 percent or about 3.

13 minus 3 = 10

h. Net log scale = 50 minus 10 (Decimal) = 40

Some logs have shallow scars on all sides that are deep enough to cause some loss in the scaling cylinder. Treat this defect the same as sap rot by making a diameter deduction.

Use the pie cut method when lightning scars are deep and affect one face.

33.3 - Breaks and Splits

Breaks and splits are mechanical defects which require special consideration. Modern-day logging, much of it in steep country, will generally result in some damage to the logs when felled, bucked, transported, and handled by various mechanical devices. In many instances this damage may result in a considerable loss of sound timber. Refer to codes 17.5 and 42 if abnormal amounts occur. Broken-end logs (shatter breaks) caused by falling, split or slabbed ends caused by poor bucking or falling, and slivers (stump pull) pulled from logs in falling are the most common types.

Breakage may occur regardless of what precautions are taken; or may result from improper bedding, felling trees across stumps, logs, rocks, or ridges. Accurate determination of the extent of lengthwise shattering is often difficult as it may be hidden by bark. Remove enough bark to insure inclusion of the entire defect in the deduction.

Buckers should usually leave some breakage in a log to avoid waste.

Lengths of broken-end logs are determined as follows:

1. Where the broken end is wholly or partly bucked, measure the log from saw cut to saw cut and make any required deduction (ex. 01, figure a).

2. When only one end is bucked, determine the most applicable scaling length and make the required deduction (ex. 01, figure b).

3. When neither end is bucked, determine the applicable scaling length and make any required deduction for defect (ex. 01, figure c).

4. When applicable scaling length is determined and the length due to breakage is less than the minimum length stated in the contract, the log is considered unmerchantable due to size. It shall be considered as substandard. Refer to section 55.63 for recording.

33.3 - Exhibit 01
Broken End Partly Bucked
Figure a

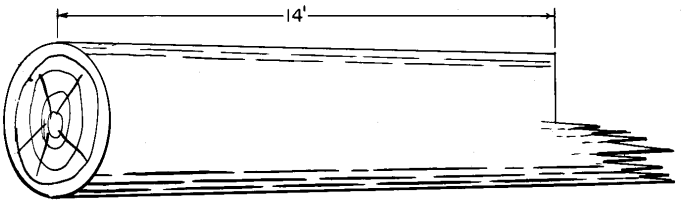


Figure b

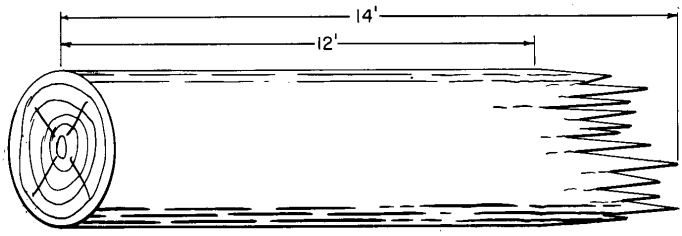
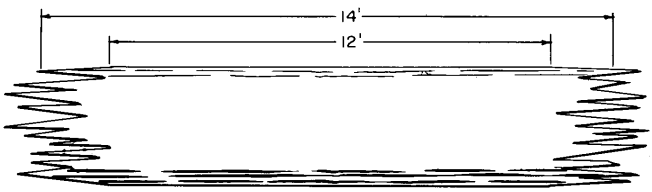


Figure c



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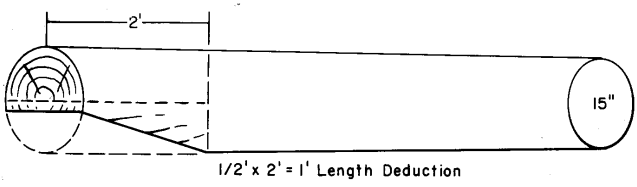
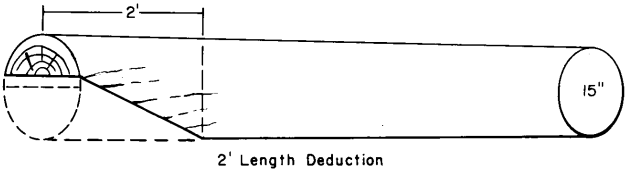
The following deduction procedure should be used to simplify and standardize treatment of broken-end logs:

1. Logs under 16 inches. If a quarter to a half of the end section within the scaling cylinder is gone, deduct half the length affected (Exhibit 02 - figure a). If more than half the end section is gone, consider the entire end lost and deduct for the full length affected (33.3, ex. 02 - fig. b).

33.3 - Exhibit 02
End Break - Small Log Deduction When Half or Less of Log End is Broken
Figure a

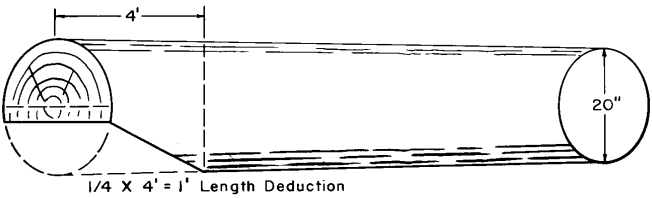


End Break – Small Long Deduction When Over Half of Log End is Broken
Figure b

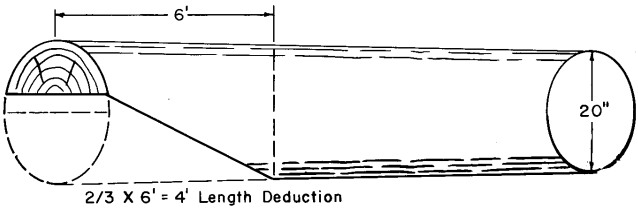


2. Logs 16 inches and over. When any portion of the end section is broken, use a combination of pie-cut and length deduction. See Ex. 03, Fig. a - c.

33.3 - Exhibit 03
End Break - Large Log Deduction When Half or Less of Log End is Broken
Figure a



End Break - Large Log Deduction When Over Half of Log End is Broken
Figure b



Falling and bucking breaks are generally avoidable, but may be caused by rot, by heavy leaning trees on steep slopes, or by some factor not readily apparent to the scaler. Deductions for these defects are generally made by the squared-defect method. Refer to chapter 40, sec. 41.2 for scaling of chunks and slabs.

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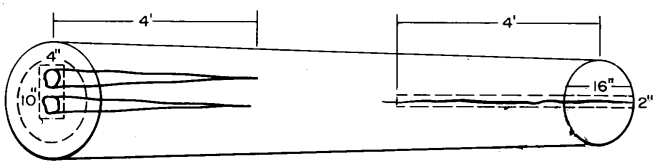
33.3 - Exhibit 03-Continued
Left, Stump Pull - Squared-defect Method Right, Bucker Break (straight) - Squared-defect Method
Figure c



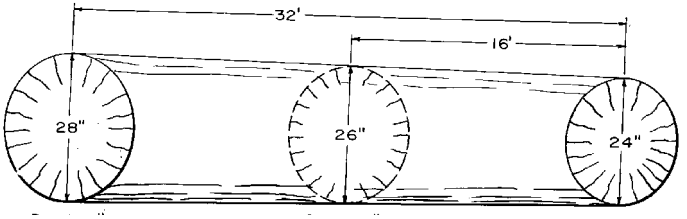
33.4 - Checks

33.4a - Check, Weather

Also known as wind and sun checks. They occur (1) in logs left in the woods or cold decks for an extended period before scaling and (2) in dead trees (snags). Make no deductions for logs that weather check when left in the woods (by the option of the purchaser) or in cold decks. However, make deductions for such logs if the purchaser was not responsible for the condition of the logs as in sales of right-of-way logs already piled, or logs resold to a new purchaser. Instructions to scalers should cover proper procedures when this condition occurs.

Exhibit 01 illustrates a 32-foot log cut from a live tree. End dimensions are 24 and 28 inches, respectively. Weather checks occurred after the tree was felled and bucked in a right-of-way clearing. Such checks usually are about twice the depth at the ends of a log than elsewhere. If these weather checks are deductible (that is, not due to delay in removal by the purchaser), deduct as follows:

33.4a - Exhibit 01
Weather Checks - Diameter-deduction Method



1. Top segment.

   a. Measure the small end diameter of the 32-foot log (24 inches in the illustration).

   b. Measure one-half of the depth of the checks on the small end (3 inches) and multiply by 2 for both sides of the segment (6 inches); this is the gross diameter deduction.

   c. Reduce the diameter of the segment (24 inches) by 6 inches to obtain a net diameter of 18 inches. The net scale then is that of a 16-foot log 18 inches in diameter, 210 board feet or 21.

2. Butt segment. In the top segment the gross diameter deduction was 6 inches or a net scale of a log 6 inches less than the diameter at the small end. Do the same thing with the butt segment, but use the midpoint diameter of the long log.

   a. Find the midpoint diameter by use of the taper in the long log. In the illustration the taper is 4 inches from butt to top. Thus the midpoint diameter is 26 inches.

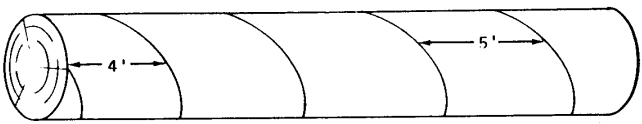
b. Reduce the segment diameter by 6 inches for a net diameter of 20 inches. The net scale then is that of a 16-foot log 20 inches in diameter, 280 board feet or 28.

Where only a fraction of the log surface or end is affected and the checks are deep, use the pie cut method, as shown in figure 14. Where (1) only a fraction of the log surface or end is affected and (2) the checks are confined to the outer surface and are deductible use a percentage or fraction of a diameter deducted for the length affected (fig. 24).

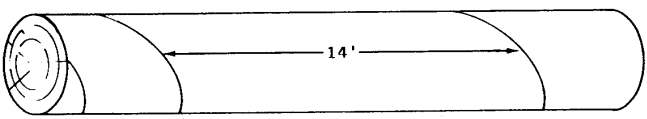
Weather checks found in logs cut from dead trees often are different from those described previously. These checks usually occur before a tree is felled. The depths of the checks in the sides of logs and at midpoint are about as deep as those in the ends. However, because of moisture retained in butts of standing trees, checks in the large end of a butt log may not be as deep as those in the top.

Weather checks often penetrate deep into the center of dead logs. If spiral grained, the log may be cull for sawtimber. However, if the log is straight grained, or the spiral is not severe, consider the possibility of cutting merchantable length lumber between the checks. By mill visits, determine the seriousness of weather checks. The statements above are guides to help in making deductions. To be merchantable, the log must meet net percent of gross stated in the contract. Exhibit 02, figures a and b, illustrate the recovery of merchantable length lumber from spiral-checked logs.

33.4a - Exhibit 02
Log is Cull because 6' Lumber Cannot be Recovered Between Checks
Figure a



Log is Merchantable Because of Recoverable Lumber Between Checks
Figure b



33.4b - Pitch Seam, Heart Check, Frost Cracks

1. Heart check is an opening or separation across the log heart at right angles to the annual rings. When filled with pitch, it is called a pitch seam. Frost cracks are similar to heart checks, except that they are usually visible in the bark and extend from the outside of the log to the heart. Often these defects run farther lengthwise than do pitch rings. Normally make deductions for seams, checks, and frost cracks by the squared-defect method.

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A word of caution in measuring the width of this type of defect; Search for "breakouts" or branches from the main check or seam. These are sometimes difficult to see, especially when log ends are wet. The minimum width of a check is 1 inch. This results in a width of 2 inches for squared defect calculations when the inch is added for waste.

33.4b - Exhibit 01
Heart Check - Squared-defect Method

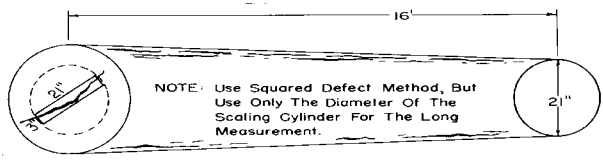
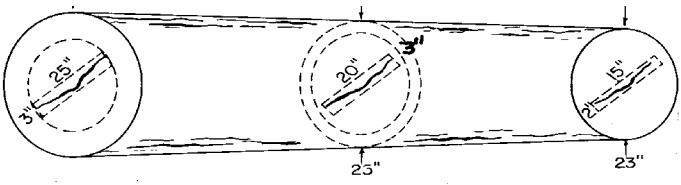


Exhibit 01 illustrates a 16-foot butt log with a heart check in the large end. Top diameter of the log is 21 inches. The actual height of the check is 23 inches, but do not add an inch for waste to this dimension. Use 21 inches (the diameter of the scaling cylinder) for the height and 3 inches for the width. The width measurement includes the 1 inch allowed for waste. The estimated depth of penetration in the log is 8 feet. The squared-defect method (sec. 22.4) then gives 3 by 21 = 63 or a deduction of 7 for a 16-foot length. One-half of this gives 4 (Decimal), the deduction for 8 feet of penetration.

2. When the check shows on both ends and apparently extends straight through the log without twisting, deduct as for heart rot: For 16- to 20-foot logs, average the end defect dimensions. For logs shorter than 16 feet, use the large end dimensions unless the Regional Forester prescribes otherwise. For logs longer than 20 feet, follow the deduction rules described under section 22.5. This includes the use of the alternative method explained under section 22.5, item 3c.

33.4b - Exhibit 02
Heart Check in 32-foot Log - Squared-defect Method



This exhibit illustrates a 32-foot butt log with heart check showing on both ends and in the same position. Small diameter of the 32-foot log is 23 inches, and midpoint diameter 25 inches. End dimensions of the defect in the 32-foot log are 2 by 15 inches and 3 by 25 inches, respectively, including waste. When dimensions of 15 and 25 inches are averaged the midpoint dimension is 20 inches.

Use 3 inches for the estimated width at the midpoint. For the butt segment, average 3 by 20 inches and 3 by 25 inches; result, 3 by 23 inches. For the top segment, average 2 by 15 inches and 3 by 20 inches; result, 3 by 18 inches. The squared-defect method (code 22.5) then gives the following deductions: Butt segment, 3 x 23 = 69 or 70 or 7. Top segment: 3 x 18 = 54 or 60 board feet (6 Decimal).

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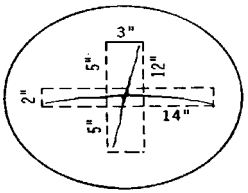
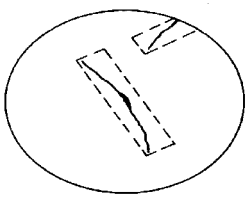
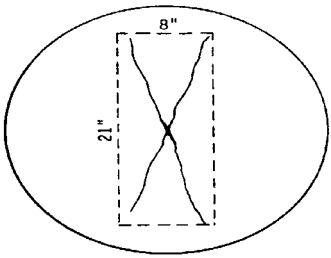
33.4b - Exhibit 03
Method for Making Deductions for Cross-checking



Deduct 2" x 14" = 28 = 3
3" x 10" = 30 = 4
Total Deduction 16' Log = 7



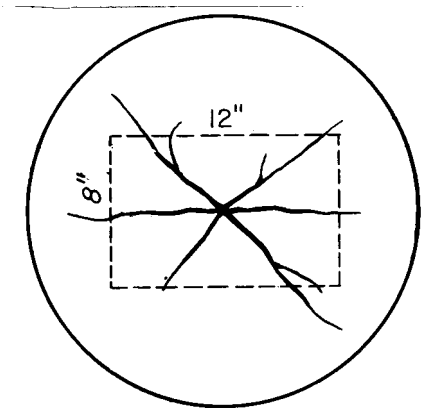


3. Deductions for two cross-checks are made as explained in item 2 preceding. In measuring height of the second check, do not include the width of the first check measured. Diagram separate checks at right angles. The “give and take” procedure explained in item 4 may also be used in determining the deduction for two cross-checks. Use the “give and take” procedure when diagramming at right angles creates a loss of recoverable material in the squared defect area of the checks.

4. Deductions for more than two, cross-checks (called multiple checks or spangle) are usually made using the squared-defect method unless the defect is large and results in a length-deduction. Some recovery might show between the ends of the check. Use the “give and take” procedures when squaring out this type of defect.

In exhibit 04 below, note that some recovery appears between the square (the "give" area). This is offset by the loss in the check ends outside the square (the "take" area).

33.4b - Exhibit 04
Multiple Checks and Pitch Spangles - Squared-defect Method



5. Heart checks and pitch seams showing on both ends of a log at different angles indicate twist. Obviously the loss here is greater than when the check is straight. The twist causes the production of short-length lumber, some of it less than 6 feet. Consider the amount of twist when deducting for this defect. If the twist is 45°, use 1.5 times the deduction for a straight check. If the twist is 90°, double the deduction for a straight check.

On one log end, place a small stick in the bark parallel to the check. This helps determine if any twist is present when you are at the other end.

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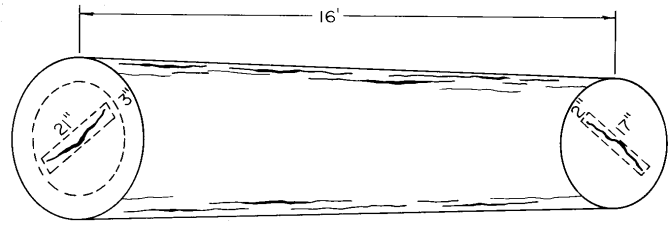
This exhibit illustrates a 16-foot log with a 2- by 20-inch heart check showing on the butt end. The same check at the top end is 1 by 16 inches, but shows a 90∞ twist. After adding 1 inch for waste and averaging the defects (3 by 21 and 2 by 17), the squared-defect method (code 22.5) gives 3 x 19=57, or a deduction of 6 for a 16-foot log with a straight check. Adjusting for the 90∞ twist, the actual deduction for the log will be 6 x 2 or 12.

33.4b - Exhibit 05
Heart Check With 90° Twist - Squared-defect Method



The next exhibit illustrates a 32-foot log with a heart check showing on both ends. End measurements of the defect are 3 by 21 inches and 2 by 12 inches, including waste. The check on the top end indicates a 90∞ twist from that showing on the butt end. By using the squared-defect method (sec. 22.5), the defect is computed as follows:

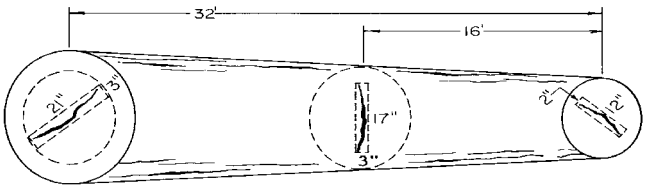
Average end defects (3 by 21 and 2 by 12 inches) to obtain dimensions of defect in the center of the log (3 by 17 inches).

Determine defect for each scaling length by averaging end defects and adjusting for twist (45 degrees in each segment).

3 by 21 and 3 by 17 average 3 by 19 inches.

Use 3 x 19 = 57 or a deduction of 6 for the 16-foot length for the butt segment if the check was straight.

33.4b - Exhibit 06
Heart Check With 90º Twist in 32-foot Log; 45º Twist in 16-foot Log – Squared-defect Method



Adjusting for the twist, the actual deduction for the butt segment will be 6 x 1.5, or 9.

3 by 17 and 2 by 12 average 3 by 15 inches.

Use 3 x 15 = 45 or a deduction of 5 for the 16-foot length of the top segment if the check was straight. Adjusting for the twist, the deduction for the top segment will be 5 x 1.5 or 8. The total defect deduction for the 32-foot log is 17.

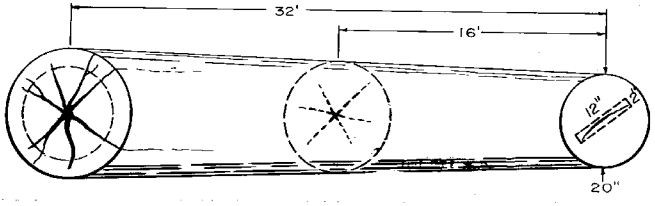
6. When logs are exposed to the sun and wind for an extended period, weather or seasoning checks often occur in the ends. The scaler must learn to detect this type because he makes no deduction for them (see Checks, Weather). Such checks often increase in length due to weather. Use a thin wire or knife blade on doubtful checks to determine the type. Look for sawdust in checks. Sometimes this is an indication of a natural heart check.

7. For multiple frost cracks, see Pitch Spangle.

33.4c - Pitch Spangle

When more than two pitch seams occur in the large ends of butt logs, the defect is called a pitch spangle. Douglas-fir and western larch are species commonly affected. Breakouts from the seams often occur. Sometimes pitch rings occur in connection with pitch seams. Defect of this type causes heavy loss in lumber manufacture. Sometimes a part of the defect extends into the second log.

33.4c - Exhibit 01
Pitch Spangle Deductions in 32-foot Log; Butt Segment - Length-deduction Method Top Segment - Length-deduction Method for Large End; Squared-defect Method for Small End



Make length-cut deductions for pitch spangles in the butt 16-foot log when the size of the spangle approaches the scaling diameter. For other logs, use the squared-defect method, as you would for multiple checks.

This exhibit illustrates a 32-foot, 20-inch log with pitch spangle. The entire scaling cylinder is affected because the seams extend beyond its edges. Some defect shows on the small end of the 32-foot log indicating the defect is greater at the 16-foot point and not as great as

in the butt end. In the illustration the butt 16-foot segment is highly defective, more than 50 percent. If the contract merchantability clause specifies 50 percent, this log is cull. If 33 1/3 percent, this log may be marginally merchantable.

If mill visits indicate that pitch spangle cuts out this way, treat the top 16-foot log as follows: Judge the large end defect as 50 percent of the scaling cylinder and the length of penetration as 8 feet. Deduct half of the 8 feet affected or 4 feet for the large end. For the small end, apply the squared-defect method and use 8 feet for the length. Compute the deduction for each, add, and then compute the net scale of the log.

Refer to examples included under Pitch Seam, Heart Check, Frost Cracks for alternate procedures for determining the volume of a top log.

33.5 - Pitch Ring, Shake Ring

33.5a - Rings, Pitch and Shake

1. Ring shake defect is the separation of one or more annual rings sufficient to cause a volume loss in manufacture. This separation is known as a pitch ring when it becomes filled with pitch, often a characteristics of species like Douglas-fir and larch.

2. Shake ring defects follow the annual rings. Sometimes they stop where knots start, for knots tend to hold the annual rings together. On some logs the length of pitch rings is shown by a narrow scar or pitchy seam running lengthwise in the bark. A scaler must look closely at log ends to locate rings and determine their size and shape. He should bear in mind that a ring that opens wide may have deep penetration into the log and that numerous rings may penetrate

deeper than one or two rings. Make no deductions for rings outside the scaling cylinder, but rings in the large end of logs that enter the scaling cylinder will need defect deductions. It is important for the scaler to make sawmill visits to develop judgment in making ring shake deductions.

3. The need for considering the number of rings, ring location, ring class, ring taper, and the scale of any solid core often makes pitch and shake rings a complex scaling problem.

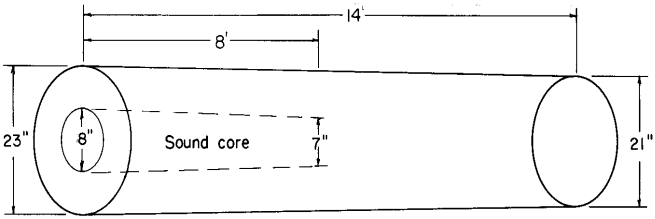
4. The basic procedure for scaling pitch and shake rings is to square the defect and replace a sound core. Rings are measured and averaged for size in the same manner as log diameters (sec. 17.3).

This rule in formula is:

Logs to 14 feet inclusive: $(\text{large ring} + 1)^2$ - (core ring scale)

Logs 16 to 20 feet inclusive: $(\text{average ring} + 1)^2$ - (core ring scale)

33.5a - Exhibit 01
Shake Ring in Large End



Example 1: A 14-foot log 21 inches in diameter has an 8-inch shake ring showing in the large end. The defect extends an estimated 8 feet.

Using the shortcut procedure (sec. 22.4), deduct as follows:

9 x 9 = 81 to the next higher 10 = 90 board feet

90 x 8/16 = 45 to the nearest 10 = 50 board feet

Replace 7-inch core (allow 1-inch taper), 8 feet long

Deduction = 50 - 10 or 40 board feet (4 Decimal)

(This is easy to compute with the Coconino scale stick.)

Example 2: A 16-foot log has a 6-inch shake ring showing at the small end and an 8-inch shake ring showing at the large end. Adding 1 inch for waste and averaging the defect (sec. 22.5):
8 x 8 = 64 to the next higher 10 = 70 board feet

Replaced 6-inch log = 20 board feet

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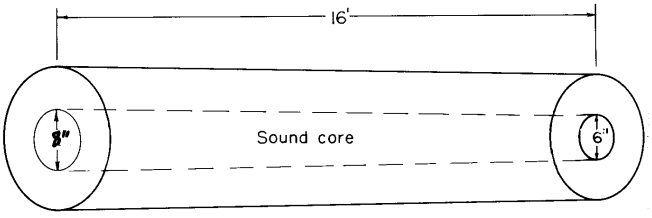
Deduction = 70 - 20 or 50 board feet (5 Decimal)

(This is easy to compute with the Coconino scale stick.)

33.5a - Exhibit 02
Shake Ring in Both Ends



5. Following are instructions for varying the above procedure in accordance with the circumstances encountered.

a. For one-quarter rings, use the squared-defect method as for checks and do not consider core.

b. For a half ring, take half the deduction for a full ring for the length affected.

c. For a three-quarter ring, take three-quarters of the deduction for a full ring for the length affected.

d. When 2 full rings are not more than 2.5 inches apart, measure diameter of the outside ring. Add 1 inch. Apply squared-defect method for gross deduction. Reduce this by the scale of a log with a diameter of the inner ring.

e. When 2 full rings are over 2.5 inches apart, measure diameters of both rings. Compute separately as per preceding examples and add deductions together.

Example 3: A 16-foot log has 6-inch and 16-inch shake rings showing at the small end and 8-inch and 18-inch rings showing at the large end. Adding 1 inch for waste and averaging the defect:

18 x 18 = 324 + (sec. 22.2) to the next higher 10 =

330 + 20 (For 17" to 21" squares) = 350

Replaced 16-inch log = 160

Deduction for large ring = 350 - 160 or 190 (19 Decimal)

8 x 8 = 64 to the next higher 10 = 70

Replaced 6-inch log = 20

Deduction for small ring 70 - 20 or 50 (5 Decimal)

Total deduction 240 board feet or 24

(This is easy to compute with the Coconino scale stick.)

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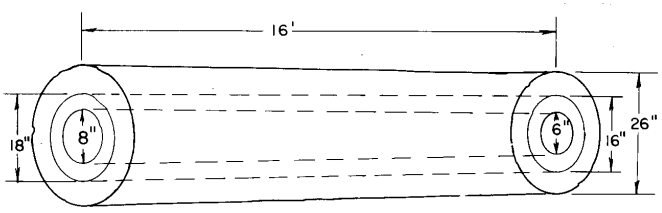
33.5a - Exhibit 03
Two Full Rings Over 2.5 Inches Apart

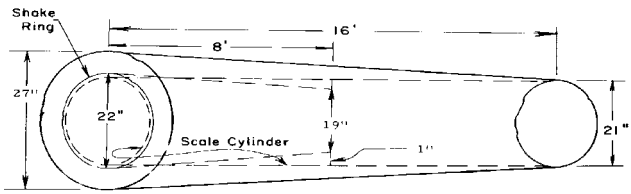


f. When multiple rings occur with no recovery between them, square the overall defect and allow for the scale of any inside log surrounded by the rings.

g. For a full or partial ring 2.5 inches or less from the outside at the top end, a perimeter ring, deduct by the diameter deduction method for the portion of the circumference and length affected.

Example 4: A 16-foot log 21 inches in diameter has a 22-inch shake ring showing in the large end. The defect extends an estimated 8 feet to where the estimated ring diameter is 19 inches. It is thus a perimeter ring at this point and a diameter reduction is used. An 8-foot log 21 inches in diameter scales 150 board feet; an 8-foot log 19 inches in diameter scales 120 board feet. The deduction is 30 board feet or 3.

33.5a - Exhibit 04
Perimeter Deduction in Stump Cut



h. Make a length deduction if deductions by the squared-defect method exceed the log scale of the part affected.

i. Do not replace the core in determining the defect when the core is too small (normally less than 6 inches) to yield standard-sized lumber.

6. The scaler must remember to follow instructions for application of the squared-defect method (sec. 22.3) in determining which measurements to use. They should also be aware that ring defects follow annual rings and taper, and remember to treat each core as a new scaling cylinder.

7. A Pitch and Shake Ring Deduction Table for 16-, 18-, and 20-foot logs with rings showing on both ends (table VI in the appendix chapter) can be used instead of making the several calculations normally required. The table is for use in scaling with the Scribner Decimal C rule and provides for taper up to 8 inches.

8. Breakouts from a shake ring sometimes occur. These numerous short radial seams usually are found in a “collar” on the outside of the ring. Obtain the average length of the seams. If 2.5

inches or less (the collar thickness) follow the deduction rule as explained in the preceding item 5. If seams are over 2.5 inches long, determine how much of the collar is affected-a third, half, or all-and use the multiple-ring rule as explained in item 5.

9. Sometimes pockets occur in annual rings. In some softwood species they are called pitch pockets.

In some hardwood species they are referred to as gum pockets. Usually there is a separation present but the pockets are too short to cause a volume loss. Make no deduction for these pockets unless they are long enough to square out for a deduction of 10 board feet or are so numerous as to cause an actual loss in lumber recovery.

10. In white fir and hemlock a combination of ring and radial shake is common in some areas. The combination often requires a length deduction. Frost cracks, splits, or seams on the outside of the log often indicate the extent or condition.

33.5b - Pitch, Massed

Massed Pitch is defined as an accumulation of solid pitch. Often massed pitch occurs in connection with fire scars and may extend beyond the scar at the top end. The concentration of pitch must be sufficient enough to cause an actual loss of merchantable lumber before any deduction is made. No deduction is made for wood lightly saturated with pitch because such material can be utilized in certain grades of lumber.

33.5c - Pitch Pockets

Defined as small, scattered crescent shaped areas of pitch (usually 1 or 2 inches in length) that are occasionally present in some species of logs. This condition is rare, but when it does occur, it is usually found in the butt logs of pine species.

No deduction is made for this condition because scattered pitch pockets rarely if ever result in a volume loss of merchantable lumber. Certain grades of lumber allow for the presence of pitch. A deduction may be made if an extreme concentration of pitch pockets is enough to cause an actual loss of merchantable lumber.

33.6 - Crook, Pistol Butt and Sweep

33.6a - Crook and Pistol Butt

When a log has an abrupt curve or bend, the defect is called crook. When crook is present in the butt end of the log, the defect is called pistol butt defect. Deductions are made for void, cross grain and any portion that will not produce 6-foot lumber recovery on either side of the crook.

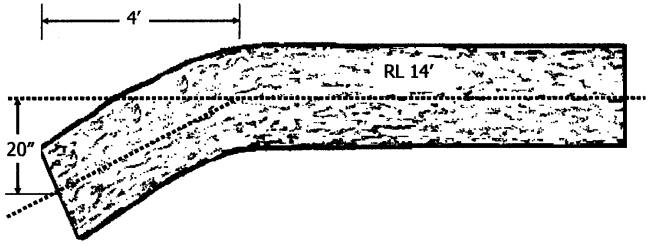
One type of crook is found in logs from upper portions of trees. Snow or falling trees that break off tops of other trees can cause this defect. Before a new leader starts, rot and black massed pitch may enter the wound. The new leader may die, leaving a large sucker-type dead knot. Breakage may occur at this point due to weakness caused by cross grain.

Cross grain material is defined as grain deviation that exceeds 3 inches per foot from straight. Measure grain deviation by projecting a straight line down the center of the segment starting from the longest

straight portion. Measure the distance between the projected straight line and the centerline of the crook portion for the length affected. If the deviation exceeds 3 inches per foot it is considered cross grain and the entire length affected by crook is deducted using a length deduction.

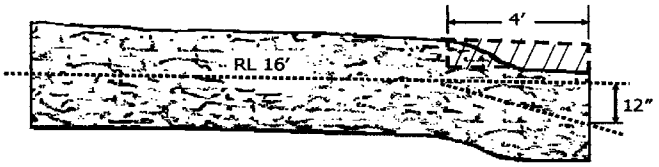
If cross grain material is not present, determine the percent loss for void and include the portion of the log that will not produce standard length lumber in the manufacturing process for the deduction.

33.6a - Exhibit 01
Crook - Length Deduction for Cross Grain



In this exhibit, 4 feet of length is affected by crook. Grain deviation measures 20 inches in 4 feet, or 5 inches in 1 foot, which exceeds 3 inches per foot. Due to cross grain, the length deduction is the full 4 feet.

33.6a - Exhibit 02
Crook - Length Deduction for Void



In this exhibit, 4 feet of length is affected by crook. Grain deviation measures 12 inches in 4 feet, or 3 inches in 1 foot, which does not exceed the allowable deviation. Void and loss due to manufacturing process affects 25% of 4 feet. Length deduction of 25% of 4 feet is taken for void.

If grain deviation had exceeded 3 inches per foot, it would be considered cross grain and a length deduction of 4 feet would be taken for the crook.

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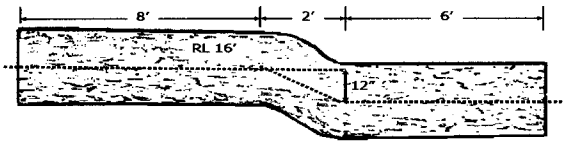
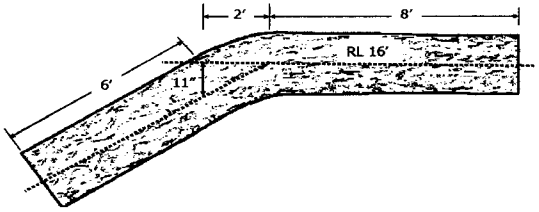
33.6a - Exhibit 03
Crook - Length Deduction for Cross Grain



In this exhibit, 2 feet of length is affected by crook. Grain deviation for the affected 2 feet measures 12 inches, or 6 inches in 1 foot, which exceeds 3 inches per foot. A 6-foot portion and an 8-foot portion remain on either side of the crook and are parallel to, or on the same plane, as each other. The length deduction is the full 2-foot portion containing cross grain. If the remaining portions on either side of the defect would not produce 6-foot lumber recovery or were not parallel and on the same plane, the deduction would include those portions.

33.6a - Exhibit 04
Crook - Length Deduction for Cross Grain and Portion Not on the Same Plane

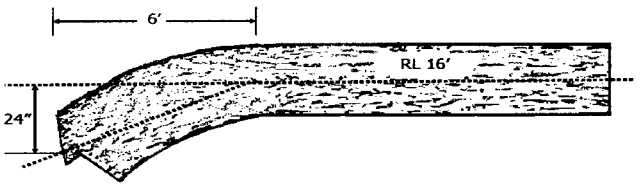


In this exhibit, 2 feet of length is affected by crook. Grain deviation for the affected 2 feet measures 11 inches, or 5.5 inches in 1 foot, which exceeds 3 inches per foot. A 6-foot portion and an 8-foot

portion remain on either side of the crook but since they are not parallel to, or not on the same plane as each other, the defect deduction includes the 6-foot portion. The length deduction is 8 feet; 2 feet for cross grain and 6 feet for the portion not on the same plane.

Trees growing on steep slopes and/or in locations of heavy snowfall are susceptible to pistol butt defect. This condition often results in cross grain material in the affected area.

33.6a - Exhibit 05
Crook - Pistol Butt Defect



In this exhibit, pistol butt defect affects 6 feet of the butt end of this log. Grain deviation measures 24 inches in 6 feet, or 4 inches in 1 foot, which exceeds the allowable 3 inches per foot. The length deduction for pistol butt defect in this example is the entire 6 feet.

33.6b - Sweep

Sweep compared with crook is less abrupt and more continuous. Sweep is often long enough to affect more than one segment. Varying the bucking lengths of logs will often reduce the loss due to sweep. If logs presented for scaling indicate poor bucking practices the scaler will report this to the Contracting Officer. Scalers will deduct for sweep in logs by scaling as presented unless otherwise instructed (sec. 17.5).

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Make deductions for sweep as follows:

1. Position the scaling cylinder in the log segment to maximize volume recovery. The scaling cylinder may extend from either end of the log segment or may be positioned in the center portion.

2. Measure the length of the log affected by sweep.

3. Deduct the fraction of this length lost in sawing, considering standard length lumber recovery.

4. Make a length deduction accordingly.

33.6b - Exhibit 01
Sweep

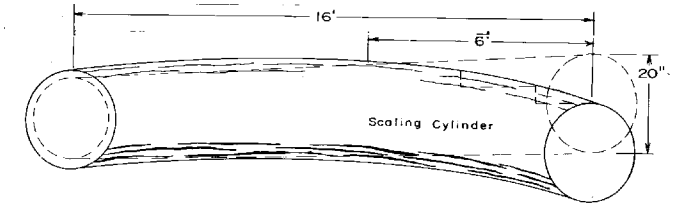
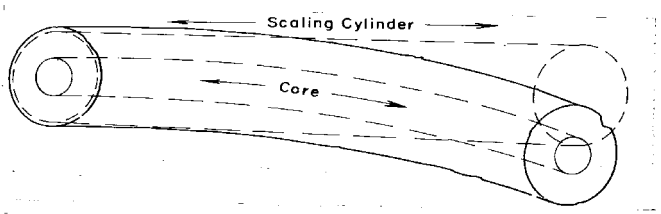


Exhibit 01 illustrates a 16-foot, 20-inch log with sweep affecting 6 feet of the scaling cylinder. It is estimated that one-third of the affected area will be lost in sawing. In this case a 2-foot-length deduction is made.

Sweep in combination with an interior defect such as rot or shake is likely to cause a cull log.

33.6b - Exhibit 02
Sweep in Combination With Shake



33.7 - Knots

Knots are normally a grade defect and are not considered a scaling defect until the knots are oversized where they enter the scaling cylinder, and their numbers and location cause a volume loss in the manufactured product. An extremely knotty log does not automatically create the need for a defect deduction.

Live knots begin to taper immediately under the log surface, whereas dead knots begin to taper at a point where the limb actually died. Volume loss associated with oversize knots occurs in the growth ring area of the knot. Logs with larger knots may produce grain distortion in and around the collarwood area causing additional volume loss due to cross grain material. A volume loss may also occur when oversize knots occur in knot whorls, knot clusters or bunch knots.

Knot clusters may consist of a group of small limbs developed from adventitious buds. It does not affect the volume of lumber produced and is not treated as a defect.

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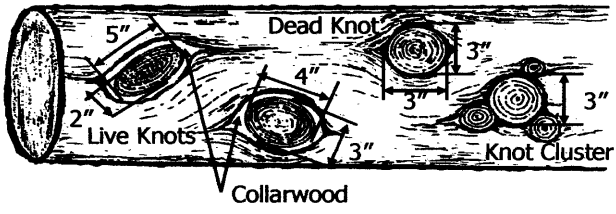
Live and dead knots are considered oversize when they exceed the maximum knot size limit for the diameter ranges shown below. Maximum knot sizes are based on the small end diameter, or scaling cylinder size, of the affected log or segment.

KNOT SIZE LIMIT

Small End Diameter	Max. Live	Max. Dead
5" to 10"	2"	1"
11" to 20"	3"	2"
21" & up	4"	3"

Knots are measured at the surface of the log and size is determined by averaging the narrow and wide measurements of the hardened area of the knot showing growth rings, excluding the collarwood surrounding the knot, as shown in Exhibit 11.

33.7 - Exhibit 02
Determining Knot Size



Make deductions for oversize knots using the Knot Deduction Guide when the entire scaling cylinder is affected with oversize knots. Consider knot location, log taper, percent of circumference and length affected and adjust the deduction outlined in the Deduction Guide to

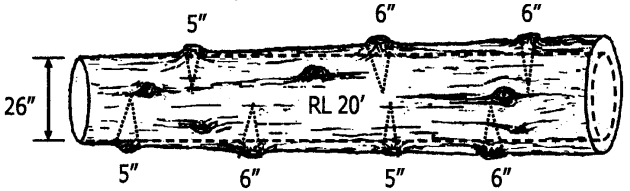
reflect only the loss within the scaling cylinder due to oversize knots. A few scattered oversize knots on a log does not create a volume loss. These deductions for oversize knots are not applicable to Ponderosa Pine, Sugar Pine, and hardwoods.

KNOT DEDUCTION GUIDE

Small End Diameter	*Diameter Deduction
5" to 15"	1"
16" to 25"	2"
26" to 35"	3"
36" to 45"	4"
46" & up	Scaler's judgment

* Reduce the defect volume if entire scaling cylinder or length is not affected.

33.7 - Exhibit 02
Mostly Live Oversize Knots



Given:

Recorded log length = 20 feet
Small end diameter = 26 inches
Live knot size limit = 4 inches.
Live knots, 5 to 6 inches in size, are affecting the entire surface of the log.

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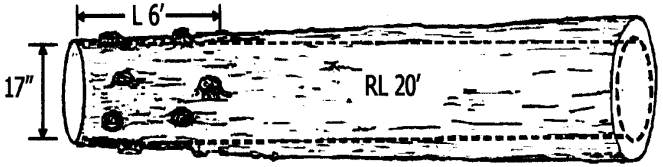
Using the Knot Deduction Guide, a 3-inch diameter deduction is indicated. Log taper is considered and it is determined that the knots would be 5 inches where they enter the scaling cylinder so no adjustment is made to the deduction.

When oversize knots do not affect the entire surface and/or length of the log, the amount of defect deduction will be reduced to represent only that portion of the log that is affected with oversize knots.

33.7 - Exhibit 03
Mostly Dead Oversize Knots



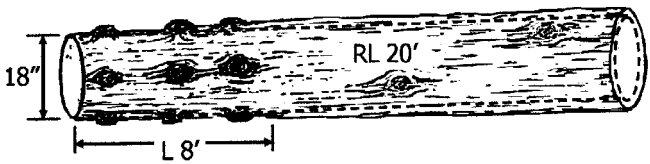
Given:

Recorded log length = 20 feet
Small end diameter = 17 inches
Dead knot size limit = 2”
Mostly dead oversize knots affect two faces, 50%, for 6 feet.

Using the Knot Deduction Guide, a 2-inch diameter deduction is indicated. Adjust the deduction to 1” for 6 feet for the percent and length affected.

Deductions will be made for oversize knots in knot whorls and knot clusters when oversize knots show on one or more faces of the log. Use the Knot Deduction Guide when making the deduction. Reduce the defect deduction for the actual length and faces affected.

33.7 - Exhibit 04
Live Oversize Knots in Knot Whorls



Given:

Recorded log length = 20 feet
Small end diameter = 18 inches
Live knot size limit = 3"
Live oversize knots in whorls affecting 8 feet.

Using the Knot Deduction Guide, a 2-inch diameter deduction is indicated. Adjust the deduction to 2" for 8 feet for the length affected.

33.8 - Other Defects

33.8a - Burls

1. Burls are dome-shaped growths of various sizes found on tree trunks. At times they penetrate into logs as far as their height above the log surface. When burls cover about 1/4 the circumference of a log, make a length deduction to cover the volume loss in the affected portion (one-fourth the length of the burl within the scaling cylinder). Usually 1 foot per major burl is sufficient. If the burls are so close together as to prevent the manufacture of merchantable length lumber between them, apply the pie-cut method for the portion of the length affected.

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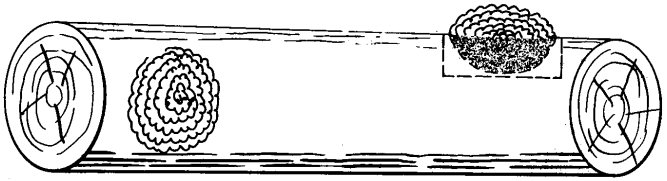
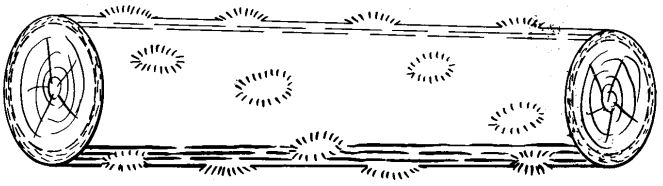
33.8a - Exhibit 01
Burls - Combination Pie-cut and Length-deduction Method



2. Numerous small burls or pitch scabs may contain massed pitch and pitch rings which occur beneath these burls and may cause a loss in the outer portions of logs. A diameter deduction for this defect equal to the depth and portion affected as for sap rot may be equitable but should be checked, and not applied automatically (Exhibit 02 - Figure a). The figure shows areas of defect only. Deductions should include all loss of standard-length lumber.

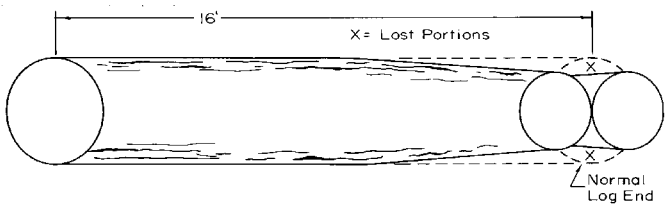
33.8a - Exhibit 02
Numerous Small Burls or Pitch Scabs - Diameter-deduction Method



33.8b - Crotch

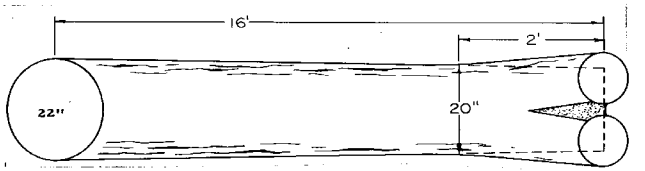
A crotch is the point in a tree where it forks into two or more leaders or stems. Proper bucking can eliminate much of the defect. Usually the loss occurs from a bark seam, split, or cross grain in the end of such logs. Loss may occur from flat sides often characteristics of a crotch condition. A deduction of 1 or 2 feet in length is often made for this type of defect, but the actual deduction depends on observation of loss during mill visits.

33.8b - Exhibit 01
Crotch Log With Characteristic Flat Sides



It may be sufficient merely to square out the bark seam. Amount of deduction depends on the point of bucking. See chapter 10, sec. 17.32 for method of measuring diameters of crotched logs.

33.8b - Exhibit 02
Crotch Log



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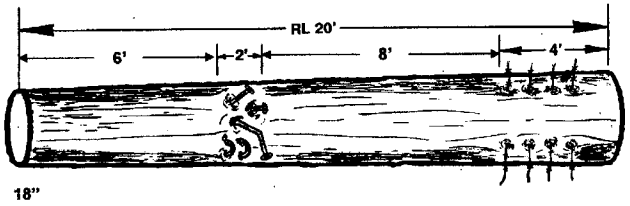
33.8c - Foreign Material

Logs that contain foreign material such as insulators, spikes, nails, staples, wire, rocks, etc., that may create a safety hazard or may damage saw mill equipment when being manufactured, shall be treated as follows:

1. The Scaler should identify the log as a safety hazard by marking the log or by using another identifying method. Inform purchaser, equipment operator or other appropriate person so the log can be set aside.

2. If the foreign material can be readily removed, remove the material or have it removed. If the foreign material cannot be readily removed, make a length deduction in even two foot multiples to eliminate the entire length affected. Since foreign material must be physically bucked out, the remaining portion of the log must meet contract minimum log length after deductions or the log is cull. If the extent of the material in the log cannot be determined, the log may be culled.

33.8c - Exhibit 01
Foreign Material Defect



Foreign material is found in two locations on this 20-foot log. Nails are located approximately 6 feet from the small end. A deduction of 8 feet is necessary to eliminate the length affected by the foreign

material and the portion of the log that is less than the contract minimum log length, which in this example, is 8 feet. The large end has wire embedded in the log 4 feet from the end. A deduction of 4 feet will eliminate the length affected. Eight feet remains between the defected areas. Total deduction for the log is 12 feet.

33.8d - Multiple Defects

More than two types of defect may occur in ends and sides of logs. To apply one or more deduction methods to each defect is often difficult and time consuming, and may result in erroneous deductions. The best method is usually to combine a pie cut with the length of defect on such logs. In some cases, the squared-defect method may be applicable.

33.8d - Exhibit 01
Multiple Defects - Combination Pie-cut and Length of Defect Method

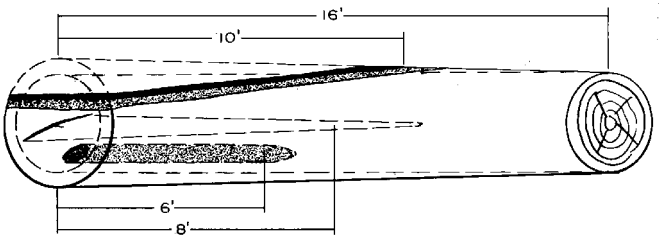


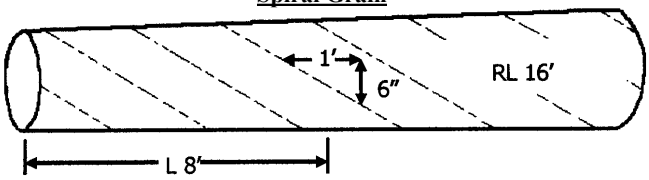
Exhibit 01 illustrates a 16-foot, 24-inch butt log with multiple defects in the large end. First estimate what fraction of the scaling cylinder is affected. About two-thirds of the tree is affected to some extent. Next, estimate the average length of the defects.

Example: Fire scar 10 feet, rot 6 feet, heart check 8 feet, making an average of 8 feet. The deduction then is 2/3 of 8 feet, or a 6-foot-length deduction.

33.8e - Spiral Grain

Any grain distortion that exceeds 3" per foot, or 1" in 4", will require a deduction. Measure spiral grain midway through the affected area. A 1" diameter deduction shall be taken for each inch by which the slope of grain exceeds 3" per foot.

33.8e - Exhibit 01
Spiral Grain



Spiral grain affects the entire log. Grain distortion measures 6" in 1-foot, which results in a diameter deduction of 3 inches.

33.8f – Stain

Stain normally affects quality of lumber recovery rather than quantity. Generally stains are blue or brown. No deduction is made when the stain is firm and light in color, but deduction is made when stain is associated with actual rot and there is a breakdown of the wood. When to make a deduction for stain in some species is difficult to know. Examine dark stain for rot, weather checks, or wormholes. Brown spots are generally an indication of actual rot. See Rot, Sap. Earlier stages of actual breakdown of wood can be determined frequently by driving the corner of a sharp hand-axe bit, or Hallin

hammer, into the end of a log and twisting. If fibers break across, the wood is weakened. Fibers of firm sound wood will cut clean and pull straight out rather than tear or break across.

The significance of mineral stain and firm blackheart varies in different areas. Become familiar with any local guides concerning these indicators.

33.8g - Wormholes

Wormholes are classed as pin size, not over 1/16 inch in diameter; small, not over 1/4 inch in diameter; and large, over 1/4 inch in diameter. Pin and small wormholes are caused by different kinds of beetles; large wormholes by wood borers or grubs. Wormholes are common in logs cut from snags and in some down timber. When found in sap rot, the deduction for rot will also include any deduction for wormholes. When found in connection with catfaces and fire and lightning scars, include large wormholes in the measurements of those defects.

Make deductions only for large (grub) wormholes when they are massed and this condition causes an actual loss of volume. Generally use the pie-cut deduction method. The diameter-deduction method may occasionally be applied when wormholes are uniformly distributed around the log.

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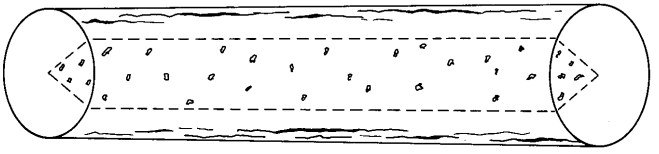
33.8g - Exhibit 01
Grubworm Holes - Pie-cut Method



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41 - LOGS NOT MEETING UTILIZATION SPECIFICATIONS

41.1 - Because of Defect

Cull logs are logs which do not meet utilization standards for net scale as a percent of gross scale under the terms of the contract. Such logs may or may not contain some merchantable material. Usually the removal of cull logs from the sale area is by the option of the purchaser. If cull logs are removed as a product specified in the contract, record the log as a cull and show the gross scale in the defect column (sec. 55.63). If cull logs are being removed from the sale area as a product not specified in the contract, inform the Contracting Officer. In such cases, the product shall be appraised, rates established, and instructions to the scaler (ex. 1, sec. 55.5) revised.

41.2 - Chunks, Slabs, and Small Logs

1. A chunk is a piece of wood in log form which measures less than the contract minimum length. Chunks may originate from long butting, bucking out defects, failure to vary log length, or breakage. When chunks result from purchasers' carelessness or waste of what would have been standard material, as determined by the Forest Service representative for the sale, chunks may be scaled. Some timber sale contracts provide that products removed which do not meet the utilization standards because of size or net scale will be paid for at the same rates as standard timber. Therefore, under this type of contract if a chunk is not cull because of defect, it will be scaled if it is removed from the sale area. Also see section 42.

2. Slabs are portions of logs created when a log splits lengthwise. The statements in paragraph 1 about chunks also apply to the treatment of slabs.

3. Scale slabs and chunks in the same manner as other logs. When slabs approximate one-half the original log, determine the gross volume as one-half the volume of a full log with the same dimensions. If pieces are not round, take square or rectangular measurements and determine the volume in the same manner as defect volumes are obtained by use of Coconino-scale stick or shortcut procedure (sec. 22). Deduct for any remaining defect.

4. Logs with top diameters smaller than the contract minimum must be measured at the top diameter specified in the contract when there would be a volume loss if scaled as presented. Also see section 17.5. An exception to this would be when a timber sale contract provided for the scaling of material with a diameter smaller than the contract minimum and needs to be converted to board feet measure. In such cases, the Regional Forester must issue special instructions and approved volume tables.

5. Except for utilization scaling in the woods (sec. 42), the minimum volume that can be recorded for any piece is 10 board feet, or 1 decimal C, unless otherwise specified by the timber sale contract.

42 - UTILIZATION INSPECTIONS

Timber sale contracts provide for the greatest practicable utilization of the included timber. Product specifications normally include minimum length, diameter, and net scale in percent of gross scale. Conduct utilization checks in cut over areas during or as soon after logging as practical. When more than incidental amounts of material meeting the product specifications have been left in the woods, the Timber Sale Administrator should promptly notify the purchaser in writing to remove the material.

Some examples of improper log manufacturing include:

1. A cull log under the terms of the contract, which would have met contract specifications if the end containing the major portion of the defect had been cut off.

2. A log left in the woods because its top diameter is smaller than the contract minimum, but it would meet minimum specifications if cut shorter.

3. Top material with a diameter larger than the contract minimum, which when properly bucked, would have been included with the log removed.

4. Excessive sound material showing on one end of a defective log or long butt which, if properly bucked, would have been included on a log that was removed.

5. Sound material wasted in bucking-out defects, breaks, or crooks which could have been utilized if bucking had been done correctly.

6. Tree not bucked so as to avoid excessive sweep deduction.

7. Long-butts that are excessive due to attempts to eliminate all the stump rot.

8. A log meeting contract specifications with less than the defect percent of the net percent of gross stated in the contract and capable of producing 6 foot lumber.

9. Stumps exceeding the contract height specification.

42.1 - Material to be Removed

All logs and pieces which meet the minimum contract specification are required to be removed. When determining the proper utilization in the woods, each piece must be considered on its own merits. Depending on the characteristics of the log or piece, one or more of the following criteria should be used to determine if the required merchantability is met.

Use these criteria to estimate proper log manufacturing in the woods and to assess merchantable material remaining after yarding:

1. The log end diameter and the diameter dimension of the defect.

2. The net scale of a log and the percent of gross scale stated in the contract (Normally 33 1/3 percent).

3. Merchantable material meets the net scale in percent of gross scale at the point it is severed.

4. The capability of the piece to produce lumber at least 6 feet in length.

42.1a - Procedure for Determining Diameters

1. Long Butts.

   a. If the butt end is defective, estimate the diameter at 4 feet above the butt end to compare to the defect diameter (large end) to determine if a long butt was warranted.

b. When checking long butts for proper utilization use the small end diameter where the piece is or should have been long butted for proper utilization. When long butts are less than 4 feet in length, measure at the small end, ignoring flare.

2. Other Logs.

a. Assess defect at the large end of the defect.

b. Use the small end diameter of the piece for log or segment diameter.

c. Check each end of the piece for merchantability requirements, such as the merchantability specifications of 33 1/3 percent where the log has been severed, and check the minimum top diameter as stated in the contract.

42.1b - Proper Utilization

When determining proper utilization in the woods, the piece left must be considered on its own merits. When determining the merchantability of a piece and the correct bucking points, 2 foot multiples must be considered when determining piece length. Determine all log lengths in even lengths in 2 foot multiples plus the specified trim allowance. For example, use lengths of 10, 12, and 14 feet, and so forth.

Refer to an appropriate utilization table for interior defect (ex. 01 and 02). The major types of defects are explained in the following sections. Examples shown are for a net of 33-1/3 percent sound volume.

42.1b - Exhibit 01
Utilization Table for Internal Defect and 33-1/3 Percent Merchantability

Small End Diameter (Inches)	Maximum Interior Defect Dianeter (Inches)
8	3
9	3
10	5
11	5
12	6
13	6
14	7
15	8
16	8
17	9
18	10
19	11
20	12
21	12
22	13
23	14
24	14
25	15
26	16
27	17
28	17
29	18
30	19
31	20
32	20
33	21
34	21
35	22
36	23
37	24
38	24
39	25
40	26

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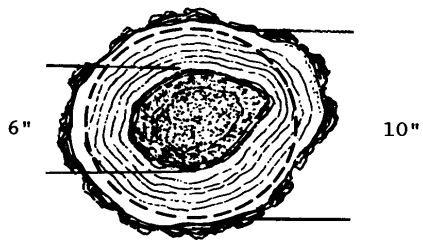
42.1b - Exhibit 02
Utilization Table for Perimeter Defect and 33-1/3 Percent Merchantability

Small End Diameter (Inches)	Maximum Interior Defect Dianeter (Inches)
7	1
8	2
9	3
10	4
11	4
12	5
13	4
14	5
15	5
16	6
17	7
18	7
19	7
20	7
21	8
22	8
23	8
24	9
25	9
26	9
27	9
28	10
29	11
30	11
31	12
32	12
33	13
34	14
35	14
36	14
37	14
38	15
39	16
40	16

42.2 - Massed Interior Defects

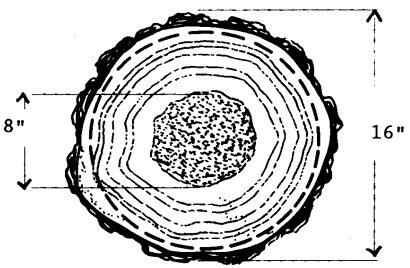
Assess a log or piece which contains interior defect for meeting the contract utilization specifications by using a utilization table for interior defect (sec. 42.1b, ex. 01).

42.2 - Exhibit 01
Cull Log End Due to Interior Defect



The log end in exhibit 02 exceeds the maximum interior defect. The tree may be long butted to a point where the interior defect is not more than the maximum shown on the interior utilization table.

42.2 - Exhibit 02
Merchantable Log End With Interior Defect



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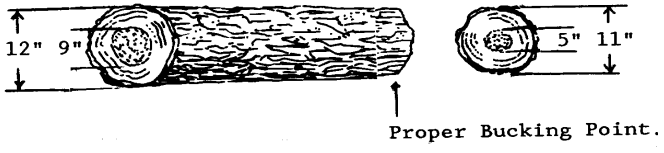
The maximum allowable interior defect for a 16” log is 8”. Long butting of this log is not necessary.

42.2a - Proper Bucking Point for Logs With Massed Interior Defect

Examine logs to determine the extent of defect, make test cuts. Check to see that the piece was bucked at the point on the log that meets minimum contract requirements such as 33-1/3 net percent of gross which is used in this example.

42.2a - Exhibit 01
Proper Bucking Point for Log With Interior Defect



Large end diameter = 12”
Defect diameter = 9”
6” is the maximum
allowed interior defect.
for a 12” log end division
(refer to exhibit 01)

Small Diameter = 11”
Defect diameter = 5”
5” is the maximum
allowed defect for
an 11” diameter

42.3 - Massed Defect With Sound Sector

On log ends containing defect which can be confined to a portion of the log, use the percentage of end area method.

42.3 - Exhibit 01
Sound Sector - Unmerchantable

Less than 33 1/3 percent

The defective portion is not merchantable as the log end does not meet contract specifications.

42.3 - Exhibit 02
Sound Sector - Merchantable

More than 33 1/3 percent

Bucking out the defect is not justified.

Logs with diameters of 6", 7", and 8" that do not contain a product (4" in width) are culls.

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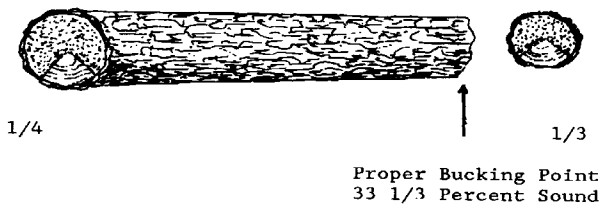
42.3a - Proper Bucking Point for Logs With Sound Sector

Examine logs to determine the extent of defect, test cuts should be made. Buck the piece at the point on the log that meets minimum contract requirements such as 33-1/3 percent of end area sound.

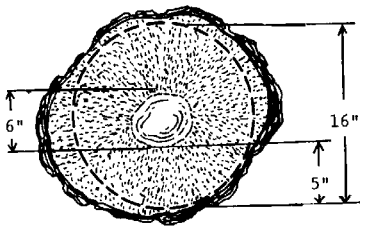
42.3a - Exhibit 01
Sound End Area



42.4 - Perimeter Defects

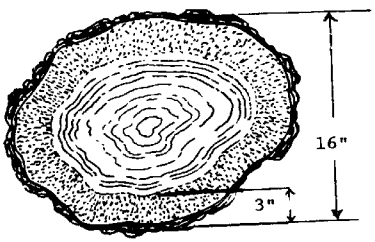
A log or piece which contains perimeter defect can be assessed for meeting the contract utilization specifications by using the utilization table for perimeter defect (sec. 42.1b, ex. 02).

42.4 - Exhibit 01
Cull Log End - Perimeter Defect



The log exceeds the maximum log perimeter defect. The tree may be long butted to a point where the perimeter defect is not more than the maximum shown on the perimeter utilization table.

42.4 - Exhibit 02
Merchantable Log End - Perimeter Defect



The maximum allowable perimeter defect for a 16" log is 6". Long butting of this log would not be appropriate.

42.4a - Proper Bucking Point for Logs With Perimeter Defect

Examine logs to determine the extent of defect, test cuts should be made. Buck the piece at the point on the log that meets minimum contract requirements.

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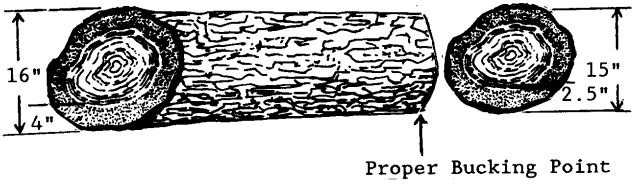
42.4a - Exhibit 01
Proper Bucking Point for Log With Perimeter Defect



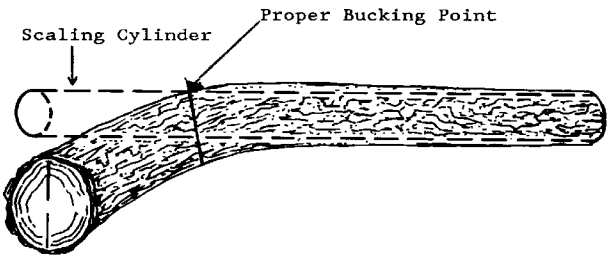
Large end diameter = 16”	Small diameter = 15”
Perimeter defect = 8”	Perimeter defect = 5”
6” is the maximum allowed interior defect a 16” log end diameter	5” is the maximum allowed defect for 15” log end diameter

42.5 - Exterior Defects

These include crooks, sweep, forks and breaks.

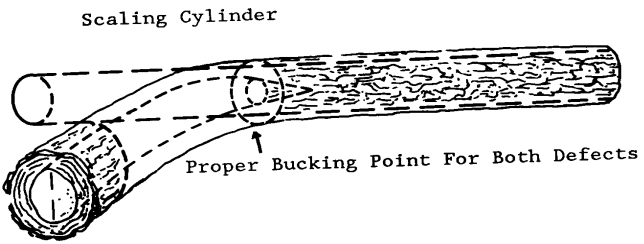
1. Determine if long butting is necessary when crook is present. If no other internal defect affects the log, determine the bucking point by extending the log through the crook. The proper bucking point is located where the extended log side emerges.

42.5 - Exhibit 01
Proper Bucking Point on a Log With Crook



2. The correct location of the bucking point changes for a log with crook or sweep that also contains an additional defect, such as heart rot. Additional long butting is appropriate in this circumstance. Determine the initial bucking point for the crook. Determine the need for additional long butting due to internal defect. The additional defect is used to determine the additional length of the long butt.

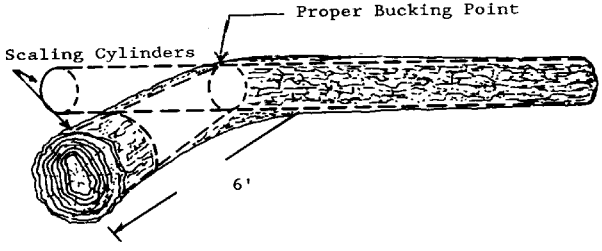
42.5 - Exhibit 02
Proper Bucking Point on a Crooked Log With Interior Defect



3. Permit long butting for sweep when the curvature is sufficiently severe to create an unmerchantable piece less than the contract minimum. These pieces more commonly occur in the top or butt end of a tree, but can occasionally occur in the middle if there is severe sweep. As with crook, it is essential to check for correct bucking prior to skidding.

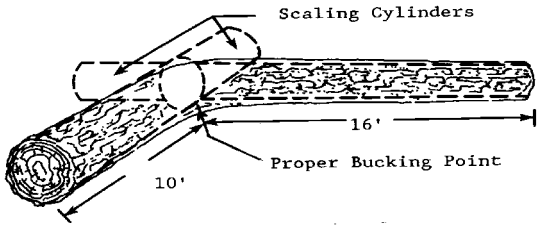
a. Long butting is permissible in the following examples because the sweep created an unmerchantable piece less than the contract minimum. This is applicable to both the butt and the top of the tree.

42.5 - Exhibit 03
Long Butting Permissible



b. Long butting would not be permissible in the following example when proper bucking would create 2 merchantable pieces or logs. This is also applicable to logs in the top of trees.

42.5 - Exhibit 04
Log With Merchantable Pieces on Each Side of the Crook



4. Consider logs containing multiple crook or sweep to be merchantable if they meet the minimum merchantable specification in the contract and contain the minimum piece length.

a. The following is an example of a tree which has an unmerchantable piece in the top due to multiple sweep. The same example could be applicable to the butt end of the tree.

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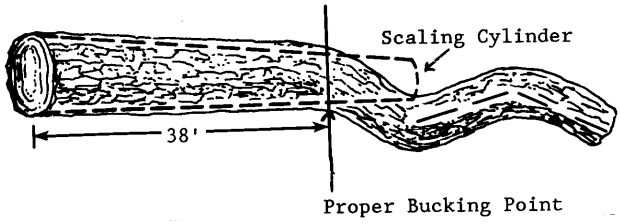
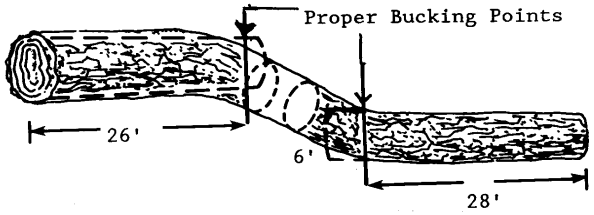
42.5 - Exhibit 05
Proper Bucking Point to Eliminate Unmerchantable Piece



b. The following is an example of a tree that has unmerchantable material in the middle but has merchantable material on both ends. For these types of external defects, it is essential that the sale administrator check bucking prior to removal of the merchantable material.

42.5 - Exhibit 06
Proper Bucking Point to Eliminate Crook

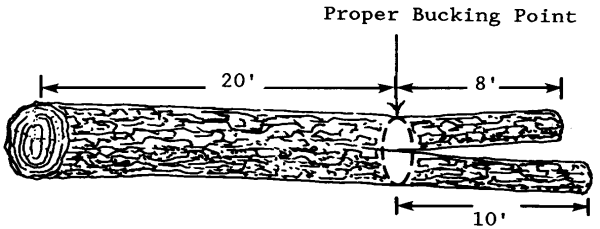


5. Proper bucking of crotched logs can eliminate much of the defect. Loss that occurs is from bark seams, splits, cross grain, and flat sides. The 2 foot multiple rule also applies to crotched logs. Measure lengths from the butt cut in 2 foot multiples, plus trim, to

determine the bucking point for a crotch. The ideal bucking point when the top contains merchantable logs in each fork would be when the 2 foot multiple falls exactly at the point where daylight shows in the crotch. When this does not occur, move back to the next 2 foot multiple towards the large end of the log for the correct bucking point.

The following exhibit is an example of bucking forked logs:

42.5 - Exhibit 07
Proper Bucking Point of Forked Logs



6. Occasionally, a tree forks near the merchantable top diameter. If the fork is less than 4 feet from the merchantable top diameter inside bark (DIB), the bucking point must be moved backward towards the large end of the log into the fork in 2 foot multiples to create a top log that meets the minimum piece length. See the following exhibit for an example:

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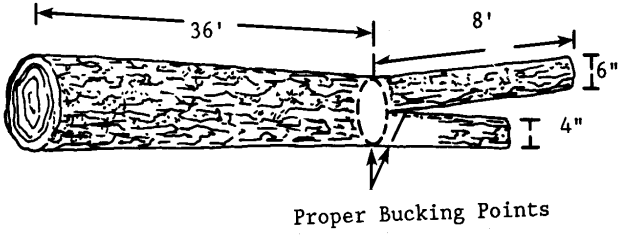
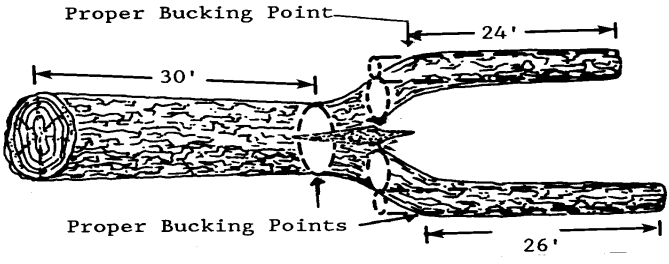
42.5 - Exhibit 08
Proper Bucking Point on Forked Logs With a Substandard Fork



7. At times, bucking out forks may be necessary.

   a. This occurs when defect, such as rot caused by a sucker limb or old dead top, is present in the fork or crotch. The first bucking point would be determined by measuring the log length from the larger end in 2 foot multiples. Determine the second bucking point at the upper end using the long butting procedure for crook, sweep, or internal defect, whichever is applicable.

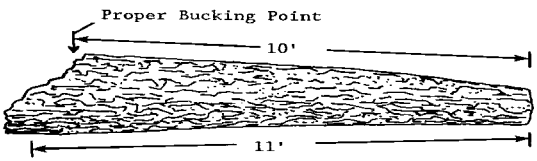
42.5 - Exhibit 09
Forked Log With Internal Defect



8. Breaks must be bucked to a point that meets contract specification, such as 33 1/3 net percent of gross as long as merchantable lumber can be manufactured.

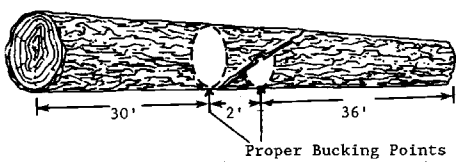
a. Breaks commonly occur in the tops of trees during felling. To determine if a piece is merchantable and/or the proper bucking point, locate the point that represents one-half of the surface area of the break on the large end and measure the length in 2 foot multiples to the minimum contract top diameter.

42.5 - Exhibit 10
Bucking Point on Broken End Log With Length Determination



b. Breaks frequently occur in a tree during felling. Utilization should occur in the bottom log(s) by measuring from the butt to the break. The length should be in 2 foot multiples.

42.5 - Exhibit 11
Log With Break in the Mid Section



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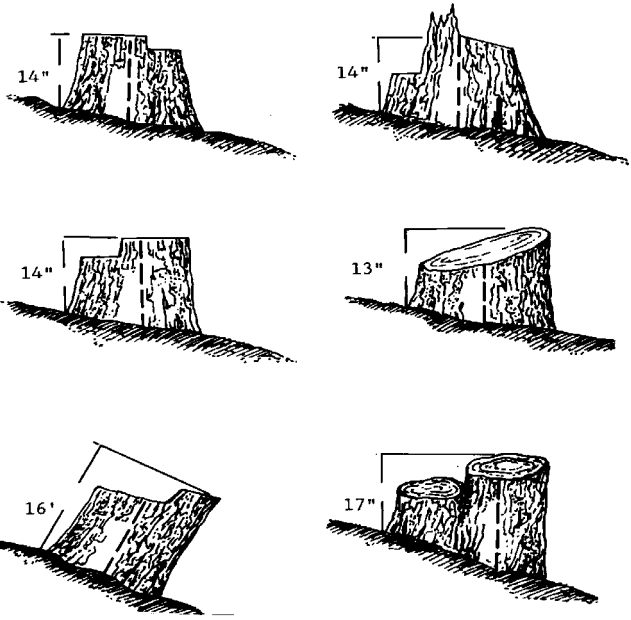
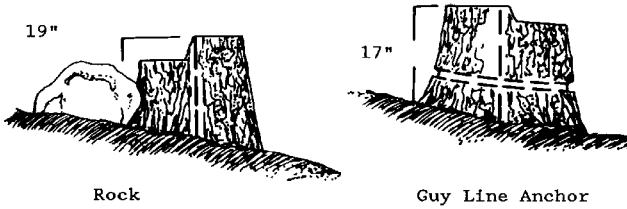
42.6 - Stump Heights

To determine stump heights, measure from high ground, paralleling the vertical axis of the stump, up to the point where a projected right angle intercepts the highest mechanical cut on the top of the stump. High stumps may be permitted when they are caused by obstructions or unsafe conditions. The contract specified maximum allowable stump height is 12 inches in the following exhibits.

42.6 - Exhibit 01
Unacceptable High Stumps



42.6 - Exhibit 02
Acceptable High Stumps



43 - SCALING DEBARKED LOGS

In some situations, logs can be presented for scaling after the bark has been removed. This may present the following problems:

1. Reduction in the scaling diameter, if any, by mechanical debarking and loss of wood fibers. This is generally no problem with hydraulic barkers. A volume-adjustment factor might be agreed upon if a study showed loss in scaling volume after debarking. Also see section 17.5.

2. Destruction of defect side indicators. This is more than compensated for by the removal of slime and dirt in the debarking process. Also the mill deck cutoff saw provides fresh end cuts.

3. Removal of species indicators, especially where large price differentials exist between species. This may be offset by arranging to paint or brand the species on the log ends before debarking or by presorting logs by species.

4. Removal of brand indicators. Procedures are similar to those outlined above.

In summary, there may be problems but also good reasons to accept debarked log scaling if proper precautions are taken to identify species and ownership.

44 - TIMBER TRESPASS

Stump scales and stump cruises are made when logs are removed from the woods before being scaled and cannot be later scaled, as is often the case in timber trespass cases. All measurements must be performed by certified scalers and cruisers, and should be coordinated with the Law Enforcement staff prior to any field work. Sections 44.1 through 44.3 contain the suggested procedure for obtaining volume.

Use extreme care in scaling trespass timber, especially by a stump scale, and keep complete accounts and legible notes of the method used. This information may be needed as legal evidence in court.

44.1 - Stump Scaling

If the logs within the tree can be reconstructed, use the following procedure:

1. Locate the top of the tree and measure the diameter at the point where the last log was bucked.

2. Measure the distance from the stump end to the top and convert this distance to the number of logs. Consider trim. Holes in the ground often help to locate where the butt rested; sawdust helps to show the length of logs.

3. Measure the stump diameter; stamp and number the stump. Establish the diameter breast height (dbh) from this measurement by comparison with adjacent trees or tested tables. Consider numbering with an aluminum tag.

4. Obtain diameter inside bark (dib) at the top of the first 16-foot log by use of d.b.h. and average form class for stand. Volume tables based on d.b.h. and number of logs is sometimes used.

5. Use actual taper, or local taper tables, to establish the diameter of all logs obtained in step 2.

6. Record length and diameters of these logs, identified by the stump number. Consider trim. Make deductions for defect on the basis of what you see in the stump, top, or any cull logs left. Record lengths according to the common bucking practice for the area.

7. Number and stamp "US" on each stump and top to indicate that logs have been scaled.

For example: (20-foot maximum scaling length.)

Top diameter-8 inches.

Distance from stump end to top-96 feet.

Number of logs from evidence on the ground-four 16-foot, one 10-foot, and one 8-foot log.

Stump diameter-30 inches; d.b.h. 26 inches.

Average form class-80; 80 percent of 26 inches 21 inches d.i.b. at top of first 16-foot log.

Taper from 8-inch top to 21 inches (diameter of first log) is 13 inches.

This provides the following diameters for all logs: 21, 19, 16, 13, 11, and 8 inches.

Record-16'-21", 16'-19", 16'-16", 16'-13", 10'-11", and 8'-8", with a total scale of 85.

Merchantable volume left in tops, in high stumps, and in unused logs are scaled and recorded separately. Stamp "US" on each stump and top, and number each piece for future identification.

44.2 - Stump Cruising

Timber theft cruising instructions are contained in Forest Service Handbook (FSH) 2409.12, chapter 80, section 81.

44.3 - Scaling When Stumps and Other Direct Evidence is Lacking

If a trespass, or other unauthorized cutting, is discovered after the stumps have been disturbed by clearing, site preparation, or similar activities, indirect methods must be used to determine actual volume. In some cases, cruise or compartment examination data may be available for the area.

If so, it should be used to the extent possible. The situation, however, may be that there is no existing data for the area. The approved method for determining volume is a cruise on similar timber using the most recent aerial photos of the cut timber as a basis for selecting

a similar stand. Other stand attributes, such as species distribution, elevation, aspect, and site index should be as close as possible to the cut timber. The selected stand should then be cruised using approved Regional standards for tree-measurement sales.

45 - SPECIAL SECTIONAL PROBLEMS

Special sectional problems such as scaling, sinkers, jackpots, and so on, which have minor general significance in the scaling of National Forest timber may be addressed in Regional supplements.

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51 - SELECTION OF SCALING LOCATIONS

The Contracting Officer is responsible for selection of scaling locations. Determination of the scaling location shall consider:

(1) the need for proper scale under safe working conditions with minimum expense to the Government and the purchaser, and

(2) adequate provisions for check scaling.

Practice economy in scaling insofar as possible. Losses from poor scaling caused by inadequate tools, training, or log presentation quickly exceed apparent savings. Inform the Contracting Officer when logs cannot be scaled efficiently and accurately. Purchasers are required by the timber sale contract to present logs so they can be scaled economically and safely.

52 - SAFETY IN SCALING

The varied hazards present in all types of scaling require the scaler to be safety minded at all times. FSH 6709.11, Health and Safety Code Handbook, provides information on good safety practices to follow in all types of scaling. Each scaler should have a copy of that handbook. Follow the safety rules of the Health and Safety Code, as well as applicable Occupational Safety and Health Administration (OSHA) standards.

53 - REQUIREMENTS OF PURCHASER

Purchasers may be required to present, assemble, or hold logs for scaling in the manner prescribed by the Forest Service. Special requirements are usually covered by the timber sale contract. Methods of scaling should consider safety, efficiency of scaling, provisions for check scales, and the operating needs of the purchaser.

54 - SCALER QUALIFICATIONS AND PROFICIENCY REQUIREMENTS

54.1 - General

The scaler makes the final determination of volume of National Forest products removed from sale areas. The scaler must be equipped with good tools, and have the ability and skill to measure length and diameters systematically and accurately. The scaler must properly identify species, detect defect, and use skill and good judgment in making deductions and in performing other phases of the job.

Team scaling can be less accurate than individual scaling and therefore must not be used. A scaler's accuracy is determined by check scales. Specific standards for satisfactory scaling are established. These are listed in chapter 60 of this handbook. Any check scale showing unsatisfactory scaling by a scaler, contract scaling organization, or third-party scaling organization (TPSO) indicates the need for corrective action. This is the responsibility of the Contracting Officer.

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The ability of a scaler to identify logs by species is extremely important. Wide differences in value result in variations in merchantability specifications by species. Species identity should be determined by bark characteristics, color and amount of sapwood and heartwood, presence of pitch, and the size and distribution of knots.

54.2 - Mill Visits to Develop Judgment

A proficient scaler must know how defects extend into logs and must keep that knowledge current. The best way to acquire skill and judgment in making defect deductions is to see defective logs opened on the saw carriage and note the losses caused by various defects.

In a mill visit the scaler should be concerned primarily with peculiarities of defects in timber from certain localities, and not quality, just as the scaler avoids scaling to include certain grades of lumber to the exclusion of other grades.

Defect in timber changes with localities, sites, and species. The scaler should make scheduled, periodic mill visits to observe sawing of logs similar to the ones being scaled. By this means the scaler can correctly maintain his judgment and proficiency.

Mill visits should be considered part of the routine of the scaler's initial and followup training.

55 - SCALING EQUIPMENT

55.1 - General

All scaling equipment must be kept serviceable and safe to use. For accurate length measurements and for checking trim allowances, a 50-foot steel tape with end hook should be carried and a steel hand-

tape makes accurate diameter measurements possible and should always be carried. Scalers should use a spud, or an equivalent device to locate and identify defect in the ends and sides of logs.

In most types of scaling, a hand held data recorder has become the best way for recording log length, diameter, net scale, and defect as standard equipment, however, a scalebook or scale sheets may be used.

55.2 - Scaler's Information Form

Each Region shall provide a standard form for informing scalers of scaling requirements, sampling information, applicable National Forest Log Scaling Handbook (FSH 2409.11) supplements, and any other pertinent scaling information such as abnormal delay.

The Contracting Officer is responsible for the completion and distribution of these scaler information forms to scalers and check scalers (and scaling organizations, when necessary) prior to hauling. Scalers shall have them available for references at the scaling site.

55.3 - Accountability

Regional Foresters issue instructions for scale data accountability, and for the place and system of storage for completed scale tickets and volume reports (electronic and hardcopy) or books and series numbered scale sheets. Keep these records for the required number of years after the sale is closed.

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55.4 - Recording Log Scale Data and Scale Sheets

Use approved scale sheets or field data recorders to record log scale data. The minimum data include:

HEADER	LOG DATA
Sale Name	Log Number
Contract Number	Species
Date/Time Scaled	Length
Receipt Number	Diameters
Scaler I.D.	Defect
Scaling Location	
Stratum I.D. (Sample Scale)	

Make corrections on the paper copy by drawing a single line through the incorrect entry and writing the correct figure beside it.

Regional Office Forest Management staff must verify that field data recorder programs identify changes or corrections to the original scale data after the load has been scaled and closed out on the field data recorder.

56 - LOG ACCOUNTABILITY

56.1 - Stamping

Forest Service scalers normally stamp logs which they have scaled with the symbol “US” as evidence that the logs have been scaled and to assist in accountability control. Specific requirements may be established by the Regional Forester.

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61 - PURPOSE

Systematic check scaling is a necessary part of timber sale administration. The purpose of check scaling is to make and keep accurate and uniform the scale of all National Forest timber. This is done by checking the scaler's work and determining sources of errors.

The check scaler should always keep in mind the need for additional training of the scaler and note their weaknesses if any.

62 - FREQUENCY

Standards for check scale frequency are difficult to set. However, the more frequent the check scales, the simpler it is to solve a situation that might result when they are unsatisfactory. A satisfactory check scale usually establishes as final the volume scaled to that date.

Minimum standards for check scaling are established by the Regional Forester with approval by the Chief. The following factors deserve consideration:

1. New scalers.

2. Volume scaled.

3. Result of last check.

4. Amount of defect. The more defective the timber, the more difficult the scaling job. Chances of error and variation in scale are more common. Make check scales more frequently in heavily defective timber.

5. Change in defect. Normally fewer checks are needed where sound timber is scaled. But if conditions vary and units of defective timber are presented, visit such scaling locations more frequently.

6. Variation in scaling load. The frequency of check scales should be increased when a scaler moves from a light-load station to a heavy-load station.

7. Changes in species. These may require more frequent training and checking until the scaler becomes familiar with appearances of defects and their effect in the new species.

63 - PROCEDURE

1. Check scaling should be done by the most experienced scalers. Regions should establish more than one check scaling position where the check scaling load is heavy. This provides a good opportunity for training scalers for Regional check scaler positions.

2. Most Forest Service Regions recognize two primary check scaler positions, (a) Forest and (b) Regional. More experienced scalers on a Ranger District often need to conduct check scales to meet the frequency standards.

a. Forest Check Scaler. This person is selected by the Forest Supervisor for assisting Rangers in training and checking all scalers scaling on the forest.

b. Regional Check Scaler. This person is selected by the Regional Forester and is responsible for technical control for all scaling within a Region. They should conduct Regional scaler-training sessions, check scale to settle controversies, and check area and forest check scalers.

3. Check scale as far as practicable under conditions similar to those under which the original scale was made. Wherever possible, check soon after the original scale and without the scaler's knowledge. In mill deck scaling and often in truck scaling, it may be necessary to check scale at the time logs are scaled. Note any effort by the scaler to change his way of scaling. Usually any serious change can be detected.

4. Normally, a check scale includes at least 200 short logs (16 to 20 feet and under) or at least 100 long logs. Sample the species and defect situation as fairly as possible. Individually analyze more complex scaling situations and increase the number of logs check scaled if necessary.

5. If possible, make check scales independent of the scaler, but when check scales are made with the scaler's knowledge, first put him at ease. Explain that Forest Service check scales are required to keep the scale of all logs accurate and uniform. When the comparison of figures shows the need, training should follow.

6. When check scaling inexperienced scalers, be sure and share the results before leaving the area. Attempt to eliminate any weaknesses found. Note all important variances in measurements, defect deductions, and defect missed. Where logs checked are still available, return with the scaler and point out these variances. Be sure they are using proper methods of measurement and deduction.

64 - STANDARDS

Use the following standards to determine the proficiency of individual scalers.

1. Gross Scale. A variance of 1 percent in gross scale is the satisfactory standard, unless otherwise justified by abnormal amounts of pieces with sloughed sap rot, fire damage, or chunks.

2. Net Scale. The allowable variance is as follows:

Check scaler's % defect in logs	Scaler's allowable variance
0 - 10%	2%
Over 10%	.2 x % defect to a maximum of 5%

Regional Foresters may supplement these standards to allow for difficult scaling situations such as very small timber or highly defective timber (defect exceeding 60%).

65 - RECORDS AND REPORTS

1. Check scale reports and summaries are primarily computer generated, however, hand generated forms are also acceptable and may be unique from Region to Region.

2. Each check scale record must contain the following information as a minimum:

a. Log number

b. Species

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c. Length

d. Diameter (small and large end when applicable)

e. Product code if applicable

f. Space for comments

g. Defect and defect type

h. Gross volume

i. Net volume

j. Grade if applicable

k. Sale name and contract number

l. Log brand

m. Load receipt number

n. Scaler name

o. Check Scaler name

p. Date and time of check scale

q. Region, Forest, District

r. Location of scaling

3. Each summary must compare the following by product or grade as a minimum:

a. Piece count (number of logs or segments)

b. Species

c. Sum of KPIs (3P) if applicable

d. Sum of Ratios (3P) if applicable

e. Gross volume

f. Net volume

g. Percent defect

h. Allowable variances for gross and net volumes

i. Gross variance

j. Net Variance

l. Remote or non-remote check scale

m. Summary rating

4. Regions are encouraged to develop their own summary reports to fit local needs.

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CHAPTER 70 - USE OF INTERNATIONAL LOG RULES

70.1 - Authority

Title 36 of the Code of Federal Regulations, part 223, section 223.36(b) (36 CFR 223.36(b)) sets out the authority for using the International 1/4-inch log rule or the International 1/4-inch Decimal Rule in log scaling.

70.3 - Policy

1. Use of International 1/4-inch log rule to obtain log scale more nearly equal to the lumber tally.

2. Use the Forest Service International 1/4-inch Decimal rule whenever necessary. This rule is applied the same as the International 1/4-inch log rule. The principal difference is that volumes are rounded to the nearest 10 board feet. Regional Foresters may authorize the use of either of these rules on any saw timber sale.

3. Use the same general scaling practices with these rules including defect deductions, as with the Scribner Decimal C rule. Differences in detail are explained in sections 71 through 74 below.

Appendix X in the appendix chapter gives the board foot contents of logs 4 to 20 feet long based on the International 1/4-inch log rule. Appendix XI in the appendix chapter gives those based on the Forest Service International 1/4-Inch Decimal rule.

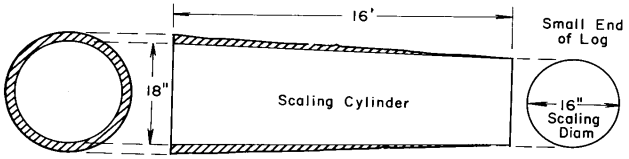
71 - SCALING CYLINDER IN INTERNATIONAL RULE

The International 1/4-inch log rule is based on a formula applied to each 4-foot section of the log and an assumed taper of 1/2 inch in each 4 feet (2 inches in 16 feet). Thus the International scaling cylinder differs from that used with the Scribner Decimal C rule. For

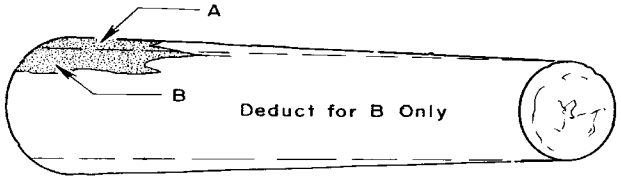
practical purposes, assume that the scaling cylinder becomes a frustum of a cone with a taper of 2 inches in 16 feet. See sec. 71-exhibits 01, 02, and 03 and compare them with chapter 10, sec. 18-exhibits 01, 02, and 03.

The International 1/4-inch log rule considers a 1-inch collar for slab, as does Forest service practice with the Scribner Decimal C rule. For sap rot and similar side defects, use of the tapered scaling cylinder results in larger deductions in comparison to deductions by the Scribner rule with its non-tapered scaling cylinder.

71 - Exhibit 01
Scaling Cylinder for International Rule



71 - Exhibit 02
Defect Both Inside and Outside the Scale Cylinder



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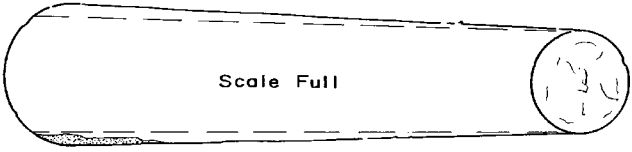
71 - Exhibit 03
Defect Outside the Scaling Cylinder



72 - MILL OVERRUN

Normally where the International 1/4-inch log rule is used, log scale closely corresponds to lumber tally. The rule considers a minimum board of 2 board feet. Inch lumber is considered if 3 inches wide by 8 feet long or any other combinations of dimensions making 2 board feet, down to 12 inches wide by 2 feet long. If a mill does not practice such good utilization, an underrun could result.

73 - LOG LENGTHS

1. In Forest Service scaling, logs as long as 20 feet are scaled as one log by the International 1/4-inch log rule and the Forest Service International 1/4-Inch Decimal rule; that is, if studies show that local timber does not greatly exceed the assumed taper of 2 inches in 16 feet. Where logs from 16 to 20 feet long average 3 inches or more taper in 16 feet, use the maximum scaling length of 16 feet. Where this condition exists, the timber sale contract should stipulate the maximum scaling length.

a. Example: With the International 1/4-Inch rule, a 16-inch log, 20 feet long, scales 235 board feet. If this log has the taper assumed in the log rule, the large-end diameter is 18 1/2 inches. But if this log were typical and had a large-end diameter of 19 3/4 inches, there would be 3-inch taper in 16 feet.

2. To scale railroad ties cut 8 1/2 feet long, scale an 8 1/2-foot log as an 8-foot log unless the difference between the scale of an 8- and a 9-foot log is 10 board feet. If so, add 5 feet to the scale of the 8-foot log.

3. If the difference is 15 feet or more, add half the difference. But use the next lower 5 feet where half the difference does not fall on a 5-foot interval. (Half of 15 is 7 1/2 use 5.)

a. Example: Scale a 10-inch, 8 1/2-foot log as an 8-foot log, with 30 board feet.

b. Example: Scale a 15-inch, 8 1/2-foot log as an 8-foot log with 75 board feet, plus 5 feet (half the difference between the scale of an 8- and a 9-foot log), or 80 board feet.

c. Example: Scale a 17-inch, 8 1/2-foot log as an 8-foot log with 95 board feet plus 5 feet (half the difference between the scale of an 8- and a 9-foot log (15 feet) rounded down to the nearest 5 feet) or 100 board feet.

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74 - DEFECT DEDUCTIONS

The International 1/4-inch log rule and the Forest Service International 1/4-Inch Decimal rule allow 1/16 inch for shrinkage in addition to the 1/4 inch for saw kerf. The net effect is to give a squared-defect deduction formula almost identical to the "shortcut" one used with the Scribner rule. The basic formula is:

$$\frac{\text{Height in inches x width in inches x length in feet}}{16}$$

However, with the International 1/4-inch log rule, round the product of height by width to the nearest 5; with the Forest Service International 1/4-Inch Decimal Rule, round to the nearest 10, above or below.

When defects extend all the way through a log, use their average dimensions. Do this because the International 1/4-inch log rule is based on the use of short and narrow material.

For sap-rot and side-defect deductions, see discussion in section 71.

Also refer to appendices XII and XIII in the appendix chapter, showing defect allowances under the International 1/4-Inch log rule and the Forest Service International 1/4-inch Decimal log rule.

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81 - CORD MEASURE

81.05 - Definitions

Cord. A unit of measure that expresses the volume of stacked wood. It differs from the board foot and cubic foot units because it is not a measure of the individual bolt or piece in terms of solid-wood content.

1. A standard cord is a pile of stacked wood measuring 8 feet long, 4 feet high, and 4 feet wide. The standard cord contains 128 cubic feet. The actual solid wood content is generally 100 cubic feet or less. Forest Service scalers measure in terms of 128 cubic feet of stacked wood. Reduce the total cubic feet occupied to cords by dividing by 128.

2. A long cord contains a greater volume of wood than the standard cord. This unit measures 8 feet long and 4 feet high with a width greater than 4 feet. A long cord may consist of pieces that exceed 4 feet in length. Often a long cord is 8 feet by 4 feet by 5 feet. Pulpwood is often sold by this unit.

3. A short cord is a unit smaller than the standard cord and is usually used for fuelwood less than 4 feet long. For fuelwood, a rick is a pile 8 feet long, 4 feet high, and 1 foot wide, or 4 ricks per cord. Fuelwood cut to a 16-inch length will stack three ricks per cord.

4. A sound cord contains only the merchantable pieces or bolts of a standard stacked cord. Merchantable pieces or bolts are defined in each timber sale permit or contract. Gross cubic foot measurement is reduced to net cubic measurement usually by applying the percentages of unmerchantable material. Since sound and net

standard cord are synonymous use of the term "sound cord" is largely obsolete. A cord of shingle bolts usually measures 8 feet by 4 feet by 4 1/3 feet.

Rough wood. The term used to designate wood with bark in contrast to smooth or peeled wood, which is wood with the bark removed. Sales contracts are normally on a rough wood basis, and if measurements of peeled wood must be made, volume must be increased by an amount determined to be equitable for the material involved.

81.1 - Measuring Methods

1. The volume in cords may be calculated by measuring length, height, and width in feet and tenths, calculating the cubic volume and dividing by 128. The scale of 48-inch wood can be converted to any other length by applying converting factors listed below.

Length (inches)	Percent of 48-inch scale
36	75
38	79
40	83
42	87
44	92
46	96
50	104
52	108
54	112
56	117
58	121
60	125

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Example: Find the contents of a stack of wood 38 feet long, average height of 52 inches, and 40 inches wide which would be 5.11 cords if it were 48-inch wood. Multiply 5.11 by 0.83, the converting factor for 40-inch wood. Answer: 4.24 standard cords.

2. Regional Foresters may specify the use of other methods of cordwood measurement if better adapted to local conditions. In lieu of measuring of stacked wood, tree or sample tree measurement, weight, or other measurement may result in lower scaling cost without sacrifice in accuracy.

81.2 - Measuring Stacked Wood

1. Measure stacks of wood accurately. Record length to the nearest foot, height to the nearest inch or tenth of foot. It is permissible to allow up to a maximum of 1 inch per foot of height to compensate for settling where long transportation to consumer is involved. The equitable settlement factor, if any, should be determined on the basis of documented tests, and not merely assumed.

2. If stacks are standing on slopes, measure the length parallel to the slope and the height at right angles to this plane. If end stakes are used here, obtain the length by measuring at a point half the distance between the top and bottom. Otherwise, measure at enough places to obtain a fair average. Measure the height at several places to obtain the true average.

3. Check piece lengths sufficiently to make sure they do not regularly overrun those specified in the sale contract. If they do, follow the procedure outlined under section 42.

81.3 - Stamping or Painting and Numbering

Regional Foresters may issue special instructions for stamping, painting, and numbering. Straight lines made with a paint gun are most effective. Household bluing in a paint gun produces a good mark that does not interfere with pulp production. Otherwise stamp or paint both ends and top of each stack. Number each stack. Enter the measurements and contents of each stack opposite its number in the scalebook or field data recorder. Indicate whether roughwood, hand peeled, or machine peeled.

81.4 - Check Measurements

Minimum standards for check measurements are established by the Regional Forester with approval by the Washington Office. In the absence of specific Regional standards, make check measurements as instructed in chapter 60, Check Scaling. Follow the same procedure as to frequency of checks, methods, reports, and action.

82 - CUBIC FOOT MEASUREMENT

See National Forest Cubic Scaling Handbook (FSH 2409.11a) for direction on cubic foot measurement.

83 - 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. Length and strength are often more important than the volume they contain. Timber sale contracts should specify the minimum length and diameter(s) of sticks classed as merchantable

for each product. Contracts under which higher prices are charged for products cut from larger materials should set maximum lengths and diameters. 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; also 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. Otherwise, use current commercial specifications of associations of local pole dealers or other associations.

83.1 - Measurement Method

Where pieces are cut in uniform standard lengths, make periodic measurements to check the bucker's work. When several products are cut in the same sale, make a similar current check of the diameter(s) of linear-foot material. Also, check periodically when prices depend upon both diameter(s) and length.

The standard trim allowance for telephone poles is 1 inch for each 5 feet of length. Regional Foresters may authorize greater allowances for specific products if local conditions require such action. Make utilization measurements for lengths with excessive trim as outlined in section 17.2. Sale contracts should specify trimming allowances for other classes of material where advisable. Sale contracts also may specify the equivalent in board feet versus linear feet. This facilitates the use of a flat stumpage rate per board foot. As standard practice, however, it is preferable to require payment on a linear foot or piece basis.

83.2 - Numbering and Stamping or Painting

Regional Foresters may establish procedures for numbering, and stamping or painting. In the absence of Regional instructions, number each pile of material measured. Do this with posts, fence poles, hop poles, converter poles, lagging, and other material which is small and of low value. Enter the number of pieces in each pile and their linear-foot contents opposite the pile number in the scalebook or the field data recorder. Number and stamp or paint large pieces equivalent in value to saw logs, such as telephone and power poles, piling, and stulls. Enter the length of each piece opposite its number in the scalebook or field data recorder.

83.3 - Check Measurements

See section 81.4 for direction on check measurements.

83.4 - Combined Linear and Diameter Measurements

Top diameters as well as lengths may affect the market value of products like telephone and power poles and stulls. Where this happens, use a schedule of stumpage rates for the various lengths and sizes. In such sales, accurately measure the diameter(s) of each piece. Average diameters to the nearest inch unless otherwise agreed upon. Number every piece and record it in a scalebook or field data recorder as with saw logs.

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84 - COUNTING

84.1 - Procedure

Standard practice of the Forest Service is to count ties sold by the piece. Ties are also counted in sales where their board foot contents are specified in the sale contract. Where ties are scaled, follow the instructions under scaling. Count poles, posts, lagging, Christmas trees, and so on, when sold by the piece.

Contract requirements should conform to the local market specifications of products concerned. Designate clearly by special contract clauses 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.

84.2 - Numbering and Stamping or Painting

Stamp or paint each piece of mine timbers, ties, posts, or poles counted. Painting helps identify the pieces counted. Christmas trees are usually counted and recorded by size classes.

Number each pile of material with crayon even though immediate removal is planned. Record the number of pieces opposite the number of the pile in the scalebook or field data recorder.

84.3 - Check Measurement

See section 81.4 for direction on check measurement.

85 - SAMPLE SCALING

Direction on sample scaling is located in Forest Service Handbook 2409.11a, National Forest Cubic Scaling Handbook in chapter 50. Procedures found in chapter 50 apply to both Cubic and Scribner scaling methods.

86 - WEIGHING PRODUCTS OTHER THAN SAW LOGS

Bark, stumps, limbs, or other material not readily measured otherwise may be sold by weight, normally with the ton as the unit. Obtain records of the actual weights whenever possible, for example, when the products are weighed by common carrier agents. Truck scales must be reliable. If the long ton of 2,240 pounds is used instead of the standard ton, specify this in the sale agreement.

86.1 - Scaling by Weight

Weight scaling is used to sell forest products by weighing every load. Weight sales should be sold using pounds/tons as the unit of measure. Weight scaling is a technically sound and an efficient way to sell and measure forest products. Variations in weight occur from environmental and biological factors. Some variables to consider are: species, uniformity in size, seasonal conditions, and defects. When selecting a weight ratio, it is very important to ensure it is accurate and has been validated. There are several ways to achieve an accurate weight ratio (see FSH 2409.12, ch. 80).

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87 - 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 and record the results in accordance with the guidelines outlined in section 17.

87.1 - Defects in Fiber Logs

Fiber defect is any unsound wood that is stringy, crumbles, or crushes when rolled in the hand, or 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 - when there is an absence of wood fiber. Gouges, slabs, stump pull and open catface are examples of void.

2. Soft Rots - resulting from advanced decay such as conk rot, heart rot, sap rot, stump (butt) rot, and rot associated with rotten knots.

3. Char - when wood fiber has been charred.

4. Massed Pitch - when the wood fiber is saturated with accumulated pitch and considered unusable.

87.2 - 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 87.3:

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

2. Make deductions for defects only when present in the scaling cylinder.

3. Consider the extent of the defect length in 1-foot multiples.

4. Consider the defect shape (cylinder, cone) in determining average defect length.

5. Use actual defect dimensions when determining loss. (Do not add an inch for waste.)

6. Apply the give and take procedure when measuring irregular shaped square, rectangular or circular defects. Dimensions should balance the unsound wood with usable fiber (sec. 87.32, ex. 01).

87.3 - 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. 87.31);

2. Circular area (sec. 87.32);

3. Length deduction (sec. 87.33); and

4. Diameter deduction (sec. 87.34).

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87.31 - 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 (sec. 22.4 and 22.5).

2. When defect occurs in one log end, use actual defect dimensions for the length affected. When defect occurs in both log ends, average the end defect dimensions for the length affected.

3. 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.

4. See section 22 for further direction on using this deduction method.

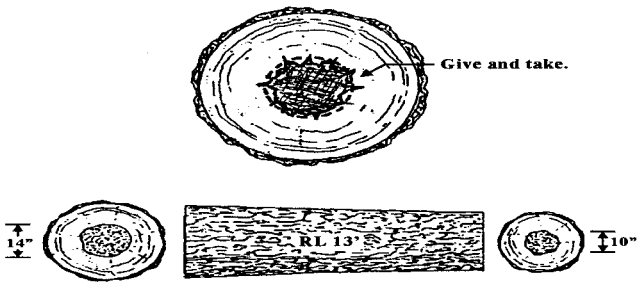
87.32 - Circular Area Deduction Method

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

2. Defect volume is calculated as core volume (do not square).

3. When defect occurs in one log end, use actual defect diameter for the length affected. When defect occurs in both log ends, average the end defect diameters for the length affected.

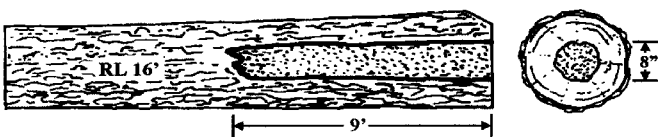
87.32 - Exhibit 01
Circular Area Defect



Given:

Average defect diameter = 12 inches
Defect length = 13 feet
Circular area deduction 12" x 13' = 6 Dec C

87.32 - Exhibit 02
Circular Area Defect



Given:

Defect diameter = 8 inches
Defect length = 9 feet
Circular area deduction 8" x 9' = 1 Dec C

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87.33 - Length Deduction Method

1. Use the length deduction method when unsound wood affects a portion of the segment length.

2. Make segment length deductions to eliminate char that penetrates the wood fiber (sec. 87.33, ex. 01 and 02).

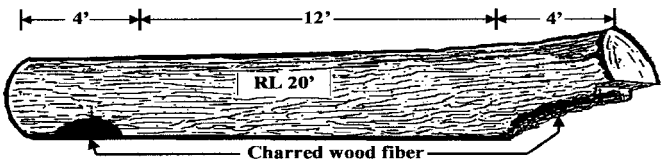
3. Make segment length deductions when logs are not 90 percent debarkable (sec. 87.4).

4. See section 24 for further direction on using this deduction method.

Any char present in the wood fiber of a log causes the entire length affected to be unusable. Deduct 100% of the length affected. The remaining portion must meet contract minimum specifications for length, or the segment is cull.

The log in exhibit 01 has two areas of charred wood fiber. A length deduction of 8 feet is made to eliminate the affected areas.

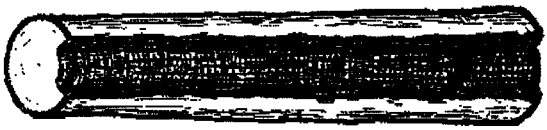
87.33 - Exhibit 01
Length Deduction for Char



Given:

Recorded length = 20 feet
Defect length = 4 feet
Length deduction = 8 feet

87.33 - Exhibit 02
Cull Log Due to Char



Char affects the full length of this log; therefore, the entire log is not usable for utility pulp chips and is cull.

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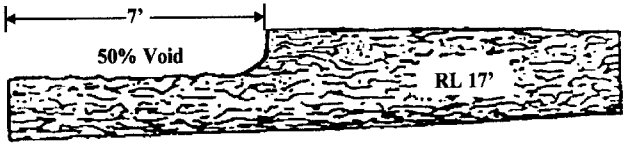
87.33 - Exhibit 03
Pie-Cut Deduction



Given:

Recorded length = 17 feet
Recorded diameter = 19 inches
Gross segment volume = 25 Dec C
Void affects 50% of 7 feet.
7-foot length deduction = 10 Dec C
50% Pie-cut deduction = 10 x .50 = 5 Dec C

87.34 - 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.

3. See section 25 for further direction on using this deduction method.

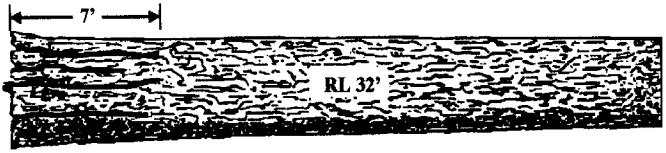
87.4 - Debarkability

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 portion of a segment that cannot be mechanically debarked will have a length deduction made to eliminate 100% of the affected length. The remaining portion must meet contract minimum specifications for length, or the segment is cull.

87.41 - Shatter

Depending on the extent of defect, shatter can be considered a non-debarkable defect. In exhibit 01, shatter affects 7 feet on the large end segment that would fall apart, and may be a safety hazard when subjected to the debarking process. Use the length deduction method to deduct for the defect.

87.41 - Exhibit 01
Log With Shatter



Given:

Recorded length = 32 feet
Segment length = 16 feet
Shatter affects 7 feet
Length deduction = 7 feet

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87.42 - 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.

87.42 - Exhibit 01
Log With Severe Crook

Given:

Recorded length = 16 feet
Defect length = 16 feet
Log is cull

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Appendix 1 - Standard Division of Long Logs for Scaling - 20-foot Maximum Scaling Length

Length (feet)	Division of log--segment lengths in feet		
	Bottom	Middle	Top
21	11	---	10
22	12	---	10
23	12	---	11
24	12	---	12
25	13	---	12
26	14	---	12
27	14	---	13
28	14	---	14
29	15	---	14
30	16	---	14
31	16	---	15
32	16	---	16
33	17	---	16
34	18	---	16
35	18	---	17
36	18	---	18
37	19	---	18
38	20	---	18
39	20	---	19
40	20	---	20
41	14	14	13
42	14	14	14
43	15	14	14
44	16	14	14
45	16	15	14
46	16	16	14
47	16	16	15
48	16	16	16
49	17	16	16
50	18	16	16

In this table any log length and segment division will be used as the overtrim scaling length for the preceding length.

Appendix 2 - Scribner Decimal C Log Rule - 4- to 20-foot Logs

[Board-foot volumes in tens—no taper considered]

Diameter (inches)	Log lengths in feet: 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20
6	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1	1	2	2	2	2
7	.5	.5	.5	1	1	1	1	2	2	2	2	2	3	3	3	3
8	.5	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3
9	1	1	1	2	2	2	3	3	3	3	3	3	4	4	4	4
10	1	1	2	2	3	3	3	3	3	4	4	5	6	6	6	7
11	1	2	2	2	3	3	4	4	4	5	5	6	7	7	8	8
12	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	10
13	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	12
14	3	4	4	5	6	6	7	8	9	9	10	11	11	12	13	14
15	4	4	5	6	7	8	9	10	11	12	12	13	14	15	16	18
16	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20
17	5	6	7	8	9	10	12	13	14	15	16	17	18	20	21	23
18	5	7	8	9	11	12	13	15	16	17	19	20	21	23	24	27
19	6	8	9	10	12	13	15	16	18	19	21	22	24	25	27	30
20	7	9	11	12	14	16	17	19	21	23	24	26	28	30	31	35
21	8	10	12	13	15	17	19	21	23	25	27	28	30	32	34	38
22	8	10	13	15	17	19	21	23	25	27	29	31	33	35	38	42
23	9	12	14	16	19	21	23	26	28	31	33	35	38	40	42	47
24	10	13	15	18	21	23	25	28	30	33	35	38	40	43	45	50
25	11	14	17	20	23	26	29	31	34	37	40	43	46	49	52	57

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Appendix 2 (continued) - Scribner Decimal C Log Rule - 4- to 20-foot Logs

Diameter (inches)	Log lengths in feet															
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20
26	12	16	19	22	25	28	31	34	37	41	44	47	50	53	56	62
27	14	17	21	24	27	31	34	38	41	44	48	51	55	58	62	68
28	15	18	22	25	29	33	36	40	44	47	51	54	58	62	65	73
29	15	19	23	27	31	35	38	42	46	49	53	57	61	65	68	76
30	16	21	25	29	33	37	41	45	49	53	57	62	66	70	74	82
31	18	22	27	31	36	40	44	49	53	58	62	67	71	75	80	89
32	18	23	28	32	37	41	46	51	55	60	64	69	74	78	83	92
33	20	24	29	34	39	44	49	54	59	64	69	73	78	83	88	98
34	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	100
35	22	27	33	38	44	49	55	60	66	71	77	82	88	93	98	109
36	23	29	35	40	46	52	58	63	69	75	81	86	92	98	104	115
37	26	32	39	45	51	58	64	71	77	84	90	96	103	109	116	129
38	27	33	40	47	54	60	67	73	80	87	93	100	107	113	120	133
39	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	140
40	30	38	45	53	60	68	75	83	90	98	105	113	120	128	135	150
41	32	39	48	56	64	72	79	87	95	103	111	119	127	135	143	159
42	33	42	50	59	67	76	84	92	101	109	117	126	134	143	151	168
43	35	43	52	61	70	79	87	96	105	113	122	131	140	148	157	174
44	37	46	56	65	74	83	93	102	111	120	129	139	148	157	166	185
45	38	47	57	66	76	85	95	104	114	123	133	143	152	161	171	190
46	39	49	59	69	79	89	99	109	119	129	139	149	159	169	178	198
47	41	52	62	72	83	93	104	114	124	134	145	155	166	176	186	207
48	43	54	65	76	86	97	108	119	130	140	151	162	173	184	194	216
49	45	56	67	79	90	101	112	124	135	146	157	168	180	191	202	225
50	47	58	70	82	94	105	117	129	140	152	164	175	187	199	211	234

Appendix 2 (continued) - Scribner Decimal C Log Rule - 4- to 20-foot Logs

Diameter (inches)	Log lengths in feet														
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20
51	48	61	73	85	97	110	122	134	146	158	170	183	195	207	219	243
52	50	63	76	89	101	114	127	139	152	165	177	190	202	215	228	253
53	52	66	79	92	105	118	132	145	158	171	184	197	210	224	237	263
54	54	68	82	96	109	123	137	150	164	177	191	205	218	232	246	273
55	56	71	85	99	113	127	142	156	170	184	198	212	227	241	255	283
56	59	73	88	103	118	132	147	162	176	191	206	220	235	250	264	294
57	61	76	91	107	122	137	152	167	183	198	213	228	244	259	274	304
58	63	79	95	110	126	142	158	174	189	205	221	237	252	268	284	315
59	65	81	98	114	131	147	163	180	196	212	229	245	261	278	294	327
60	67	84	101	118	135	152	169	186	203	220	237	253	270	287	304	338
61	70	87	105	123	140	158	175	193	210	228	245	263	280	298	315	350
62	72	90	108	127	145	163	181	199	217	235	253	271	289	307	325	362
63	74	93	112	131	149	168	187	205	224	243	261	280	299	317	336	373
64	77	96	116	135	154	174	193	213	232	251	270	290	309	329	348	387
65	79	99	119	139	159	179	199	219	239	259	279	299	319	339	358	398
66	82	103	123	144	164	185	206	226	247	268	288	309	329	350	370	412
67	85	106	127	148	170	191	212	233	254	275	297	318	339	360	381	423
68	87	109	131	153	175	197	219	240	262	284	306	328	350	371	393	437
69	90	113	135	158	180	203	226	248	271	294	316	339	361	384	406	452
70	93	116	139	163	186	209	232	256	279	302	325	349	372	395	419	465
71	96	120	144	167	192	215	240	263	287	311	335	359	383	407	430	478
72	98	123	148	173	197	222	247	271	296	321	345	370	395	419	444	493
73	101	127	152	178	203	229	254	280	305	330	356	381	406	432	457	508
74	104	130	157	183	209	236	261	288	314	340	366	393	418	445	471	523
75	107	134	161	188	215	242	269	296	323	350	377	404	430	458	484	538

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Appendix 2 (continued) - Scribner Decimal C Log Rule - 4- to 20-foot Logs

Diameter (inches)	Log lengths in feet															
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20
76	110	138	166	194	221	249	277	304	332	360	387	415	443	470	498	553
77	114	142	171	199	228	256	285	313	341	369	398	426	455	483	511	568
78	117	146	176	205	234	263	293	322	351	380	410	439	468	497	527	585
79	120	150	180	211	240	271	301	331	361	391	421	451	481	511	541	602
80	123	154	185	216	247	278	309	340	371	402	432	464	494	526	556	618
81	127	158	190	222	254	286	317	349	381	413	444	476	508	540	572	635
82	130	163	196	228	261	293	326	358	391	424	456	489	521	554	586	652
83	134	167	201	234	268	301	335	368	401	434	468	501	535	568	601	668
84	137	171	206	240	275	309	343	378	412	446	481	515	549	584	618	687
85	140	175	210	246	281	316	351	386	421	456	491	526	561	596	631	702
86	143	179	215	251	287	323	359	395	431	467	503	539	575	611	646	718
87	147	184	221	258	295	332	368	405	442	479	516	553	589	626	663	737
88	150	188	226	264	301	339	377	414	452	490	527	565	603	640	678	753
89	154	192	231	270	308	347	385	424	462	501	539	578	616	655	693	770
90	157	196	236	275	315	354	393	433	472	511	551	590	629	669	708	787
91	161	201	241	282	322	362	402	443	483	523	563	604	644	684	725	805
92	164	205	246	288	329	370	411	452	493	534	575	616	657	698	740	822
93	167	209	251	293	335	377	419	461	503	545	587	629	671	713	755	838
94	171	214	257	300	343	386	428	471	514	557	600	643	685	728	771	857
95	175	218	262	306	350	394	437	481	525	569	612	656	700	744	788	875
96	178	223	268	313	357	402	446	491	536	581	625	670	715	759	804	893
97	182	227	273	319	364	410	455	501	546	592	637	683	728	774	819	910
98	185	232	278	325	371	418	464	511	557	603	650	696	743	789	836	928
99	189	236	284	331	379	426	473	521	568	614	653	710	757	805	852	947
100	193	241	289	338	386	434	482	531	579	627	675	724	772	820	869	965

Appendix 2 (continued) - Scribner Decimal C Log Rule - 4- to 20-foot Logs

Diameter (inches)	Log lengths in feet														
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20
101	196	246	295	344	393	443	492	541	590	639	688	738	787	836	885	983
102	200	251	301	351	401	452	502	552	602	652	702	753	803	853	903	1003
103	204	256	307	358	409	461	512	563	614	665	716	768	819	870	921	1023
104	208	261	313	365	417	470	522	574	626	678	730	783	835	887	939	1043
105	212	266	319	372	425	479	532	585	638	691	744	798	851	904	957	1063
106	216	271	325	379	433	488	542	596	650	704	758	813	867	921	975	1083
107	221	276	331	387	442	497	553	608	663	718	773	829	884	939	995	1105
108	225	281	337	394	450	506	563	619	675	731	788	844	900	956	1013	1125
109	229	286	344	401	459	516	573	631	688	745	803	860	917	975	1032	1147
110	233	291	350	408	467	525	583	642	700	758	817	875	933	992	1050	1167
111	237	297	356	416	475	535	594	654	713	772	832	891	951	1010	1070	1188
112	241	302	362	423	483	544	604	665	725	785	846	906	967	1027	1088	1208
113	246	307	369	431	492	554	615	677	738	800	861	923	984	1046	1107	1230
114	250	313	375	438	501	563	626	688	751	814	876	939	1001	1064	1127	1252
115	254	318	382	446	509	573	637	700	764	828	891	955	1019	1082	1146	1273
116	259	324	389	454	519	584	648	713	778	843	908	973	1037	1102	1167	1297
117	264	330	396	462	528	594	660	726	792	858	924	990	1056	1122	1188	1320
118	268	336	403	470	537	605	672	739	806	873	940	1008	1075	1142	1209	1343
119	273	341	410	478	547	615	683	752	820	888	957	1025	1093	1162	1230	1367
120	278	347	417	487	556	626	695	765	834	904	973	1043	1112	1182	1251	1390

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Appendix 3 - Long Logs, Volume According to Taper, Maximum Scaling Length 20 Feet

[Scribner Decimal C rule—board feet in tens]

Top diam. (in.)	22-foot logs (1 10- and 1 12-foot segment)								24-foot logs (2 12-foot segments)							
	Taper in inches (difference between diameters of 2 ends)															
	1–2	3–4	5–6	7–8	9–10	11–12	13–14	15–16	1–2	3–4	5–6	7–8	9–10	11–12	13–14	15–16
6	3	3	4	4	5	7	8	10	3	3	4	4	5	7	8	10
7	3	4	4	5	7	8	10	12	4	5	5	6	8	9	11	13
8	5	5	6	8	9	11	13	14	5	5	6	8	9	11	13	14
9	6	7	9	10	12	14	15	17	6	7	9	10	12	14	15	17
10	7	9	10	12	14	15	17	19	7	9	10	12	14	15	17	19
11	10	11	13	15	16	18	20	22	10	11	13	15	16	18	20	22
12	12	14	16	17	19	21	23	26	13	15	17	18	20	22	24	27
13	15	17	18	20	22	24	27	29	16	18	19	21	23	25	28	30
14	18	19	21	23	25	28	30	32	20	21	23	25	27	30	32	34
15	21	23	25	27	30	32	34	37	23	25	27	29	32	34	36	39
16	24	26	28	31	33	35	38	40	26	28	30	33	35	37	40	42
17	28	30	33	35	37	40	42	46	30	32	35	37	39	42	44	48
18	31	34	36	38	41	43	47	50	34	37	39	41	44	46	50	53
19	36	38	40	43	45	49	52	56	39	41	43	46	48	52	55	59
20	40	42	45	47	51	54	58	61	44	46	49	51	55	58	62	65
21	44	47	49	53	56	60	63	65	48	51	53	57	60	64	67	69
22	49	51	55	58	62	65	67	70	53	55	59	62	66	69	71	74
23	53	57	60	64	67	69	72	76	58	62	65	69	72	74	77	81
24	59	62	66	69	71	74	78	80	64	67	71	74	76	79	83	85
25	66	70	73	75	78	82	84	88	71	75	78	80	83	87	89	93
26	72	75	77	80	84	86	90	91	78	81	83	86	90	92	96	97
27	78	80	83	87	89	93	94	100	85	87	90	94	96	100	101	107
28	82	85	89	91	95	96	102	105	90	93	97	99	103	104	110	113
29	87	91	93	97	98	104	107	115	95	99	101	105	106	112	115	123
30	94	96	100	101	107	110	118	121	102	104	108	109	115	118	126	129
31	99	103	104	110	113	121	124	128	108	112	113	119	122	130	133	137
32	105	106	112	115	123	126	130	136	114	115	121	124	132	135	139	145
33	109	115	118	126	129	133	139	144	119	125	128	136	139	143	149	154
34	116	119	127	130	134	140	145	151	126	129	137	140	144	150	155	161
35	124	132	135	139	145	150	156	160	135	143	146	150	156	161	167	171
36	135	138	142	148	153	159	163	169	146	149	153	159	164	170	174	180
37	144	148	154	159	165	169	175	178	157	161	167	172	178	182	188	191
38	151	157	162	168	172	178	181	186	164	170	175	181	185	191	194	199
39	160	165	171	175	181	184	189	194	174	179	185	189	195	198	203	208
40	170	176	180	186	189	194	199	205	185	191	195	201	204	209	214	220
41	180	184	190	193	198	203	209	214	196	200	206	209	214	219	225	230
42	189	195	198	203	208	214	219	224	206	212	215	220	225	231	236	241
43	198	201	206	211	217	222	227	233	216	219	224	229	235	240	245	251
44	207	212	217	223	228	233	239	245	225	230	235	241	246	251	257	263
45	214	219	225	230	235	241	247	253	233	238	244	249	254	260	266	272
46	223	229	234	239	245	251	257	263	243	249	254	259	265	271	277	283
47	234	239	244	250	256	262	268	274	254	259	264	270	276	282	288	294
48	243	248	254	260	266	272	278	284	265	270	276	282	288	294	300	306
49	252	258	264	270	276	282	288	295	275	281	287	293	299	305	311	318
50	263	269	275	281	287	293	300	306	286	292	298	304	310	316	323	329

Refer to code 17.33 for scaling of butt logs.

Appendix 3 (continued) - Long Logs, Volume According to Taper, Maximum Scaling Length 20 Feet

[Scribner Decimal C rule—board feet in tens]

Top diam. (in.)	26- foot logs (1 12- and 1 14-foot segment)								28-foot logs (2 14-foot segments)							
	Taper in inches (difference between diameters of 2 ends)															
	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16
6	3	3	4	5	6	8	9	11	3	3	4	5	6	8	9	11
7	4	5	6	7	9	10	12	14	4	5	6	7	9	10	12	14
8	5	6	7	9	10	12	14	16	5	6	7	9	10	12	14	16
9	7	8	10	11	13	15	17	19	7	8	10	11	13	15	17	19
10	8	10	11	13	15	17	19	22	9	11	12	14	16	18	20	23
11	11	12	14	16	18	20	23	25	12	13	15	17	19	21	24	26
12	14	16	18	20	22	25	27	30	15	17	19	21	23	26	28	31
13	17	19	21	23	26	28	31	34	18	20	22	24	27	29	32	35
14	21	23	25	28	30	33	36	38	22	24	26	29	31	34	37	39
15	25	27	30	32	35	38	40	44	26	28	31	33	36	39	41	45
16	28	31	33	36	39	41	45	47	30	33	35	38	41	43	47	49
17	33	35	38	41	43	47	49	54	35	37	40	43	45	49	51	56
18	37	40	43	45	49	51	56	60	40	43	46	48	52	54	59	63
19	42	45	47	51	53	58	62	66	45	48	50	54	56	61	65	69
20	48	50	54	56	61	65	69	72	51	53	57	59	64	68	72	75
21	52	56	58	63	67	71	74	76	56	60	62	67	71	75	78	80
22	58	60	65	69	73	76	78	82	62	64	69	73	77	80	82	86
23	63	68	72	76	79	81	85	90	68	73	77	81	84	86	90	95
24	70	74	78	81	83	87	92	94	75	79	83	86	88	92	97	99
25	78	82	85	87	91	96	98	103	84	88	91	93	97	102	104	109
26	85	88	90	94	99	101	106	107	92	95	97	101	106	108	113	114
27	92	94	98	103	105	110	111	118	99	101	105	110	112	117	118	125
28	97	101	106	108	113	114	121	125	104	108	113	115	120	121	128	132
29	103	108	110	115	116	123	127	136	110	115	117	122	123	130	134	143
30	111	113	118	119	126	130	139	142	119	121	126	127	134	138	147	150
31	117	122	123	130	134	143	146	151	126	131	132	139	143	152	155	160
32	124	125	132	136	145	148	153	160	133	134	141	145	154	157	162	169
33	129	136	140	149	152	157	164	170	139	146	150	159	162	167	174	180
34	137	141	150	153	158	165	171	177	147	151	160	163	168	175	181	187
35	147	156	159	164	171	177	183	188	158	167	170	175	182	188	194	199
36	159	162	167	174	180	186	191	198	171	174	179	186	192	198	203	210
37	170	175	182	188	194	199	206	210	183	188	195	201	207	212	219	223
38	178	185	191	197	202	209	213	219	191	198	204	210	215	222	226	232
39	189	195	201	206	213	217	223	229	203	209	215	220	227	231	237	243
40	201	207	212	219	223	229	235	241	216	222	227	234	238	244	250	256
41	212	217	224	228	234	240	246	252	228	233	240	244	250	256	262	268
42	223	230	234	240	246	252	258	265	239	246	250	256	262	268	274	281
43	234	238	244	250	256	262	269	275	251	255	261	267	273	279	286	292
44	244	250	256	262	268	275	281	288	262	268	274	280	286	293	299	306
45	253	259	265	271	278	284	291	298	272	278	284	290	297	303	310	317
46	264	270	276	283	289	296	303	310	284	290	296	303	309	316	323	330
47	275	281	288	294	301	308	315	322	296	302	309	315	322	329	336	343
48	287	294	300	307	314	321	328	336	308	315	321	328	335	342	349	357
49	299	305	312	319	326	333	341	348	321	327	334	341	348	355	363	370
50	310	317	324	331	338	346	353	361	334	341	348	355	362	370	377	385

Refer to code 17.33 for scaling of butt logs.

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Appendix 3 (continued) - Long Logs, Volume According to Taper, Maximum Scaling Length 20 Feet

[Scribner Decimal C rule—board feet in tens]

Top diam. (in.)	30- foot logs (1 14- and 1 16-foot segment)								32-foot logs (2 16-foot segments)							
	Taper in inches (difference between diameters of 2 ends)															
	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16
6 ----------	4	4	5	7	8	9	11	12	5	5	6	8	9	10	12	13
7 ----------	5	6	8	9	10	12	13	16	6	7	9	10	11	13	14	17
8 ----------	6	8	9	10	12	13	16	18	7	9	10	11	13	14	17	19
9 ----------	9	10	11	13	14	17	19	21	10	11	12	14	15	18	20	22
10 ----------	11	12	14	15	18	20	22	25	13	14	16	17	20	22	24	27
11 ----------	13	15	16	19	21	23	26	29	15	17	18	21	23	25	28	31
12 ----------	17	18	21	23	25	28	31	35	18	19	22	24	26	29	32	36
13 ----------	19	22	24	26	29	32	36	38	21	24	26	28	31	34	38	40
14 ----------	24	26	28	31	34	38	40	43	25	27	29	32	35	39	41	44
15 ----------	28	30	33	36	40	42	45	50	30	32	35	38	42	44	47	52
16 ----------	32	35	38	42	44	47	52	54	34	37	40	44	46	49	54	56
17 ----------	37	40	44	46	49	54	56	62	39	42	46	48	51	56	58	64
18 ----------	43	47	49	52	57	59	65	69	45	49	51	54	59	61	67	71
19 ----------	49	51	54	59	61	67	71	76	52	54	57	62	64	70	74	79
20 ----------	54	57	62	64	70	74	79	82	58	61	66	68	74	78	83	86
21 ----------	60	65	67	73	77	82	85	88	63	68	70	76	80	85	88	91
22 ----------	67	69	75	79	84	87	90	95	71	73	79	83	88	91	94	99
23 ----------	73	79	83	88	91	94	99	104	78	84	88	93	96	99	104	109
24 ----------	81	85	90	93	96	101	106	109	86	90	95	98	101	106	111	114
25 ----------	90	95	98	101	106	111	114	118	96	101	104	107	112	117	120	124
26 ----------	99	102	105	110	115	118	122	124	105	108	111	116	121	124	128	130
27 ----------	106	109	114	119	122	126	128	136	113	116	121	126	129	133	135	143
28 ----------	112	117	122	125	129	131	139	143	119	124	129	132	136	138	146	150
29 ----------	119	124	127	131	133	141	145	156	127	132	135	139	141	149	153	164
30 ----------	128	131	135	137	145	149	160	164	137	140	144	146	154	158	169	173
31 ----------	136	140	142	150	154	165	169	174	145	149	151	159	163	174	178	183
32 ----------	142	144	152	156	167	171	176	184	152	154	162	166	177	181	186	194
33 ----------	149	157	161	172	176	181	189	196	158	166	170	181	185	190	198	205
34 ----------	158	162	173	177	182	190	197	204	168	172	183	187	192	200	207	214
35 ----------	169	180	184	189	197	204	211	217	180	191	195	200	208	215	222	228
36 ----------	184	188	193	201	208	215	221	229	195	199	204	212	219	226	232	240
37 ----------	197	202	210	217	224	230	238	242	210	215	223	230	237	243	251	255
38 ----------	205	213	220	227	233	241	245	252	219	227	234	241	247	255	259	266
39 ----------	218	225	232	238	246	250	257	264	232	239	246	252	260	264	271	278
40 ----------	232	239	245	253	257	264	271	278	247	254	260	268	272	279	286	293
41 ----------	245	251	259	263	270	277	284	291	261	267	275	279	286	293	300	307
42 ----------	257	265	269	276	283	290	297	304	274	282	286	293	300	307	314	321
43 ----------	270	274	281	288	295	302	309	317	288	292	299	306	313	320	327	335
44 ----------	281	288	295	302	309	316	324	331	300	307	314	321	328	335	343	350
45 ----------	292	299	306	313	320	328	335	343	311	318	325	332	339	347	354	362
46 ----------	305	312	319	326	334	341	349	357	325	332	339	346	354	361	369	377
47 ----------	318	325	332	340	347	355	363	372	339	346	353	361	368	376	384	393
48 ----------	331	338	346	353	361	369	378	386	353	360	368	375	383	391	400	408
49 ----------	344	352	359	367	375	384	392	401	367	375	382	390	398	407	415	424
50 ----------	359	366	374	382	391	399	408	416	382	389	397	405	414	422	431	439

Refer to code 17.33 for scaling of butt logs.

Appendix 3 (continued) - Long Logs, Volume According to Taper, Maximum Scaling Length 20 Feet

[Scribner Decimal C rule—board feet in tens]

Top diam. (in.)	34- foot logs (1 16- and 1 18-foot segment)								35-foot logs (2 18-foot segments)							
	Taper in inches (difference between diameters of 2 ends)															
	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16
6	5	5	6	8	10	11	1.3	15	5	5	6	8	10	11	1.3	15
7	6	7	9	11	12	14	16	19	6	7	9	11	12	14	16	19
8	7	9	11	12	14	16	19	21	7	9	11	12	14	16	19	21
9	10	12	13	15	17	20	22	25	10	12	13	15	17	20	22	25
10	14	15	17	19	22	24	27	30	14	15	17	19	22	24	27	30
11	16	18	20	23	25	28	31	34	17	19	21	24	26	29	32	35
12	19	21	24	26	29	32	35	39	20	22	25	27	30	33	36	40
13	23	26	28	31	34	37	41	44	24	27	29	32	35	38	42	45
14	27	29	32	35	38	42	45	49	29	31	34	37	40	44	47	51
15	32	35	38	41	45	48	52	56	34	37	40	43	47	50	54	58
16	37	40	43	47	50	54	58	61	39	42	45	49	52	56	60	63
17	42	45	49	52	56	60	63	70	45	48	52	55	59	63	66	73
18	48	52	55	59	63	66	73	77	51	55	58	62	66	69	76	80
19	55	58	62	66	69	76	80	86	58	61	65	69	72	79	83	89
20	62	66	70	73	80	84	90	93	65	69	73	76	83	87	93	96
21	68	72	75	82	86	92	95	98	72	76	79	86	90	96	99	102
22	75	78	85	89	95	98	101	107	80	83	90	94	100	103	106	112
23	83	90	94	100	103	106	112	118	87	94	98	104	107	110	116	122
24	92	96	102	105	108	114	120	123	97	101	107	110	113	119	125	128
25	102	108	111	114	120	126	129	134	108	114	117	120	126	132	135	140
26	112	115	118	124	130	133	138	140	118	121	124	130	136	139	144	146
27	120	123	129	135	138	143	145	153	127	130	136	142	145	150	152	160
28	126	132	138	141	146	148	156	162	133	139	145	148	153	155	163	169
29	135	141	144	149	151	159	165	177	142	148	151	156	158	166	172	184
30	146	149	154	156	164	170	182	186	154	157	162	164	172	178	190	194
31	154	159	161	169	175	187	191	197	163	168	170	178	184	196	200	206
32	162	164	172	178	190	194	200	209	171	173	181	187	199	203	209	218
33	168	176	182	194	198	204	213	221	178	186	192	204	208	214	223	231
34	178	184	196	200	206	215	223	231	188	194	206	210	216	225	233	241
35	192	204	208	214	223	231	239	245	202	214	218	224	233	241	249	255
36	208	212	218	227	235	243	249	258	220	224	230	239	247	255	261	270
37	223	229	238	246	254	260	269	274	236	242	251	259	267	273	282	287
38	233	242	250	258	264	273	278	285	246	255	263	271	277	286	291	298
39	247	255	263	269	278	283	290	298	261	269	277	283	292	297	304	312
40	263	271	277	286	291	298	306	314	278	286	292	301	306	313	321	329
41	278	284	293	298	305	313	321	329	294	300	309	314	321	329	337	345
42	291	300	305	312	320	328	336	345	308	317	322	329	337	345	353	362
43	306	311	318	326	334	342	351	359	323	328	335	343	351	359	368	376
44	319	326	334	342	350	359	367	376	337	344	352	360	368	377	385	394
45	330	338	346	354	363	371	380	389	349	357	365	373	382	390	399	408
46	345	353	361	370	378	387	396	405	364	372	380	389	397	406	415	424
47	360	368	377	385	394	403	412	421	380	388	397	405	414	423	432	441
48	375	384	392	401	410	419	428	437	396	405	413	422	431	440	449	458
49	391	399	408	417	426	435	444	454	413	421	430	439	448	457	466	476
50	406	415	424	433	442	451	461	471	430	439	448	457	466	475	485	495

Refer to code 17.33 for scaling of butt logs.

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NATIONAL FOREST LOG SCALING HANDBOOK
APPENDIX

Appendix 3 (continued) - Long Logs, Volume According to Taper, Maximum Scaling Length 20 Feet

[Scribner Decimal C rule—board feet in tens]

Top diam. (in.)	38- foot logs (1 18- and 1 20-foot segment)								40-foot logs (2 20-foot segments)							
	Taper in inches (difference between diameters of 2 ends)															
	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16
6 ----------	5	5	6	9	10	12	14	16	5	5	6	9	10	12	14	16
7 ----------	6	7	10	11	13	15	17	21	6	7	10	11	13	15	17	21
8 ----------	7	10	11	13	15	17	21	23	7	10	11	13	15	17	21	23
9 ----------	11	12	14	16	18	22	24	27	11	12	14	16	18	22	24	27
10 ----------	14	16	18	20	24	26	29	33	15	17	19	21	25	27	30	34
11 ----------	18	20	22	26	28	31	35	38	18	20	22	26	28	31	35	38
12 ----------	21	23	27	29	32	36	39	44	22	24	28	30	33	37	40	45
13 ----------	25	29	31	34	38	41	46	49	26	30	32	35	39	42	47	50
14 ----------	31	33	36	40	43	48	51	55	32	34	37	41	44	49	52	56
15 ----------	36	39	43	46	51	54	58	63	38	41	45	48	53	56	60	65
16 ----------	41	45	48	53	56	60	65	68	43	47	50	55	58	62	67	70
17 ----------	48	51	56	59	63	68	71	78	50	53	58	61	65	70	73	80
18 ----------	54	59	62	66	71	74	81	86	57	62	65	69	74	77	84	89
19 ----------	62	65	69	74	77	84	89	95	65	68	72	77	80	87	92	98
20 ----------	69	73	78	81	88	93	99	104	73	77	82	85	92	97	103	108
21 ----------	76	81	84	91	96	102	107	110	80	85	88	95	100	106	111	114
22 ----------	85	88	95	100	106	111	114	120	89	92	99	104	110	115	118	124
23 ----------	92	99	104	110	115	118	124	131	97	104	109	115	120	123	129	136
24 ----------	102	107	113	118	121	127	134	137	107	112	118	123	126	132	139	142
25 ----------	114	120	125	128	134	141	144	150	119	125	130	133	139	146	149	155
26 ----------	124	129	132	138	145	148	154	156	130	135	138	144	151	154	160	162
27 ----------	135	138	144	151	154	160	162	171	141	144	150	157	160	166	168	177
28 ----------	141	147	154	157	163	165	174	180	149	155	162	165	171	173	182	188
29 ----------	150	157	160	166	168	177	183	197	158	165	168	174	176	185	191	205
30 ----------	163	166	172	174	183	189	203	207	171	174	180	182	191	197	211	215
31 ----------	172	178	180	189	195	209	213	220	181	187	189	198	204	218	222	229
32 ----------	181	183	192	198	212	216	223	233	190	192	201	207	221	225	232	242
33 ----------	188	197	203	217	221	228	238	247	198	207	213	227	231	238	248	257
34 ----------	199	205	219	223	230	240	249	258	209	215	229	233	240	250	259	268
35 ----------	213	227	231	238	248	257	266	272	224	238	242	249	259	268	277	283
36 ----------	233	237	244	254	263	272	278	289	244	248	255	265	274	283	289	300
37 ----------	249	256	266	275	284	290	301	306	262	269	279	288	297	303	314	319
38 ----------	260	270	279	288	294	305	310	318	273	283	292	301	307	318	323	331
39 ----------	276	285	294	300	311	316	324	333	290	299	308	314	325	330	338	347
40 ----------	294	303	309	320	325	333	342	351	309	318	324	335	340	348	357	366
41 ----------	311	317	328	333	341	350	359	368	327	333	344	349	357	366	375	384
42 ----------	325	336	341	349	358	367	376	385	342	353	358	366	375	384	393	402
43 ----------	342	347	355	364	373	382	391	400	359	364	372	381	390	399	408	417
44 ----------	356	364	373	382	391	400	409	419	375	383	392	401	410	419	428	438
45 ----------	369	378	387	396	405	414	424	434	388	397	406	415	424	433	443	453
46 ----------	385	394	403	412	421	431	441	451	405	414	423	432	441	451	461	471
47 ----------	402	411	420	429	439	449	459	469	423	432	441	450	460	470	480	490
48 ----------	419	428	437	447	457	467	477	488	441	450	459	469	479	489	499	510
49 ----------	436	445	455	465	475	485	496	506	459	468	478	488	498	508	519	529
50 ----------	454	464	474	484	494	505	515	526	477	487	497	507	517	528	538	549

Refer to code 17.33 for scaling of butt logs.

Appendix 3 (continued) - Long Logs, Volume According to Taper, Maximum Scaling Length 20 Feet

[Scribner Decimal C rule—board feet in tens]

Top diam. (in,)	42-foot logs (three 14-foot segments)										44-foot logs (two 14- and one 16-foot segments)									
	Taper in inches (difference between diameters of 2 ends)																			
	1	2-3	4	5-6	7	8-9	10	11-12	13	14-15	1	2-3	4	5-6	7	8-9	10	11-12	13	14-15
6	5	5	6	7	9	11	13	15	18	20	6	6	7	9	11	12	15	16	20	22
7	6	7	9	10	13	14	17	19	23	25	7	8	11	12	14	16	18	21	25	27
8	8	9	11	13	15	17	21	23	26	29	9	11	13	14	17	18	23	25	28	31
9	11	12	15	16	20	22	25	27	32	34	13	14	16	18	21	24	27	29	34	37
10	14	16	19	21	24	26	30	33	37	40	16	17	21	22	26	28	32	35	40	44
11	19	20	23	25	29	31	36	38	43	46	20	22	24	27	31	33	38	41	47	49
12	23	25	29	31	35	38	42	45	50	52	25	26	31	33	37	40	45	49	53	56
13	28	30	34	36	41	43	48	51	55	60	29	32	36	38	43	46	52	54	60	65
14	34	36	40	43	47	50	56	58	64	66	36	38	42	45	50	54	59	62	69	71
15	40	42	47	49	55	58	62	66	71	76	42	44	49	52	59	61	66	71	76	82
16	46	49	54	57	62	64	71	73	81	85	48	51	57	61	65	68	76	78	87	91
17	54	56	61	64	69	73	78	83	89	93	56	59	65	67	73	78	83	89	95	100
18	61	64	70	72	79	81	88	92	100	103	64	68	73	76	84	86	94	98	107	110
19	69	72	77	81	85	90	98	102	107	109	73	75	81	86	90	96	104	109	114	117
20	78	80	86	88	97	101	107	110	117	121	81	84	91	93	103	107	114	117	125	130
21	85	89	95	100	106	110	118	120	128	133	89	94	100	106	112	117	125	128	137	142
22	95	97	104	108	117	120	126	130	139	141	100	102	110	114	124	127	134	139	148	151
23	103	108	117	121	128	130	138	143	148	153	108	114	123	128	135	138	147	152	158	162
24	115	119	127	130	136	140	148	150	157	158	121	125	134	137	144	149	157	160	166	168
25	128	132	139	141	148	153	157	162	167	174	134	139	146	149	157	162	167	171	177	185
26	140	143	148	152	159	161	170	171	183	187	147	150	156	161	168	171	179	181	194	198
27	150	152	158	163	169	174	180	187	193	202	157	160	167	172	179	183	190	198	204	215
28	157	161	170	172	182	183	192	196	210	213	165	170	179	182	191	193	203	207	223	227
29	167	172	179	184	187	194	203	212	216	221	176	181	189	193	197	205	214	225	230	235
30	181	183	190	191	203	207	217	220	232	239	190	193	199	201	214	218	230	234	246	254
31	190	195	201	208	213	222	232	237	248	254	200	204	211	219	224	235	246	251	263	270
32	202	203	211	215	231	234	243	250	265	271	211	213	222	226	244	248	257	265	281	288
33	209	216	227	236	243	248	264	270	279	284	219	227	238	249	257	262	279	286	296	302
34	224	228	241	244	258	265	274	280	290	297	235	239	254	258	272	280	290	297	308	316
35	239	248	260	265	275	281	292	297	311	315	250	261	274	279	290	297	309	315	330	334
36	261	264	272	279	290	296	308	315	325	331	274	278	286	294	306	313	326	334	344	351
37	276	281	293	299	312	317	330	334	346	352	290	295	308	315	329	335	349	353	366	373
38	289	296	309	315	326	333	343	349	360	366	303	311	325	332	344	352	362	369	381	388
39	308	314	326	331	344	348	359	365	378	384	323	330	343	349	363	367	379	386	400	407
40	327	333	344	351	360	366	379	385	395	402	343	350	362	370	379	386	400	407	418	425
41	345	350	362	366	379	385	395	401	414	420	362	368	381	385	399	406	417	424	437	445
42	361	368	379	385	395	401	413	420	432	439	379	387	398	405	416	423	436	443	457	464
43	380	384	394	400	412	418	431	437	450	457	399	403	414	421	434	441	454	462	475	483
44	395	401	413	419	431	438	450	457	470	477	414	421	434	441	454	461	475	482	496	504
45	411	417	429	435	448	454	467	474	488	495	431	438	451	458	471	479	492	500	515	524
46	429	435	447	454	466	473	487	494	507	515	450	457	470	477	491	498	513	521	536	544
47	447	453	466	472	486	493	506	513	528	535	469	476	489	497	511	519	533	542	557	566
48	465	472	485	492	505	512	526	534	548	556	488	495	510	517	531	539	555	563	579	587
49	485	491	504	511	525	532	547	554	569	577	508	516	529	537	552	561	576	585	600	609
50	504	511	525	532	546	554	568	576	591	599	529	536	551	559	575	583	599	607	623	632

Refer to code 17.33 for scaling of butt logs.

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Appendix 3 (continued) - Long Logs, Volume According to Taper, Maximum Scaling Length 20 Feet

[Scribner Decimal C rule—board feet in tens]

Top diam. (in.)	46-foot logs (1 14-foot and 2 16-foot segments)										48-foot logs (3 16-foot segments)									
	Taper in inches (difference between diameters of 2 ends)																			
	1	2-3	4	5-6	7	8-9	10	11-12	13	14-15	1	2-3	4	5-6	7	8-9	10	11-12	13	14-15
6	7	7	8	10	12	13	17	18	22	24	8	8	9	11	13	14	18	19	23	25
7	8	9	12	13	16	18	20	23	26	28	9	10	13	14	17	19	21	24	27	29
8	10	12	15	16	19	20	24	26	30	33	11	13	16	17	20	21	25	27	31	34
9	15	16	18	20	22	25	29	31	35	38	16	17	19	21	23	26	30	32	36	39
10	18	19	22	23	28	30	33	36	43	46	20	21	24	25	30	32	35	38	44	48
11	21	23	26	29	32	34	40	43	49	51	23	25	28	31	34	36	42	45	51	53
12	27	28	32	34	39	42	47	51	55	58	28	29	33	35	40	43	48	52	56	59
13	30	33	38	40	45	48	54	56	62	67	32	35	40	42	47	50	56	58	64	69
14	38	40	44	47	52	56	61	64	72	74	39	41	45	48	53	57	62	65	73	75
15	44	46	51	54	61	63	69	74	80	86	46	48	53	56	63	65	71	76	82	88
16	50	53	59	63	68	71	80	82	90	94	52	55	61	65	70	73	82	84	92	96
17	58	61	68	70	77	82	86	92	99	104	60	63	70	72	79	84	88	94	101	106
18	67	71	77	80	87	89	98	102	112	115	69	73	79	82	89	91	100	104	114	117
19	77	79	84	89	94	100	109	114	119	122	80	82	87	92	97	103	112	117	122	125
20	84	87	95	97	108	112	119	122	131	136	88	91	99	101	112	116	123	126	135	140
21	93	98	105	111	117	122	131	134	143	148	96	101	108	114	120	125	134	137	146	151
22	105	107	115	119	130	133	140	145	155	158	109	111	119	123	134	137	144	149	159	162
23	113	119	129	134	141	144	154	159	165	169	118	124	134	139	146	149	159	164	170	174
24	127	131	140	143	151	156	164	167	174	176	132	136	145	148	156	161	169	172	179	181
25	140	145	153	156	164	169	175	179	186	194	146	151	159	162	170	175	181	185	192	200
26	154	157	163	168	176	179	188	190	203	207	160	163	169	174	182	185	194	196	209	213
27	164	167	175	180	188	192	199	207	214	225	171	174	182	187	195	199	206	214	221	232
28	173	178	188	191	200	202	213	217	232	236	180	185	195	198	207	209	220	224	239	243
29	185	190	198	202	207	215	223	234	240	245	193	198	206	210	215	223	231	242	248	253
30	199	202	209	211	223	227	240	244	257	265	208	211	218	220	232	236	249	253	266	274
31	210	214	220	228	234	245	257	262	274	281	219	223	229	237	243	254	266	271	283	290
32	220	222	232	236	255	259	268	276	294	301	230	232	242	246	265	269	278	286	304	311
33	229	237	249	260	268	273	292	299	310	316	238	246	258	269	277	282	301	308	319	325
34	246	250	265	269	285	293	304	311	322	330	256	260	275	279	295	303	314	321	332	340
35	261	272	287	292	304	311	323	329	345	349	272	283	298	303	315	322	334	340	356	360
36	287	291	300	308	320	327	341	349	360	367	298	302	311	319	331	338	352	360	371	378
37	304	309	322	329	344	350	365	369	383	390	317	322	335	342	357	363	378	382	396	403
38	317	325	340	347	360	368	379	386	399	406	331	339	354	361	374	382	393	400	413	420
39	338	345	359	365	380	384	397	404	419	426	352	359	373	379	394	398	411	418	433	440
40	359	366	379	387	397	404	419	426	437	444	374	381	394	402	412	419	434	441	452	459
41	379	385	399	403	418	425	436	443	457	465	395	401	415	419	434	441	452	459	473	481
42	397	405	417	424	435	442	456	463	478	485	414	422	434	441	452	459	473	480	495	502
43	418	422	433	440	454	461	475	483	497	505	436	440	451	458	472	479	493	501	515	523
44	433	440	454	461	475	482	497	504	519	527	452	459	473	480	494	501	516	523	538	546
45	451	458	472	479	493	501	515	523	538	547	470	477	491	498	512	520	534	542	557	566
46	471	478	492	499	514	521	536	544	561	569	491	498	512	519	534	541	556	564	581	589
47	491	498	512	520	534	542	558	567	582	591	512	519	533	541	555	563	579	588	603	612
48	511	518	533	540	556	564	580	588	605	613	533	540	555	562	578	586	602	610	627	635
49	531	539	554	562	577	586	602	611	627	636	554	562	577	585	600	609	625	634	650	659
50	554	561	576	584	601	609	626	634	652	661	577	584	599	607	624	632	649	657	675	684

Refer to code 17.33 for scaling of butt logs.

Appendix 4 - Deductions for Squared Defects From Solid Board-foot Contents, Based on Formula[1]

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches [2]	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16 [3]	17 [3]	18 [3]	19 [3]	20 [3]
2×2	------	------	------	------	------	------	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
3×3	------	0.5	0.5	0.5	0.5	0.5	.5	.5	.5	1	1	1	1	1	1	1	1
4×4	0.5	.5	.5	1	1	1	1	1	1	1	1	2	2	2	2	2	2
5×5	.5	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3
6×6	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5
7×7	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7
8×8	2	2	3	3	3	4	4	5	5	6	6	6	7	7	8	8	9
9×9	2	3	3	4	4	5	5	6	6	7	8	8	9	9	10	10	11
10×10	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12	13	13
11×11	3	4	5	6	6	7	8	9	10	10	11	12	13	14	15	15	16
12×12	4	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19
13×13	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	23
14×14	5	7	8	9	10	12	13	14	16	17	18	20	21	22	24	25	26
15×15	6	8	9	10	12	14	15	16	18	20	21	22	24	26	27	28	30
16×16	7	9	10	12	14	15	17	19	20	22	24	26	27	29	31	32	34

[1] Formula is: $\frac{\text{Width of defect in inches} \times \text{height in inches} \times \text{length in feet}}{15}$

Derivation: $X = \frac{W \times H \times L}{12} \times \frac{80}{100} = \frac{W \times H \times L}{15}$

$\frac{80}{100}$ represents contents in board feet less 20 percent for saw kerf.

[2] This is the measurement of the defect including 1-inch allowance for waste.

[3] Use average widths and heights for both ends of defect.

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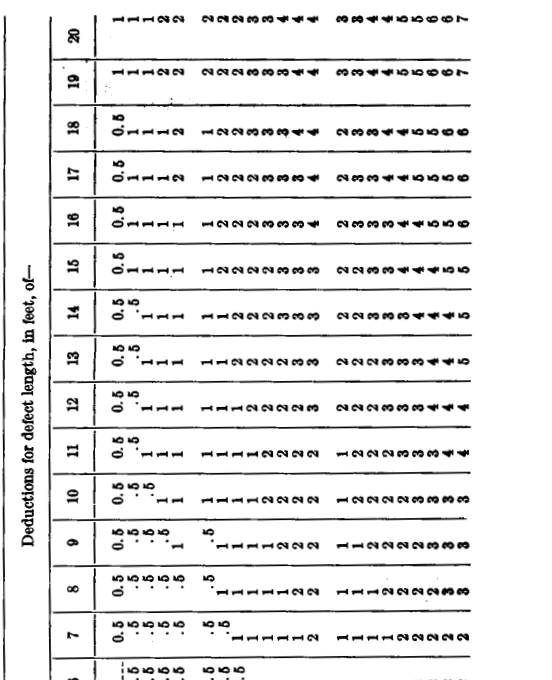
Appendix 4 (continued) - Deductions for Squared Defects From Solid Board-foot Contents, Based on Formula[1]

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches[3]	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16[3]	17[3]	18[3]	19[3]	20[3]
17×17	8	10	12	13	15	17	19	21	23	25	27	29	31	33	35	37	39
18×18	9	11	13	15	17	19	22	24	26	28	30	32	35	37	39	41	43
19×19	10	12	14	17	19	22	24	26	29	31	34	36	39	41	43	46	48
20×20	11	13	16	19	21	24	27	29	32	35	37	40	43	45	48	51	53
21×21	12	15	18	21	24	26	29	32	35	38	41	44	47	50	53	56	59
22×22	13	16	19	23	26	29	32	35	39	42	45	48	52	55	58	61	65
23×23	14	18	21	25	28	32	35	39	42	46	49	53	56	60	63	67	71
24×24	15	19	23	27	31	35	38	42	46	50	54	58	61	65	69	73	77
25×25	17	21	25	29	33	38	42	46	50	54	58	63	67	71	75	79	83
26×26	18	23	27	32	36	41	45	50	54	59	63	68	72	77	81	86	90
27×27	19	24	29	34	39	44	49	53	58	63	68	73	78	83	87	92	97
28×28	21	26	31	37	42	47	52	57	63	68	73	78	84	89	94	99	105
29×29	22	28	34	39	45	50	56	62	67	73	78	84	90	95	101	107	112
30×30	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120

See footnotes on preceding page.

Appendix 5 - Deductions for Rectangular Defects, From Solid Board-foot Contents



[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																			
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2X3	----	----	----	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1
4	0.5	0.5	0.5	.5	.5	.5	.5	.5	.5	.5	.5	1	1	1	1	1	1
5	.5	.5	.5	.5	.5	.5	.5	1	1	1	1	1	1	1	1	1	1
6	.5	.5	.5	.5	.5	.5	1	1	1	1	1	1	1	1	2	2	2
7	.5	.5	.5	.5	.5	1	1	1	1	1	1	1	1	2	2	2	2
3X4	.5	.5	.5	.5	.5	.5	1	1	1	1	1	1	1	1	1	2	2
5	.5	.5	.5	.5	1	1	1	1	1	1	1	2	2	2	2	2	2
6	.5	.5	.5	.5	1	1	1	1	2	2	2	2	2	2	2	2	2
7	.5	.5	.5	1	1	1	1	2	2	2	2	2	2	2	3	3	3
8	.5	.5	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4
9	.5	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4	4
10	1	1	1	1	1	2	2	2	3	3	3	3	4	4	4	4	4
11	1	1	1	2	2	2	2	2	3	3	3	4	4	4	4	4	4
4X5	.5	.5	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
6	.5	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3
7	.5	1	1	1	1	2	2	2	2	3	3	3	3	3	3	4	4
8	1	1	1	1	2	2	2	2	3	3	3	4	4	4	4	4	4
9	1	1	1	2	2	2	2	3	3	3	4	4	4	4	4	5	5
10	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	5	6
11	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6
12	1	1	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7
13	1	2	2	2	3	3	4	4	4	5	5	5	6	6	6	7	7

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Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
5×6	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4
7	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	5
8	1	1	2	2	2	2	3	3	3	3	4	4	4	5	5	5	5
9	1	2	2	2	2	3	3	3	4	4	4	4	5	5	5	6	6
10	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7
11	1	2	2	3	3	3	4	4	4	5	5	6	6	6	7	7	7
12	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	8
13	2	2	3	3	3	4	4	5	5	6	6	6	7	7	8	8	9
14	2	2	3	3	4	4	5	5	6	6	7	7	7	8	8	9	9
15	2	2	3	4	4	4	5	6	6	6	7	8	8	8	9	10	10
16	2	3	3	4	4	5	5	6	6	7	7	8	9	9	10	10	11
6×7	1	1	2	2	2	3	3	3	3	4	4	4	4	5	5	5	6
8	1	2	2	2	3	3	3	4	4	4	4	5	5	5	6	6	6
9	1	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7
10	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	8
11	2	2	3	3	4	4	4	5	5	6	6	7	7	7	8	8	9
12	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10
13	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10
14	2	3	3	4	4	5	6	6	7	7	8	8	9	10	10	11	11
15	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	11	12
16	3	3	4	4	5	6	6	7	8	8	9	10	10	11	12	12	13
17	3	3	4	5	5	6	7	7	8	9	10	10	11	12	12	13	14
18	3	4	4	5	6	6	7	8	9	9	10	11	12	12	13	14	14
19	3	4	5	5	6	7	8	8	9	10	11	11	12	13	14	14	15
20	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16
21	3	4	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17
22	4	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18

Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
7×8	1	2	2	3	3	3	4	4	4	5	5	6	6	6	7	7	7
9	2	2	3	3	3	4	4	5	5	5	6	6	7	7	8	8	8
10	2	2	3	3	4	4	5	5	6	6	7	7	7	8	8	9	9
11	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10
12	2	3	3	4	4	5	6	6	7	7	8	8	9	10	10	11	11
13	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	12	12
14	3	3	4	5	5	6	7	7	8	8	9	10	10	11	12	12	13
15	3	4	4	5	6	6	7	8	8	9	10	10	11	12	13	13	14
16	3	4	4	5	6	7	7	8	9	10	10	11	12	13	13	14	15
17	3	4	5	6	6	7	8	9	10	10	11	12	13	13	14	15	16
18	3	4	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17
19	4	4	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18
20	4	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19
21	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
22	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21
23	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21
24	4	6	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22
8×9	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10
10	2	3	3	4	4	5	5	6	6	7	7	8	9	9	10	10	11
11	2	3	4	4	5	5	6	6	7	8	8	9	9	10	11	11	12
12	3	3	4	4	5	6	6	7	8	8	9	10	10	11	12	12	13
13	3	3	4	5	6	6	7	8	8	9	10	10	11	12	12	13	14
14	3	4	4	5	6	7	7	8	9	10	10	11	12	13	13	14	15
15	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16
16	3	4	5	6	7	8	9	9	10	11	12	13	14	15	15	16	17
17	4	5	5	6	7	8	9	10	11	12	13	14	15	15	16	17	18
18	4	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19
19	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	4	5	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21

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Appendix 5 - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
8×21	4	6	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22
22	5	6	7	8	9	11	12	13	14	15	16	18	19	20	21	22	23
23	5	6	7	9	10	11	12	13	15	16	17	18	20	21	22	23	25
24	5	6	8	9	10	12	13	14	15	17	18	19	20	22	23	24	26
25	5	7	8	9	11	12	13	15	16	17	19	20	21	23	24	25	27
26	6	7	8	10	11	12	14	15	17	18	19	21	22	24	25	26	28
27	6	7	9	10	12	13	14	16	17	19	20	22	23	24	26	27	29
28	6	7	9	10	12	13	15	16	18	19	21	22	24	25	27	28	30
29	6	8	9	11	12	14	15	17	19	20	22	23	25	26	28	29	31
30	6	8	10	11	13	14	16	18	19	21	22	24	26	27	29	30	32
9×10	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	11	12
11	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12	13	13
12	3	4	4	5	6	6	7	8	9	9	10	11	12	12	13	14	14
13	3	4	5	5	6	7	8	9	9	10	11	12	12	13	14	15	16
14	3	4	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17
15	4	4	5	6	7	8	9	10	11	12	13	14	14	15	16	17	18
16	4	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19
17	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
18	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	21	22
19	5	6	7	8	9	10	11	13	14	15	16	17	18	19	21	22	23
20	5	6	7	8	10	11	12	13	14	16	17	18	19	20	22	23	24
21	5	6	8	9	10	11	13	14	15	16	18	19	20	21	23	24	25
22	5	7	8	9	11	12	13	15	16	17	18	20	21	22	24	25	26
23	6	7	8	10	11	12	14	15	17	18	19	21	22	23	25	26	28
24	6	7	9	10	12	13	14	16	17	19	20	22	23	24	26	27	29

Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
9×25	6	8	9	10	12	14	15	16	18	20	21	22	24	26	27	28	30
26	6	8	9	11	12	14	16	17	19	20	22	23	25	27	28	30	31
27	6	8	10	11	13	15	16	18	19	21	23	24	26	28	29	31	32
28	7	8	10	12	13	15	17	18	20	22	24	25	27	29	30	32	34
29	7	9	10	12	14	16	17	19	21	23	24	26	28	30	31	33	35
30	7	9	11	13	14	16	18	20	22	23	25	27	29	31	32	34	36
10×11	3	4	4	5	6	7	7	8	9	10	10	11	12	12	13	14	15
12	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16
13	3	4	5	6	7	8	9	10	10	11	12	13	14	15	16	16	17
14	4	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19
15	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
16	4	5	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21
17	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	22	23
18	5	6	7	8	10	11	12	13	14	16	17	18	19	20	22	23	24
19	5	6	8	9	10	11	13	14	15	16	18	19	20	22	23	24	25
20	5	7	8	9	11	12	13	15	16	17	19	20	21	23	24	25	27
21	6	7	8	10	11	13	14	15	17	18	20	21	22	24	25	27	28
22	6	7	9	10	12	13	15	16	18	19	21	22	23	25	26	28	29
23	6	8	9	11	12	14	15	17	18	20	21	23	25	26	28	29	31
24	6	8	10	11	13	14	16	18	19	21	22	24	26	27	29	30	32
25	7	8	10	12	13	15	17	18	20	22	23	25	27	28	30	32	33
26	7	9	10	12	14	16	17	19	21	23	24	26	28	29	31	33	35
27	7	9	11	13	14	16	18	20	22	23	25	27	29	31	32	34	36
28	7	9	11	13	15	17	19	21	22	24	26	28	30	32	34	35	37
29	8	10	12	14	15	17	19	21	23	25	27	29	31	33	35	37	39
30	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40

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Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
11X12	4	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18
13	4	5	6	7	8	9	10	10	11	12	13	14	15	16	17	18	19
14	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21
15	4	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22
16	5	6	7	8	9	11	12	13	14	15	16	18	19	20	21	22	23
17	5	6	7	9	10	11	12	14	15	16	17	19	20	21	22	24	25
18	5	7	8	9	11	12	13	15	16	17	18	20	21	22	24	25	26
19	6	7	8	10	11	13	14	15	17	18	20	21	22	24	25	26	28
20	6	7	9	10	12	13	15	16	18	19	21	22	23	25	26	28	29
21	6	8	9	11	12	14	15	17	18	20	22	23	25	26	28	29	31
22	6	8	10	11	13	15	16	18	19	21	23	24	26	27	29	31	32
23	7	8	10	12	13	15	17	19	20	22	24	25	27	29	30	32	34
24	7	9	11	12	14	16	18	19	21	23	25	26	28	30	32	33	35
25	7	9	11	13	15	16	18	20	22	24	26	28	29	31	33	35	37
26	8	10	11	13	15	17	19	21	23	25	27	29	31	32	34	36	38
27	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
28	8	10	12	14	16	18	21	23	25	27	29	31	33	35	37	39	41
29	9	11	13	15	17	19	21	23	26	28	30	32	34	36	38	40	43
30	9	11	13	15	18	20	22	24	26	29	31	33	35	37	40	42	44
12X13	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21
14	4	6	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22
15	5	6	7	8	10	11	12	13	14	16	17	18	19	20	22	23	24
16	5	6	8	9	10	12	13	14	15	17	18	19	20	22	23	24	26
17	5	7	8	10	11	12	14	15	16	18	19	20	22	23	24	26	27
18	6	7	9	10	12	13	14	16	17	19	20	22	23	24	26	27	29
19	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	30
20	6	8	10	11	13	14	16	18	19	21	22	24	26	27	29	30	32

Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
12X21	7	8	10	12	13	15	17	18	20	22	24	25	27	29	30	32	34
22	7	9	11	12	14	16	18	19	21	23	25	26	28	30	32	33	35
23	7	9	11	13	15	17	18	20	22	24	26	28	29	31	33	35	37
24	8	10	12	13	15	17	19	21	23	25	27	29	31	33	35	36	38
25	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
26	8	10	12	15	17	19	21	23	25	27	29	31	33	35	37	40	42
27	9	11	13	15	17	19	22	24	26	28	30	32	35	37	39	41	43
28	9	11	13	16	18	20	22	25	27	29	31	34	36	38	40	43	45
29	9	12	14	16	19	21	23	26	28	30	33	35	37	39	42	44	46
30	10	12	14	17	19	22	24	26	29	31	34	36	38	41	43	46	48
13X14	5	6	7	8	10	11	12	13	15	16	17	18	19	21	22	23	24
15	5	6	8	9	10	12	13	14	16	17	18	20	21	22	23	25	26
16	6	7	8	10	11	12	14	15	17	18	19	21	22	24	25	26	28
17	6	7	9	10	12	13	15	16	18	19	21	22	24	25	27	28	29
18	6	8	9	11	12	14	16	17	19	20	22	23	25	27	28	30	31
19	7	8	10	12	13	15	16	18	20	21	23	25	26	28	30	31	33
20	7	9	10	12	14	16	17	19	21	23	24	26	28	29	31	33	35
21	7	9	11	13	15	16	18	20	22	24	25	27	29	31	33	35	36
22	8	10	11	13	15	17	19	21	23	25	27	29	31	32	34	36	38
23	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
24	8	10	12	15	17	19	21	23	25	27	29	31	33	35	37	40	42
25	9	11	13	15	17	20	22	24	26	28	30	32	35	37	39	41	43
26	9	11	14	16	18	20	23	25	27	29	32	34	36	38	41	43	45
27	9	12	14	16	19	21	23	26	28	30	33	35	37	40	42	44	47
28	10	12	15	17	19	22	24	27	29	32	34	36	39	31	44	46	49
29	10	13	15	18	20	23	25	28	30	33	35	38	40	43	45	48	50
30	10	13	16	18	21	23	26	29	31	34	36	39	42	44	47	49	52

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Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
14×15	6	7	8	10	11	13	14	15	17	18	20	21	22	24	25	27	28
16	6	7	9	10	12	13	15	16	18	19	21	22	24	25	27	28	30
17	6	8	10	11	13	14	16	17	19	21	22	24	25	27	29	30	32
18	7	8	10	12	13	15	17	18	20	22	24	25	27	29	30	32	34
19	7	9	11	12	14	16	18	20	21	23	25	27	28	30	32	34	35
20	7	9	11	13	15	17	19	21	22	24	26	28	30	32	34	35	37
21	8	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37	39
22	8	10	12	14	16	18	21	23	25	27	29	31	33	35	37	39	41
23	9	11	13	15	17	19	21	24	26	28	30	32	34	36	39	41	43
24	9	11	13	16	18	20	22	25	27	29	31	34	36	38	40	43	45
25	9	12	14	16	19	21	23	26	28	30	33	35	37	40	42	44	47
26	10	12	15	17	19	22	24	27	29	32	34	36	39	41	44	46	49
27	10	13	15	18	20	23	25	28	30	33	35	38	40	43	45	48	50
28	10	13	16	18	21	24	26	29	31	34	37	39	42	44	47	50	52
29	11	14	16	19	22	24	27	30	32	35	38	41	43	46	49	51	54
30	11	14	17	20	22	25	28	31	34	36	39	42	45	48	50	53	56
15×16	6	8	10	11	13	14	16	18	19	21	22	24	26	27	29	30	32
17	7	8	10	12	14	15	17	19	20	22	24	26	27	29	31	32	34
18	7	9	11	13	14	16	18	20	22	23	25	27	29	31	32	34	36
19	8	10	11	13	15	17	19	21	23	25	27	28	30	32	34	36	38
20	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
21	8	10	13	15	17	19	21	23	25	27	29	32	34	36	38	40	42
22	9	11	13	15	18	20	22	24	26	29	31	33	35	37	40	42	44
23	9	12	14	16	18	21	23	25	28	30	32	34	37	39	41	44	46
24	10	12	14	17	19	22	24	26	29	31	34	36	38	41	43	46	48
25	10	12	15	18	20	22	25	28	30	32	35	38	40	42	45	48	50

Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
15×26	10	13	16	18	21	23	26	29	31	34	36	39	42	44	47	49	52
27	11	14	16	19	22	24	27	30	32	35	38	40	43	46	49	51	54
28	11	14	17	20	22	25	28	31	34	36	39	42	45	48	50	53	56
29	12	14	17	20	23	26	29	32	35	38	41	44	46	49	52	55	58
30	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
16×17	7	9	11	13	15	16	18	20	22	24	25	27	29	31	33	34	36
18	8	10	12	13	15	17	19	21	23	25	27	29	31	33	35	36	38
19	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	39	41
20	9	11	13	15	17	19	21	23	26	28	30	32	34	36	38	41	43
21	9	11	13	16	18	20	22	25	27	29	31	34	36	38	40	43	45
22	9	12	14	16	19	21	23	26	28	31	33	35	38	40	42	45	47
23	10	12	15	17	20	22	25	27	29	32	34	37	39	42	44	47	49
24	10	13	15	18	20	23	26	28	31	33	36	38	41	44	46	49	51
25	11	13	16	19	21	24	27	29	32	35	37	40	43	45	48	51	53
26	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50	53	55
27	12	14	17	20	23	26	29	32	35	37	40	43	46	49	52	55	58
28	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
29	12	15	19	22	25	28	31	34	37	40	43	46	49	53	56	59	62
30	13	16	19	22	26	29	32	35	38	42	45	48	51	54	58	61	64
17×18	8	10	12	14	16	18	20	22	24	27	29	31	33	35	37	39	41
19	9	11	13	15	17	19	22	24	26	28	30	32	34	37	39	41	43
20	9	11	14	16	18	20	23	25	27	29	32	34	36	39	41	43	45
21	10	12	14	17	19	21	24	26	29	31	33	36	38	40	43	45	48
22	10	12	15	17	20	22	25	27	30	32	35	37	40	42	45	47	50
23	10	13	16	18	21	23	26	29	31	34	36	39	42	44	47	50	52
24	11	14	16	19	22	24	27	30	33	35	38	41	44	46	49	52	54

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Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
17×25	11	14	17	20	23	26	28	31	34	37	40	42	45	48	51	54	57
26	12	15	18	21	24	27	29	32	35	38	41	44	47	50	53	56	59
27	12	15	18	21	24	28	31	34	37	40	43	46	49	52	55	58	61
28	13	16	19	22	25	29	32	35	38	41	44	48	51	54	57	60	63
29	13	16	20	23	26	30	33	36	39	43	46	49	53	56	59	62	66
30	14	17	20	24	27	31	34	37	41	44	48	51	54	58	61	65	68
18×19	9	11	14	16	18	21	23	25	27	30	32	34	36	39	41	43	46
20	10	12	14	17	19	22	24	26	29	31	34	36	38	41	43	46	48
21	10	13	15	18	20	23	25	28	30	33	35	38	40	43	45	48	50
22	11	13	16	18	21	24	26	29	32	34	37	40	42	45	48	50	53
23	11	14	17	19	22	25	28	30	33	36	39	41	44	47	50	52	55
24	12	14	17	20	23	26	29	32	35	37	40	43	46	49	52	55	58
25	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
26	12	16	19	22	25	28	31	34	37	41	44	47	50	53	56	59	62
27	13	16	19	23	26	29	32	36	39	42	45	49	52	55	58	62	65
28	13	17	20	24	27	30	34	37	40	44	47	50	54	57	60	64	67
29	14	17	21	24	28	31	35	38	42	45	49	52	56	59	63	66	70
30	14	18	22	25	29	32	36	40	43	47	50	54	58	61	65	68	72
19×20	10	13	15	18	20	23	25	28	30	33	35	38	41	43	46	48	51
21	11	13	16	19	21	24	27	29	32	35	37	40	43	45	48	51	53
22	11	14	17	20	22	25	28	31	33	36	39	42	45	47	50	53	56
23	12	15	17	20	23	26	29	32	35	38	41	44	47	50	52	55	58
24	12	15	18	21	24	27	30	33	36	40	43	46	49	52	55	58	61
25	13	16	19	22	25	28	32	35	38	41	44	48	51	54	57	60	63
26	13	16	20	23	26	30	33	36	40	43	46	49	53	56	59	63	66
27	14	17	21	24	27	31	34	38	41	44	48	51	55	58	62	65	68

Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
19×28	14	18	21	25	28	32	35	39	43	46	50	53	57	60	64	67	71
29	15	18	22	26	29	33	37	40	44	48	51	55	59	62	66	70	73
30	15	19	23	27	30	34	38	42	46	49	53	57	61	65	68	72	76
20×21	11	14	17	20	22	25	28	31	34	36	39	42	45	48	50	53	56
22	12	15	18	21	23	26	29	32	35	38	41	44	47	50	53	56	59
23	12	15	18	21	25	28	31	34	37	40	43	46	49	52	55	58	61
24	13	16	19	22	26	29	32	35	38	42	45	48	51	54	58	61	64
25	13	17	20	23	27	30	33	37	40	43	47	50	53	57	60	63	67
26	14	17	21	24	28	31	35	38	42	45	49	52	55	59	62	66	69
27	14	18	22	25	29	32	36	40	43	47	50	54	58	61	65	68	72
28	15	19	22	26	30	34	37	41	45	49	52	56	60	63	67	71	75
29	15	19	23	27	31	35	39	43	46	50	54	58	62	66	70	73	77
30	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
21×22	12	15	18	22	25	28	31	34	37	40	43	46	49	52	55	59	62
23	13	16	19	23	26	29	32	35	39	42	45	48	52	55	58	61	64
24	13	17	20	24	27	30	34	37	40	44	47	50	54	57	60	64	67
25	14	18	21	24	28	32	35	38	42	46	49	52	56	60	63	66	70
26	15	18	22	25	29	33	36	40	44	47	51	55	58	62	66	69	73
27	15	19	23	26	30	34	38	42	45	49	53	57	60	64	68	72	76
28	16	20	24	27	31	35	39	43	47	51	55	59	63	67	71	74	78
29	16	20	24	28	32	37	41	45	49	53	57	61	65	69	73	77	81
30	17	21	25	29	34	38	42	46	50	55	59	63	67	71	76	80	84

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Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
22×23	13	17	20	24	27	30	34	37	40	44	47	51	54	57	61	64	67
24	14	18	21	25	28	32	35	39	42	46	49	53	56	60	63	67	70
25	15	18	22	26	29	33	37	40	44	48	51	55	59	62	66	70	73
26	15	19	23	27	31	34	38	42	46	50	53	57	61	65	69	72	76
27	16	20	24	28	32	36	40	44	48	51	55	59	63	67	71	75	79
28	16	21	25	29	33	37	41	45	49	53	57	62	66	70	74	78	82
29	17	21	26	30	34	38	43	47	51	55	60	64	68	72	77	81	85
30	18	22	26	31	35	40	44	48	53	57	62	66	70	75	79	84	88
23×24	15	18	22	26	29	33	37	40	44	48	52	55	59	63	66	70	74
25	15	19	23	27	31	34	38	42	46	50	54	58	61	65	69	73	77
26	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
27	17	21	25	29	33	37	41	46	50	54	58	62	66	70	75	79	83
28	17	21	26	30	34	39	43	47	52	56	60	64	69	73	77	82	86
29	18	22	27	31	36	40	44	49	53	58	62	67	71	76	80	84	89
30	18	23	28	32	37	41	46	51	55	60	64	69	74	78	83	87	92
24×25	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
26	17	21	25	29	33	37	42	46	50	54	58	62	67	71	75	79	83
27	17	22	26	30	35	39	43	48	52	56	60	65	69	73	78	82	86
28	18	22	27	31	36	40	45	49	54	58	63	67	72	76	81	85	90
29	19	23	28	32	37	42	46	51	56	60	65	70	74	79	84	88	93
30	19	24	29	34	38	43	48	53	58	62	67	72	77	82	86	91	96

Appendix 5 (continued) - Deductions for Rectangular Defects, From Solid Board-foot Contents

[Scribner Decimal C log rule—board feet in tens]

End dimensions, inches	Deductions for defect length, in feet, of— 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
25×26	17	22	26	30	35	39	43	48	52	56	61	65	69	74	78	82	87
27	18	22	27	32	36	40	45	50	54	58	63	68	72	76	81	86	90
28	19	23	28	33	37	42	47	51	56	61	65	70	75	79	84	89	93
29	19	24	29	34	39	44	48	53	58	63	68	72	77	82	87	92	97
30	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
26×27	19	23	28	33	37	42	47	51	56	61	66	70	75	80	84	89	94
28	19	24	29	34	39	44	49	53	58	63	68	73	78	83	87	92	97
29	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	96	101
30	21	26	31	36	42	47	52	57	62	68	73	78	83	88	94	99	104
27×28	20	25	30	35	40	45	50	55	60	66	71	76	81	86	91	96	101
29	21	26	31	37	42	47	52	57	63	68	73	78	84	89	94	99	104
30	22	27	32	38	43	49	54	59	65	70	76	81	86	92	97	103	108
28×29	22	27	32	38	43	49	54	60	65	70	76	81	87	92	97	103	108
30	22	28	34	39	45	50	56	62	67	73	78	84	90	95	101	106	112
29×30	23	29	35	41	46	52	58	64	70	75	81	87	93	99	104	110	116

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Appendix 6 - Deductions for Pitch and Shake Rings Showing on Both Ends of Logs, With Various Amounts of Ring Taper[1]

[Scribner Decimal C rule—board feet in tens]

Inside diameter of ring, small end of log	Ring taper in log											
	1 or 2 inches			3 or 4 inches			5 or 6 inches			7 or 8 inches		
	16 ft.	18 ft.	20 ft.	16 ft.	18 ft.	20 ft.	16 ft.	18 ft.	20 ft.	16 ft.	18 ft.	20 ft.
6	5	6	7	7	8	9	9	10	11	11	13	14
7	6	7	8	8	9	10	10	12	13	12	14	16
8	8	9	10	10	12	13	12	14	16	15	17	20
9	9	11	12	11	13	15	14	16	19	17	20	22
10	9	11	12	12	14	16	15	18	19	18	21	23
11	11	12	15	14	16	18	17	19	22	20	23	26
12	13	15	16	16	18	20	19	22	24	23	26	29
13	14	16	18	17	20	22	21	24	27	25	28	31
14	16	18	20	20	22	25	24	26	29	28	30	34
15	17	19	21	21	23	25	25	27	30	29	32	35
16	19	21	23	23	25	28	27	30	33	31	35	39
17	21	22	25	25	27	30	29	32	36	34	37	42
18	22	24	26	26	29	32	31	34	38	35	39	44
19	23	26	29	28	31	35	32	36	41	37	42	47
20	24	27	30	28	32	36	33	38	42	39	44	48
21	26	29	33	31	35	39	37	41	45	42	47	52
22	28	31	35	34	37	41	39	43	48	45	49	55
23	29	33	36	34	39	43	40	45	50	46	52	58
24	32	36	40	38	42	47	44	49	55	50	56	62
25	32	35	40	38	42	48	44	49	55	50	56	63
26	34	38	43	40	45	50	46	52	58	53	60	66
27	35	39	44	41	46	52	48	54	60	54	62	68
28	38	43	47	45	51	55	51	59	63	58	67	73
29	42	48	52	48	56	60	55	64	70	62	72	80
30	43	50	54	50	58	64	57	66	74	65	74	82

[1] Example: A 16-foot log has a ring 10 inches in diameter in the top end and 14 inches in the butt end. Thus with a 4-inch taper, a 10-inch ring diameter, and a 16-foot length, the deduction is 12.

Appendix 6 (continued) - Deductions for Pitch and Shake Rings Showing on Both Ends of Logs, With Various Amounts of Ring Taper[1]

Instructions for Use of Appendix 6 Pitch and Shake Ring Deduction Table.

1. Measure rings at both ends to obtain taper.
2. Refer to table. Use small end ring and proper taper column for deduction.
3. When 2 full rings are over 2 1/2 inches apart, measure diameter of both rings, refer to the proper columns for deductions. Add deductions together.

Supplementary Instructions

For rings showing on one end only, use squared-defect method and replace volume of core.

For logs shorter than 16 feet, use the large end ring and the Coconino scale stick.

When 2 full rings are not more than 2 1/2 inches apart, measure diameter of the outside ring. Add 1 inch. Apply squared-defect method for gross deduction. Reduce this by the scale of a log with a diameter of the inner ring.

When multiple rings occur with no recovery between them, square the overall defect and allow for the scale of any inside log surrounded by rings.

For a full or partial ring 2 1/2 inches or less from the outside at the top end (perimeter ring), deduct as for sap rot.

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Appendix 7 - Twelve Common Rots and Fungi in Saw Logs

1. Fomes pini

Common name.—Conk rot, red ring rot; sometimes called honeycomb rot, particularly in pine and larch.

Hosts.—Western white, ponderosa lodgepole, white bark, limber pine; Engelmann spruce; western hemlock; sugar pine; mountain hemlock; white, alpine, Shasta red fir; Douglas-fir; western redcedar; western larch.

General form.—Trunk rot rarely acting as butt rot. Generally patchy. Enters through dead branch stubs, rarely through wounds. The rot column is roughly conical in both directions from area of greatest decay in trunk. Often as patchy ring- or crescent-shaped areas not uniformly attacking the heartwood except in very advanced stages.

The rot column may extend from a few feet to entire tree length.

Characteristics.—Heart rot In resinous trees, heart rot or sap rot in trees with little or no resin. Rot In early stages reddish color In split section with small white patches mingled with pitted areas and In advanced stages ring-scaled. Delignifying rot, converting wood to cellulose; white pocket rot.

External signs.—Typical fruiting bodies or conks of fungus on log. Indications at old branch whorls, either by swells or by brownish punky substance, that fruiting bodies have dropped off. Soundings made on trunk to detect punkiness Indicating decay. Punk knots or blind conks.

Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

Fruiting body.—Sometimes called ring-scale fungus, brown shell fungus. Fruiting body Is hoof or shell shape, perennial, hard, woody, upper surface dark brown, rough, hairy when young, with concentric raised zones, substance brown, pores usually large and round, pore layer stratified.

2. Polyporus schweinitzii
Common name.—Red-brown butt rot. Stump or ground rot.

Hosts.—Western white, ponderosa, lodgepole, whitebark, limber pine; Douglas-fir; grand, white, alpine, Shasta red fir; western redcedar; Engelmann spruce.

General form.—A uniform circular butt rot; a wound fungus. The rot column Is generally conical from base of tree upward. Uniform, usually not advancing beyond first log. The rot column may extend from roots to 8 to 12 feet up Into first log. Usually not more than 5 or 6 feet upward.

Characteristics.—Uniform heart rot of butt of tree, also enters roots. Rot in the early stage is light reddish brown; typical stage is reddish brown, pronounced cubical, crumbly, brittle when dry; occasionally with thin resinous crusts of white felt like material (mycelium), odor of turpentine. Carbonizing rot.

External signs.—Typical fruiting bodies of the fungus on the ground near the tree (often partly covered by debris), sometimes found as bracket fungus issuing from injuries at base of the tree (never high up

on the trunk). Indications of brown rot in the exposed roots. Soundings on the basal portion of the tree and exposed roots. Indications of typical rot.

Fruiting body.—Sometimes called velvet-top or cowdung fungus. Fruiting body annual, stem short, dark brown, covered with stiff hairs, flesh brown, soft and spongy when fresh, brittle when dry, pores large when young, becoming torn with age. Attached to the roots near the base of the tree or directly on the base of the tree.

3. Echinodontium tinctorium
Common name.—Brown stringy rot; rust-red stringy rot.

Hosts.—Alpine, white, grand fir; western, mountain hemlock. Of economic Importance only on true firs and hemlocks. Shasta red fir; Engelmann spruce.

General form.—A uniform circular trunk rot, entering through branch stubs and wounds. The rot column is roughly conical in both directions from area of greatest decay. Very uniform in occupying most or all of the heartwood. The rot column may extend from a few feet to entire tree length, depending upon the degree of infection.

Characteristics.—Uniform heart rot, confined to given trees almost entirely. Rot in early stages: wood spongy yellow stained; typical stage: soft stringy, often separating along the annual rings, brownish

Appendix 7 (continued) -Twelve Common Rots and Fungi in Saw Logs

to rusty red in color, knots show deep rusty red color. Sawed surface of cross section pitted, broken, stringy with reddish brown discolorations, often hollow rotted, carbonizing rot; viz, reducing cellulose, producing dark-colored decay.

External signs.—Typical fruiting bodies of the fungus on the tree. Indications at branch whorls either by swells or by deep rust red punk knots that fruiting bodies had dropped off. Large number of dead branch stubs accompanied by pronounced swells of whorls. Deep rusty red color in old branch stubs. Soundings made on trunk.

Many injuries, such as logging scars, fire scars, frost cracks, blazes, etc., are indications of typical rot.

Fruiting body.—Sometimes called Indian paint fungus, fruiting body perennial, hard and woody, gray or black above with concentric growth zones, substance brick red, lower surface covered with hard sharp spines when mature.

4. Fomes pinicola
Common name.—Brown crumbling rot.

Hosts.—Attacks all the imports conifers, but principally western larch; western, mountain hemlock; alpine, grand fir; Douglas-fir (dead); Shasta red, white fir; especially Sitka spruce and hemlock In Alaska.

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Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

General form.—A uniform circular trunk rot; a wound fungus. The rot column is generally uniform and conical. The rot column usually occupies entire heartwood of tree on the portion of the tree infected. Rarely extending beyond the first log length.

Characteristics.—Uniform heart rot found principally in dead, standing, and down timber, occasionally acting as heart rot in living trees by gaining entrance through injuries. In early stages rot is light brown; typical stage, reddish brown, cubical, crumbly and brittle when dry, white feltlike layers of mycelium between cubical patches. Felt patches larger, thicker, and nonresinous as compared to those of velvet-top fungus. Carbonizing rot.

External signs.—Typical "red belt" fruiting bodies of the fungus on the tree. Typical rot at old branch stubs. Soundings made on the trunk. Indications of typical rot.

Fruiting body.—Sometimes called red-margin Fomes; red belt Fomes. Fruiting body, perennial, hard, woody, flat or **hoof**-shaped, surface smooth, furrowed gray or black with resinous crust, margin white or reddish, substance whitish or wood colored, pores In layers.

5. Polyporus sulphureus
Common name.—Brown cubical rot; reddish-brown heart rot.

Hosts.—Attacks most all of the important conifers but principally ponderosa, western white pine; Douglas-fir; western larch Shasta red fir; Engelmann spruce; white fir.

Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

General form.—This is a uniform circular butt and trunk rot. A wound fungus.

The rot column is generally uniform and conical.

The rot column usually occupies the entire heartwood of the tree at point of greatest infection. Usually a butt rot, rarely extending beyond the first log length.

Characteristics.—Uniform heart rot. Rot in early stages light brown, typical stage, dark reddish brown, brittle dry, crumbly, not pronounced cubical, with thick felty mycelial masses In clefts, arranged star-shaped in cross section. Carbonizing rot.

External signs.—Typical fruiting bodies of the fungus on the tree. Soundings made on the trunk. Indications of typical rot.

Fruiting body.—Sometimes called sulfur fungus. Fruiting structure annual, broad, with several parts one above another, smooth, zoned, lemon yellow to orange, white when old, flesh white, crumbly when dry, pores small, sulfur yellow.

6. Fomes officinalis
Common name.—Reddish-brown heart rot; brown trunk rot.

Hosts.—Attacks all important conifers but principally western larch; ponderosa, sugar pine; white, Shasta red fir; Douglas-fir; Engelmann spruce.

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Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

General form.—Trunk rot. Wound fungus.

The rot column to generally uniform and conical.

The rot column usually occupies the entire heartwood of the tree in advanced stages. Most commonly occupies upper portion of merchantable timber; rarely a typical butt rot.

Characteristics.—Uniform heart rot. Rot in early stages light brown; typical stage, dark reddish brown, brittle dry, crumbly with thin felty mycelial masses in clefts. Carbonizing rot.

External signs.—Typical fruiting bodies of the fungus on the tree, the principal means of distinction between rots of this species and that of sulfur fungus. Soundings made on the trunk. Indications of typical rot.

Fruiting body.—Also known as Fomes laricis (chalky quinine fungus). Perennial hoof-shaped, sometimes cylindrical, snow white, substance white soft, bitter to the taste, pores small, white arranged in layers.

7. Poria weirii
Common name.—Yellow laminated rot.

Hosts.—Western redcedar and eastern arborvitae. Douglas-fir.

General form.—Butt rot. Uniform circular rot. Wound fungus.

Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

The rot column is generally uniform and conical.

The rot column may extend from roots to 5 to 8 feet up into first log, often causing hollow butts. Rarely throughout entire pole length in old trees.

Characteristics.—Uniform heart rot. Rot yellow color, decays springwood, separating annual rings. In advanced stages brown, felty, mycelium between layers. Carbonizing rot.

External signs—Typical fruiting bodies of the fungus on the tree (in the root crotches, often cementing the forest debris about the roots into a punky mass). Soundings at base of tree and exposed root spurs.

Fruiting body.—Sometimes called brown cedar Poria. Fruiting structure flat growing, inconspicuous, perennial, stratified, substance brown. Grows in root crotches and underside of down trees and logs.

8. Fomes annosus
Common name.—White spongy rot.

Hosts.--Western white, ponderosa, lodgepole, whitebark, limber pine; Engelmann spruce; western, mountain hemlock; Shasta red, alpine, grand, white fir; Douglas-fir; western redcedar; western larch.

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Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

General form.--Butt rot. Uniform circular. Pathogenic: can attack the cambium layer.

The rot column is generally conical and uniform, filling heartwood and part or all sapwood.

The rot column may extend from roots to 6 or 8 feet into first log; sometimes much higher in hemlock. Soon producing hollow butts.

Characteristics.--Uniform sap rot and heart rot of butt. Rot in early stages, ranging from lilac to reddish color; typical stage in whitish areas separated by smaller areas of sound wood, not prominently pitted, occasionally with black dots in center of white areas, in last stages annual rings separated; finally wet spongy. Fine felty masses (mycelium) under bark scales. Delignifying rot.

External signs.—Typical fruiting bodies of the fungus in root crotches usually covered by litter or duff. Resin flow at base of tree and exposed roots. Soundings at base of tree and exposed roots.

Fruiting body.—Sometimes called root Fomes. Fruiting body woody, usually thin and irregular, with a smooth brown crust, perennial; substance white or pale yellowish, pores small stratified and white. Found in the root crotches or under litter, not easily seen.

Appendix 7 (continued) - Example of Local Chart Guide for Conk Rot for One Species

9. Pholiota adiposa
Common name.—Mottled rot; yellow heart rot.

Hosts.—Alpine, grand, white, Shasta red fir; western, mountain hemlock; Engelmann spruce; western white pine. Usually of most importance on the true firs.

General form.—Trunk rot. Uniform circular.

The rot column is generally conical in heartwood.

The rot column may extend from stumps to entire merchantable tree length. Usually confined to the first two log lengths. Sometimes localized in a single log.

Characteristics.—Uniform. Heart rot, principally of trees with little or no resin. Rot in early stages a light yellow stain; typical stage, yellow or honey color, brownish streaks, yellowish to light tan or white felty masses. Running across grain, breaking up in the last stages and separating annual rings, finally becoming hollow rotted. Carbonizing rot.

External signs.—Typical fruiting bodies of the fungus on the tree. Soundings made on the trunk. Indications of typical rot.

Fruiting body.—Sometimes called scaly Pholiota or yellow cap fungus. Fruiting body annual, mushroom type, appearing in clusters, yellow on upper surface, sticky when wet, stem yellow, gills yellowish to brown.

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Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

10. Ceratostomella species
Common name.—Blue stain.

Hosts.—Especially ponderosa, southern yellow, lodgepole, white-bark, limber pine; Engelmann spruce; western hemlock; but all soft and hard woods are affected.

General form.—Sap stain. Since the bluing fungus does not attack the cell walls except to a negligible extent and feeds only upon the cell contents, blued wood is not weakened. This has been determined by comparative mechanical tests on stained and unstained wood. But high moisture content and warm weather, which promote the development of the bluing fungus, are highly favorable to the development of true wood-destroying fungi. The fact that blued wood may soon show evidences of decay when put in service is due to the true wood-destroying fungi and not to the bluing fungus. Although the strength of blued wood is not impaired by the color, the wood may be objectionable in places where color is a factor.

NOTE: Certain other discolorations of sapwood are produced by fungi belonging to the molds, of which the green mold on fruits or in certain cheeses is an example. Such stains are usually superficial and may be planed off. They are difficult to distinguish by visual inspection from the true blue stain.

Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

Characteristics.—Blue or bluish gray or black color of the sapwood, rarely in the heartwood, color usually most intense in the rays, causing it to appear in streaks in early stages. Due to the character of the wood, conifers are more susceptible than hardwoods. Fruiting body of the bluing fungus not readily seen. When the color Is so dense that it is almost black, small bristles with a bulbous base may be seen with a hand lens. The color, depending upon the weather conditions, usually appears very rapidly In trees killed by bark beetles or fire, or in piled logs cut from green trees. Lumber in yards may blue very rapidly if not properly piled or treated. Blue color is due to the reflection to the surface of the wood of the colored mycelium in the wood cells. The wood itself is not stained by the true bluing fungus.

External signs.—"Blued" sapwood. Blued streaks extending from the sap into the heartwood of some logs. Dead and dying trees, killed by bark beetles, fire, or various other agents, are very susceptible to blue stain.

Fruiting body.—Sometimes called Bluing fungus. Fruiting body small, black, with long appendages, can best be seen with hand lens, appears on surface of boards or on wood of logs beneath bark.

11. Polyporus amarus
Comon name.—Pocket dry rot.

Hosts.—Incense-cedar.

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Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

General form.—Trunk rot. The rot column usually occupies entire heartwood, not common In butt portion.

Characteristics.—In early stage, pocket dry rot appears as a faint yellowish-brown discoloration of the heartwood. Later elongated pockets with pointed ends develop, longer than broad, from 1/2 inch to 12 inches. Wood broken down into a dark brown friable residue. Pockets confined to the heartwood of the main trunk or bases of large limbs. Pockets seldom form in exposed heartwood, are sparse near large open wounds.

External signs.—Typical fruiting bodies on the tree, rare. Open borings or shot-hole cups replace conks. Large open fire wounds are indicators of this rot in most locations.

Fruiting body.—Half bell-shaped or somewhat hoof-shaped, 4 to 8 inches wide, buff to tan on top, bright sulfur-yellow underneath, darkens In age to chalky tan, soft and moist when fresh, firm and dry when old.

12. Polyporus anceps
Common name.—Western red rot; red ray rot.

Host.—Ponderosa pine.

General form.—Heart rot. Fungus does not require conspicuous entrance courts such as wounds, fire scars, or dead tops. Enters only through recently dead, bark-covered branches. Requires moisture to sustain attack. The rot column extending to heartwood is invaded

Appendix 7 (continued) - Twelve Common Rots and Fungi in Saw Logs

longitudinally by a localized infection in the form of a decay column from a knot. Radial and tangential spread is initially slow; may spread through entire tree length but affects mostly logs from middle portion.

Characteristics.—Wood decayed in irregular streaks or pockets. In early stage of decay, heartwood reddish to dark brown. Discolored areas, often fan-shaped, radiate out from the log center, resemble spokes of a wheel or may be isolated anywhere in heartwood. In advanced stage, heartwood is whitish or grayish in color. Rotted wood consists of soft white strands of cellulose Intermixed with less rotted wood particles, often wet and soggy, usually in log center, often surrounded by the fanlike areas of an early stage. In longitudinal section, Incipient decay often appears as several separate discolored areas. In advanced stage, appears continuous. Decay entering through knots may be concentrated in the pith cavity.

External signs.—Limited. Fruiting bodies rarely formed on trees and then only on dead bark-covered branches. No swollen knots.

Fruiting body.—Fruiting bodies found mostly on decaying dead material in contact with the ground.

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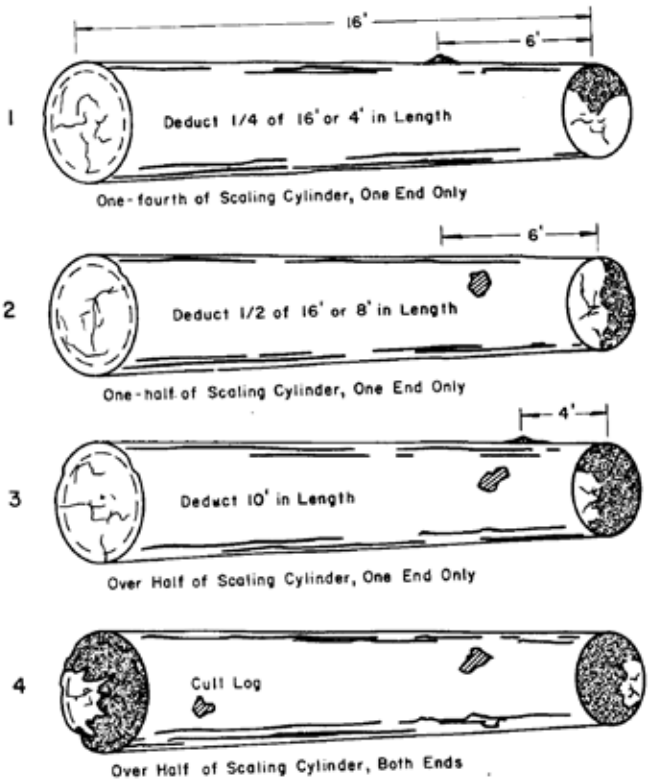
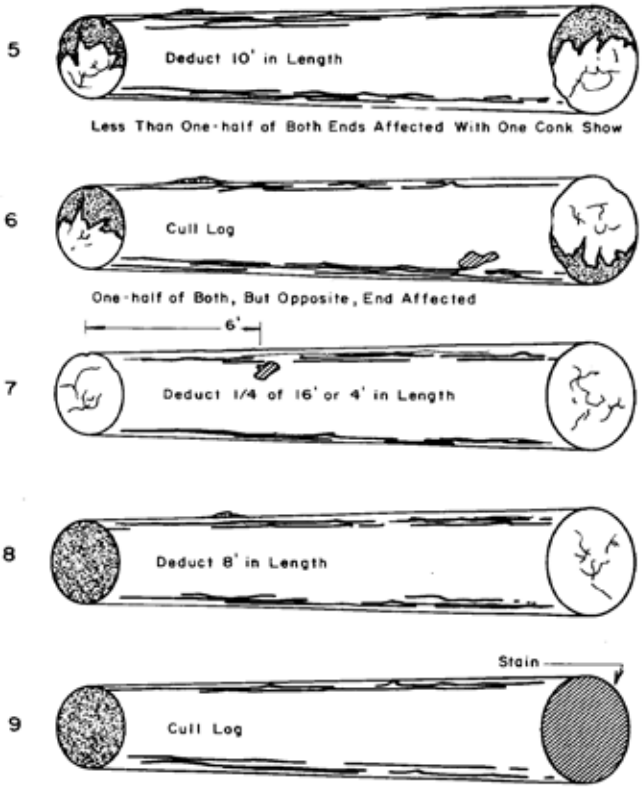
Appendix 7 (continued) - Example of Local Chart Guide for Conk Rot for One Species



Appendix 7 (continued) - Example of Local Chart Guide for Conk Rot for One Species



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Appendix 8 - International 1/4-inch Log Rule[1]

Diameter (inches)	Volume (board feet) according to length, in feet—								
	4	5	6	7	8	9	10	11	12
5			5	5	5	5	5	5	10
6	5	5	5	5	10	10	10	10	15
7	5	5	10	10	10	15	15	15	20
8	10	10	10	15	15	20	20	25	25
9	10	15	15	20	20	25	30	30	35
10	15	15	20	25	30	35	35	40	45
11	15	20	25	30	35	40	45	50	55
12	20	25	30	40	45	50	55	65	70
13	25	30	40	45	55	60	70	75	85
14	30	40	45	55	65	70	80	90	100
15	35	45	55	65	75	85	95	105	115
16	40	50	60	75	85	95	110	120	130
17	45	60	70	85	95	110	125	135	150
18	55	65	80	95	110	125	140	155	170
19	60	75	90	105	125	140	155	175	190
20	65	85	100	120	135	155	175	195	210
21	75	95	115	135	155	175	195	215	235
22	80	105	125	145	170	190	215	235	260
23	90	115	140	160	185	210	235	260	285
24	100	125	150	175	205	230	255	285	310
25	110	135	165	195	220	250	280	310	340
26	120	150	180	210	240	275	305	335	370
27	130	160	195	225	260	295	330	365	400
28	140	175	210	245	280	320	355	395	430
29	150	185	225	265	305	345	385	425	465
30	160	200	245	285	325	370	410	455	495
31	170	215	260	305	350	395	440	485	530
32	185	230	280	325	375	420	470	520	570
33	195	245	295	345	400	450	500	555	605
34	210	260	315	370	425	480	535	590	645
35	220	280	335	390	450	510	565	625	685
36	235	295	355	415	475	540	600	665	725
37	250	315	375	440	505	570	635	700	770
38	265	330	400	465	535	605	670	740	810
39	280	350	420	490	565	635	710	785	855
40	295	370	445	520	595	670	750	825	900
41	310	385	465	545	625	705	785	870	950
42	325	405	490	575	655	740	825	910	995
43	340	420	515	600	690	780	870	955	1,045
44	355	450	540	630	725	815	910	1,005	1,095
45	375	470	565	660	755	855	955	1,050	1,150

[1] Values as published by H. H. Chapman, extended by formula: $V=(0.22D^2-0.71D)\times.905$ for 4-foot section. Taper allowance: ½ inch per 4 feet lineal.

Appendix 8 (continued) - International 1/4-inch Log Rule[1]

Diameter (inches)	Volume (board feet) according to length, in feet—							
	13	14	15	16	17	18	19	20
5	10	10	10	10	15	15	15	15
6	15	15	20	20	20	25	25	25
7	20	25	25	30	30	35	35	40
8	30	35	35	40	40	45	50	50
9	40	45	45	50	55	60	65	70
10	50	55	60	65	70	75	80	85
11	65	70	75	80	85	95	100	105
12	75	85	90	95	105	110	120	125
13	90	100	105	115	125	135	140	150
14	105	115	125	135	145	155	165	175
15	125	135	145	160	170	180	195	205
16	145	155	170	180	195	205	220	235
17	165	180	190	205	220	235	250	265
18	185	200	215	230	250	265	280	300
19	205	225	245	260	280	300	315	335
20	230	250	270	290	310	330	350	370
21	255	280	300	320	345	365	390	410
22	285	305	330	355	380	405	430	455
23	310	335	360	390	415	445	470	495
24	340	370	395	425	455	485	515	545
25	370	400	430	460	495	525	560	590
26	400	435	470	500	535	570	605	640
27	435	470	505	540	580	615	655	690
28	470	510	545	585	625	665	705	745
29	505	545	590	630	670	715	755	800
30	540	585	630	675	720	765	810	860
31	580	625	675	720	770	820	870	915
32	620	670	720	770	825	875	925	980
33	660	715	765	820	875	930	985	1,045
34	700	760	815	875	930	990	1,050	1,110
35	745	805	865	925	990	1,050	1,115	1,175
36	790	855	920	980	1,045	1,115	1,180	1,245
37	835	905	970	1,040	1,110	1,175	1,245	1,315
38	885	955	1,025	1,095	1,170	1,245	1,315	1,390
39	930	1,005	1,080	1,155	1,235	1,310	1,390	1,465
40	980	1,060	1,140	1,220	1,300	1,380	1,460	1,540
41	1,030	1,115	1,200	1,280	1,365	1,450	1,535	1,620
42	1,085	1,170	1,260	1,345	1,435	1,525	1,615	1,705
43	1,140	1,230	1,320	1,410	1,505	1,600	1,695	1,785
44	1,195	1,290	1,385	1,480	1,580	1,675	1,775	1,870
45	1,250	1,350	1,450	1,550	1,650	1,755	1,855	1,960

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Appendix 8 (continued) - International 1/4-inch Log Rule[1]

Diameter (inches)	Volume (board feet) according to length, in feet—								
	4	5	6	7	8	9	10	11	12
46	390	490	590	690	795	895	995	1,100	1,200
47	410	515	620	725	830	935	1,040	1,150	1,255
48	430	535	645	755	865	975	1,090	1,200	1,310
49	445	560	675	790	905	1,020	1,135	1,250	1,370
50	465	585	705	820	940	1,060	1,185	1,305	1,425
51	485	610	735	855	980	1,105	1,235	1,360	1,485
52	505	635	760	890	1,020	1,150	1,285	1,415	1,545
53	525	660	795	925	1,060	1,195	1,335	1,470	1,605
54	545	685	825	965	1,100	1,245	1,385	1,530	1,670
55	565	710	855	1,000	1,145	1,290	1,440	1,585	1,735
56	590	740	890	1,040	1,190	1,340	1,495	1,645	1,800
57	610	765	920	1,075	1,230	1,390	1,550	1,705	1,865
58	635	795	955	1,115	1,275	1,440	1,605	1,770	1,930
59	655	820	990	1,155	1,320	1,490	1,660	1,830	2,000
60	680	850	1,025	1,195	1,370	1,545	1,720	1,895	2,070

Diameter (inches)	Volume (board feet) according to length, in feet—							
	13	14	15	16	17	18	19	20
46	1,305	1,410	1,515	1,620	1,730	1,835	1,940	2,050
47	1,365	1,475	1,585	1,695	1,805	1,915	2,030	2,140
48	1,425	1,540	1,655	1,770	1,885	2,000	2,115	2,235
49	1,485	1,605	1,725	1,845	1,965	2,085	2,205	2,330
50	1,550	1,675	1,795	1,920	2,045	2,175	2,300	2,425
51	1,615	1,745	1,870	2,000	2,130	2,265	2,395	2,525
52	1,680	1,815	1,945	2,080	2,215	2,355	2,490	2,625
53	1,745	1,885	2,025	2,165	2,305	2,445	2,590	2,730
54	1,815	1,960	2,100	2,245	2,395	2,540	2,690	2,835
55	1,885	2,035	2,185	2,330	2,485	2,640	2,790	2,945
56	1,955	2,110	2,265	2,420	2,575	2,735	2,895	3,050
57	2,025	2,185	2,345	2,510	2,670	2,835	3,000	3,165
58	2,100	2,265	2,430	2,600	2,770	2,935	3,105	3,275
59	2,170	2,345	2,515	2,690	2,865	3,040	3,215	3,390
60	2,250	2,425	2,605	2,785	2,965	3,145	3,325	3,510

Appendix 9 - Forest Service International 1/4-inch Decimal Rule

[Board-foot volumes in tens]

Diameter (in.)	Volume according to log length, in feet—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
5	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2
6	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3
7	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	4	4
8	1	1	1	1	2	2	2	2	3	3	3	4	4	4	5	5	5
9	1	1	2	2	2	3	3	3	4	4	4	5	5	6	6	6	7
10	1	2	2	2	3	3	4	4	5	5	6	6	6	7	8	8	9
11	2	2	3	3	4	4	5	5	6	6	7	7	8	9	9	10	11
12	2	3	3	4	4	5	6	6	7	8	8	9	10	10	11	12	13
13	3	3	4	5	5	6	7	8	8	9	10	11	12	12	13	14	15
14	3	4	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18
15	4	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20
16	4	5	6	7	8	10	11	12	13	14	16	17	18	19	21	22	23
17	5	6	7	8	10	11	12	14	15	16	18	19	21	22	24	25	27
18	5	7	8	10	11	12	14	15	17	18	20	22	23	25	27	28	30
19	6	8	9	11	12	14	16	17	19	21	22	24	26	28	30	32	33
20	7	8	10	12	14	16	17	19	21	23	25	27	29	31	33	35	37
21	7	9	11	13	15	17	19	21	23	26	28	30	32	34	37	39	41
22	8	10	13	15	17	19	21	24	26	28	31	33	35	38	40	43	45
23	9	11	14	16	19	21	24	26	28	31	34	36	39	42	44	47	50
24	10	13	15	18	20	23	26	28	31	34	37	40	42	45	48	51	54
25	11	14	16	19	22	25	28	31	34	37	40	43	46	49	53	56	59
26	12	15	18	21	24	27	30	34	37	40	43	47	50	54	57	60	64
27	13	16	19	23	26	30	33	36	40	43	47	51	54	58	62	65	69
28	14	17	21	25	28	32	36	39	43	47	51	55	58	62	66	70	74
29	15	19	23	26	30	34	38	42	46	50	55	59	63	67	71	76	80
30	16	20	24	28	33	37	41	45	50	54	59	63	67	72	77	81	86
31	17	22	26	30	35	39	44	49	53	58	63	67	72	77	82	87	92
32	18	23	28	33	37	42	47	52	57	62	67	72	77	82	87	93	98
33	20	25	30	35	40	45	50	55	61	66	71	77	82	88	93	99	104
34	21	26	32	37	42	48	53	59	64	70	76	82	87	93	99	105	111
35	22	28	34	39	45	51	57	63	68	74	81	87	93	99	105	111	118
36	23	30	36	42	48	54	60	66	73	79	85	92	98	105	111	118	124
37	25	31	38	44	50	57	64	70	77	84	90	97	104	111	118	125	132
38	26	33	40	47	53	60	67	74	81	88	95	103	110	117	124	132	139
39	28	35	42	49	56	64	71	78	86	93	101	108	116	123	131	139	146
40	29	37	44	52	59	67	75	82	90	98	106	114	122	130	138	146	154

See note at end of table.

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Appendix 9 (continued) - Forest Service International 1/4-inch Decimal Rule

[Board-foot volumes in tens]

Diameter (in.)	Volume according to log length, in feet—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
41	31	39	47	55	62	71	79	87	95	103	111	120	128	137	145	154	162
42	32	41	49	57	66	74	83	91	100	108	117	126	135	144	152	161	170
43	34	43	51	60	69	78	87	96	105	114	123	132	141	151	160	169	179
44	36	45	54	63	72	82	91	100	110	119	129	138	148	158	168	177	187
45	37	47	57	66	76	86	95	105	115	125	135	145	155	165	175	186	196
46	39	49	59	69	79	89	100	110	120	131	141	152	162	173	183	194	205
47	41	51	62	72	83	94	104	115	126	137	147	158	169	181	192	203	214
48	43	54	65	76	87	98	109	120	131	143	154	165	177	188	200	212	223
49	45	56	67	79	90	102	114	125	137	149	161	172	184	196	209	221	233
50	47	58	70	82	94	106	118	130	143	155	167	180	192	205	217	230	243
51	49	61	73	86	98	111	123	136	149	161	174	187	200	213	226	239	253
52	50	63	76	89	102	115	128	141	155	168	181	195	208	222	235	249	263
53	53	66	79	93	106	120	133	147	161	175	188	202	216	230	245	258	273
54	55	68	82	96	110	124	139	153	167	181	196	210	225	239	254	269	284
55	57	71	86	100	114	129	144	159	173	188	203	218	233	248	264	279	294
56	59	74	89	104	119	134	149	165	180	195	211	226	242	258	274	289	305
57	61	77	92	108	123	139	155	171	186	203	219	235	251	267	284	300	316
58	63	79	95	112	128	144	160	177	193	210	226	243	260	277	294	311	328
59	66	82	99	116	132	149	166	183	200	217	234	252	269	287	304	322	339
60	68	85	102	120	137	154	172	189	207	225	243	260	278	296	315	333	351
61	70	88	106	124	142	160	178	196	214	233	251	269	288	307	325	344	363
62	73	91	109	128	146	165	184	203	221	240	259	278	297	317	336	356	375
63	75	94	113	132	151	171	190	209	229	248	268	288	307	327	347	367	387
64	77	97	117	136	156	176	196	216	236	256	277	297	317	338	359	379	400
65	80	100	121	141	161	182	202	223	244	265	286	306	327	349	370	391	412
66	82	103	124	145	166	188	209	230	251	273	295	316	337	360	382	403	425
67	85	107	128	150	171	193	215	237	259	281	304	326	348	371	393	416	439
68	88	110	132	154	177	199	222	244	267	290	313	336	359	382	405	429	452
69	90	113	136	159	182	205	229	252	275	299	322	346	370	393	417	441	465
70	93	117	140	164	187	211	235	259	283	308	332	356	380	405	430	454	479
71	96	120	144	169	193	218	242	267	292	317	342	367	392	417	442	468	493
72	99	124	149	174	199	224	249	275	300	326	351	377	405	429	455	481	507
73	101	127	153	179	204	230	256	282	309	335	361	388	414	441	468	495	521
74	104	131	157	184	210	237	264	290	317	344	371	399	426	453	481	508	536
75	107	134	161	189	216	243	271	298	326	354	382	410	438	466	494	522	551
76	110	138	166	194	222	250	278	307	335	363	392	421	449	478	507	537	566
77	113	142	170	199	228	257	286	315	344	373	403	432	461	491	521	551	581
78	116	146	175	204	234	264	293	323	353	383	413	443	474	504	535	565	596
79	119	149	180	210	240	270	301	332	362	393	424	455	486	517	549	580	611
80	122	153	184	215	246	277	309	340	372	403	435	467	499	531	563	595	627

See note at end of table.

Appendix 9 (continued) - Forest Service International 1/4-inch Decimal Rule

[Board-foot volumes in tens]

Diameter (In.)	Volume according to log length, in feet—																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
81	125	157	189	221	252	285	317	349	381	414	446	479	511	544	577	610	643
82	129	161	194	226	259	292	325	358	391	424	457	491	524	558	592	625	659
83	132	165	199	232	265	299	333	367	400	435	460	503	537	572	606	641	675
84	135	169	203	238	272	306	341	376	410	445	489	515	550	586	621	657	692
85	138	173	208	243	278	314	349	385	420	456	492	528	564	600	636	672	709
86	142	178	213	249	285	321	358	394	430	467	504	540	577	614	651	688	726
87	145	182	219	255	292	329	366	403	440	478	516	553	591	629	667	705	743
88	149	186	224	261	299	337	375	413	451	489	528	566	605	643	682	721	760
89	152	190	229	267	306	345	383	422	461	501	540	579	618	658	698	738	777
90	155	195	234	273	313	352	392	432	472	512	552	592	633	673	714	755	795
91	159	199	239	280	320	360	401	442	482	524	565	606	647	688	730	772	813
92	163	204	245	286	327	369	410	452	493	535	577	619	661	704	746	789	831
93	166	208	250	292	334	377	419	462	504	547	590	633	676	719	763	806	849
94	170	213	256	299	342	385	428	472	515	559	603	647	691	735	779	824	868
95	174	217	261	305	349	393	438	482	526	571	616	661	706	751	796	841	887
96	177	221	267	312	357	402	447	492	538	583	629	675	721	767	813	859	906
97	181	227	273	318	364	410	457	503	549	596	642	689	736	783	830	877	925
98	185	232	278	325	372	419	466	513	561	608	656	704	751	799	848	896	944
99	189	236	284	332	379	428	476	524	572	621	669	718	767	816	865	914	963
100	193	241	290	339	387	436	486	535	584	634	683	733	783	833	883	933	983
101	197	246	296	346	395	445	496	546	596	646	697	748	798	850	901	952	1003
102	201	251	302	353	403	454	505	557	608	659	711	763	814	867	919	971	1023
103	205	256	308	360	411	463	516	568	620	673	725	778	831	884	937	990	1043
104	209	261	314	367	419	473	526	579	632	686	740	793	847	901	955	1010	1064
105	213	266	320	374	428	482	536	590	644	699	754	809	863	919	974	1029	1085
106	217	272	326	381	436	491	546	602	657	713	769	824	880	936	993	1049	1105
107	221	277	333	388	444	501	557	613	670	726	783	840	897	954	1012	1069	1127
108	225	282	339	396	453	510	567	625	682	740	798	856	914	972	1031	1089	1148
109	230	287	345	403	461	520	578	637	695	754	813	872	931	991	1050	1110	1169
110	234	293	352	411	470	529	589	648	708	768	828	888	948	1009	1070	1130	1191
111	238	298	358	418	479	539	600	660	721	782	843	905	966	1028	1089	1151	1213
112	243	304	365	426	487	549	611	673	734	797	859	921	983	1046	1109	1172	1235
113	247	309	372	434	496	559	622	685	748	811	874	938	1001	1065	1129	1193	1257
114	251	315	378	442	505	569	633	697	761	826	890	955	1019	1084	1149	1215	1280
115	256	320	385	450	514	579	644	709	775	840	906	972	1037	1104	1170	1236	1302
116	260	326	392	458	523	589	656	722	788	855	922	989	1056	1123	1190	1258	1325
117	265	332	399	466	532	600	667	735	802	870	938	1006	1074	1143	1211	1280	1348
118	270	338	406	474	542	610	679	747	816	885	954	1024	1093	1162	1232	1302	1372
119	274	343	413	482	551	621	690	760	830	900	971	1041	1111	1182	1253	1324	1395
120	279	349	420	490	560	631	702	773	844	916	987	1059	1130	1202	1274	1347	1419

Note: International 1/8-inch rule volumes computed electronically to a 4-decimals, rounded to nearest tenth board foot. This volume multiplied by 0.905 for 1/4-inch rule volumes, recorded to 1 decimal, rounded to nearest 10 board feet. Volumes that could be influenced by the rounding to a tenth in the 1/8-inch calculations were recalculated, using all decimals. Decimal volumes thus are the same as if all decimals had been used in the calculations.

Volumes are as calculated from the basic equation for the volume of a 4-foot section; i.e., volume=0.22 (D^2)—0.71 D).

Volumes for sections 8, 12, 16, and 20 feet were obtained by allowing 1/2-inch taper for each 4 feet of length and totaling the volumes for the sections. For other log lengths between 4 and 20 feet, linear interpolation was used.

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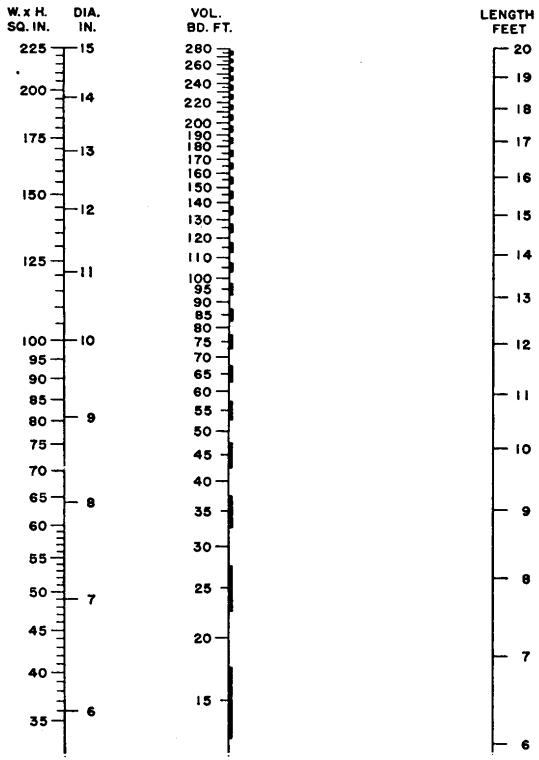
Appendix 10 - Defect Allowance Chart—International 1/4-inch Log Rule

$$\text{Board feet} = \frac{W'' \times H'' \times L'}{16} \quad \text{or} \quad \frac{(D'')^2 \, L'}{16} \quad \text{(for Circular Defect)}$$



Appendix 10 (continued) - Instructions for Use of Defect Allowance Chart

1. Measure width and height of defect in inches. Add 1 inch to each to allow for waste.

2. Multiply width by height.

3. Measure or estimate length of defect.

4. Place straightedge through product of W X H (left line) and length (right line).

5. Read deduction, to nearest 5 board feet, on center line.

For example, if a defect measured 7" by 8" by 10', the deduction would be determined by holding the straightedge through 72 on the left line (7 + 1) X (8 + 1) and 10 on the right line. The deduction, center line intersection, is 45 board feet.

Shortcut method: Width of defect In inches X height in inches = deduction if defect extends through a 16-foot log. Otherwise take proper proportion, round to nearest 5 bd. ft. (or 10 bd. ft. if scaling by Forest Service International 1/4-Inch Decimal rule).

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Appendix 11 - Defect Allowances - For Optional Use

[Forest Service International ¼-Inch Decimal log rule—board-feet in tens]

Length (feet)	Squared end defect [1]												
	10	20	30	40	50	60	70	80	90	100	110	120	130
1	0	0	0	0	0	0	0	1	1	1	1	1	1
2	0	0	0	0	1	1	1	1	1	1	1	1	2
3	0	0	1	1	1	1	1	2	2	2	2	2	2
4	0	1	1	1	1	1	2	2	2	3	3	3	3
5	0	1	1	1	2	2	2	3	3	3	3	4	4
6	0	1	1	2	2	2	3	3	3	4	4	5	5
7	0	1	1	2	2	3	3	4	4	4	5	5	6
8	1	1	2	2	2	3	4	4	5	5	6	6	7
9	1	1	2	2	3	3	4	5	5	6	6	7	7
10	1	1	2	2	3	4	4	5	6	6	7	7	8
11	1	1	2	3	3	4	5	6	6	7	8	8	9
12	1	2	2	3	4	4	5	6	7	8	8	9	10
13	1	2	2	3	4	5	6	7	7	8	9	10	11
14	1	2	3	3	4	5	6	7	8	9	10	10	11
15	1	2	3	4	5	6	7	8	8	9	10	11	12
16	1	2	3	4	5	6	7	8	9	10	11	12	13

[1] Width (inches) × height (inches), rounded to nearest 10. Round a product ending in 5 to the next higher 10.

Appendix 11 (continued) - Instructions for Use of Defect Allowance Chart

1. Measure width and height of defect in inches. Add 1 inch to each to allow for waste.

2. Multiply width by height.

3. Measure or estimate length of defect.

4. Place straightedge through product of W X H (left line) and length (right line).

5. Read deduction, to nearest 5 board feet, on center line.

For example, if a defect measured 7" by 8" by 10', the deduction would be determined by holding the straightedge through 72 on the left line (7 + 1) X (8 + 1) and 10 on the right line. The deduction, center line intersection, is 45 board feet.

Shortcut method: Width of defect In inches X height in inches = deduction if defect extends through a 16-foot log. Otherwise take proper proportion, round to nearest 5 bd. ft. (or 10 bd. ft. if scaling by Forest Service International 1/4-Inch Decimal rule).

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Appendix 12 - Standard Converting Factors

Product	Assumed dimensions	Equivalent in board feet
Cord, standard	4 by 4 by 8 feet	500
Cord, long	4 by 5 by 8 feet	625
Cord, shingle bolts	4 by 4 by 8 feet	600
Cord, small material (averaging less than 5 inches middle diameter in the round).	do	333⅓
Cord, short	4 by 3 by 8 feet	375
Cord, short, small material.	do	250
Load (small, irregular pieces that can not be ricked).	4 by 4 by 8 feet	333⅓
Tie, standard	7 by 9 inches by 8 feet	35
Do	7 by 8 inches by 8 feet	30
Do	6 by 6 inches by 8 feet	20
Tie, narrow gage	7 by 8 inches by 6½ feet	25
Do	6 by 7 inches by 6½ feet	20
Do	6 by 6 inches by 6½ feet	15
Pole (telephone) or piling	8 inches by 45 feet	200
Do	8 inches by 40 feet	150
Do	8 inches by 35 feet	100
Do	7 inches by 60 feet	280
Do	7 inches by 50 feet	200
Do	7 inches by 40 feet	100
Do	7 inches by 35 feet	80
Do	7 inches by 30 feet	60
Do	7 inches by 25 feet	50
Do	5 inches by 25 feet	30
Cubic foot	13.6 inches by 1 foot	6
Linear foot	10 inches by 1 foot	3
Linear foot (long piling)	80 to 125 feet by 6 inches.	5½
Derrick pole	7 inches by 30 feet	60
Derrick set (11 pieces)		480
Post, fence	6 inches by 7 feet	7
Do	5 inches by 7 feet	5

Appendix 12 (continued) - Standard Converting Factors

Product	Assumed dimensions	Equivalent in board feet
Post, split	18 inches circumference by 7 feet.	6
Brace, fence	4 inches by 6 feet	2
Stake, fence	3 inches by 5 feet	1
Stay, fence	2 inches by 6 feet	½
Rail, fence (split)	20 inches circumference by 16 feet.	15
Pole, fence	4 inches by 20 feet	10
Pole (12 pieces)	4 inches by 16 feet	100
Pole, converter	4 inches by 20 feet	10
Prop	6 inches by 10 feet	10
Lagging (6 pieces)	3 inches by 6 feet	10

CONVERTING FACTORS

For convenience in preparing statistics, such as reports of timber cut and sold, and for price determinations in sales of products for which prices have not been established by the Chief, it is necessary to convert other products than sawtimber into feet board measure. Regional Foresters will establish converting factors by Forests for these purposes. It is often possible and desirable to establish a converting factor for all standard-gage hewn ties cut on a given Forest based on the size of the average tie; and similar factors are often applicable to groups of sizes of telephone poles, piling, or posts. Standard conversion factors established by Regional Foresters will not be inconsistent with this table, which will be used in the absence of approved local tables.

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Appendix 13 - Board-foot Contents of Standard Lumber and Timber Sizes

End dimensions (inches)	Volume (board feet) according to length, in feet—							
	10	12	14	16	18	20	22	24
1 by 2	1⅔	2	2⅓	2⅔	3	3⅓	3⅔	4
3	2½	3	3½	4	4½	5	5½	6
4	3⅓	4	4⅔	5⅓	6	6⅔	7⅓	8
5	4⅙	5	5⅚	6⅔	7½	8⅓	9⅙	10
6	5	6	7	8	9	10	11	12
7	5⅚	7	8⅙	9⅓	10½	11⅔	12⅚	14
8	6⅔	8	9⅓	10⅔	12	13⅓	14⅔	16
10	8⅓	10	11⅔	13⅓	15	16⅔	18⅓	20
12	10	12	14	16	18	20	22	24
14	11⅔	14	16⅓	18⅔	21	23⅓	25⅔	28
16	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32
18	15	18	21	24	27	30	33	36
20	16⅔	20	23⅓	26⅔	30	33⅓	36⅔	40
1¼ by 4	4⅙	5	5⅚	6⅔	7½	8⅓	9⅙	10
6	6¼	7½	8¾	10	11¼	12½	13¾	15
8	8⅓	10	11⅔	13⅓	15	16⅔	18⅓	20
10	10	12½	14 1/12	16⅔	18¾	20⅚	22 11/12	25
12	12½	15	17½	20	22½	25	27½	30
1½ by 4	5	6	7	8	9	10	11	12
6	7½	9	10½	12	13½	15	16½	18
8	10	12	14	16	18	20	22	24
10	12½	15	17½	20	22½	25	27½	30
12	15	18	21	24	27	30	33	36
2 by 3	5	6	7	8	9	10	11	12
4	6⅔	8	9⅓	10⅔	12	13⅓	14⅔	16
6	10	12	14	16	18	20	22	24
8	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32
10	16⅔	20	23⅓	26⅔	30	33⅓	36⅔	40
12	20	24	28	32	36	40	44	48
14	23⅓	28	32⅔	37⅓	42	46⅔	51⅓	56
16	26⅔	32	37⅓	42⅔	48	53⅓	58⅔	64
2½ by 12	25	30	35	40	45	50	55	60
14	29⅙	35	40⅚	46⅔	52½	58⅓	64⅙	70
16	33⅓	40	46⅔	53⅓	60	66⅔	73⅓	80
3 by 4	10	12	14	16	18	20	22	24
6	15	18	21	24	27	30	33	36
8	20	24	28	32	36	40	44	48
10	25	30	35	40	45	50	55	60
12	30	36	42	48	54	60	66	72
14	35	42	49	56	63	70	77	84
16	40	48	56	64	72	80	88	96

Appendix 13 (continued) - Board-foot Contents of Standard Lumber and Timber Sizes

End dimensions (inches)	Volume (board feet) according to length, in feet—							
	10	12	14	16	18	20	22	24
4 by 4	13⅓	16	18⅔	21⅓	24	26⅔	29⅓	32
6	20	24	28	32	36	40	44	48
8	26⅔	32	37⅓	42⅔	48	53⅓	58⅔	64
10	33⅓	40	46⅔	53⅓	60	66⅔	73⅓	80
12	40	48	56	64	72	80	88	96
14	46⅔	56	65⅓	74⅔	84	93⅓	102⅔	112
5 by 8	33⅓	40	46⅔	53⅓	60	66⅔	73⅓	80
6 by 6	30	36	42	48	54	60	66	72
8	40	48	56	64	72	80	88	96
10	50	60	70	80	90	100	110	120
12	60	72	84	96	108	120	132	144
14	70	84	98	112	126	140	154	168
16	80	96	112	128	144	160	176	192
8 by 8	53⅓	64	74⅔	85⅓	96	106⅔	117⅓	128
10	66⅔	80	93⅓	106⅔	120	133⅓	146⅔	160
12	80	96	112	128	144	160	176	192
14	93⅓	112	130⅔	149⅓	168	186⅔	205⅓	224
10 by 10	83⅓	100	116⅔	133⅓	150	166⅔	183⅓	200
12	100	120	140	160	180	200	220	240
14	116⅔	140	163⅓	186⅔	210	233⅓	256⅔	280
16	133⅓	160	186⅔	213⅓	240	266⅔	293⅓	320
12 by 12	120	144	168	192	216	240	264	288
14	140	168	196	224	252	280	308	336
16	160	192	224	256	288	320	352	384
14 by 14	163⅓	196	228⅔	261⅓	294	326⅔	359⅓	392
16	186⅔	224	261⅓	298⅔	336	373⅓	410⅔	448
18	210	252	294	336	378	420	462	504
16 by 16	213⅓	256	298⅔	341⅓	384	426⅔	469⅓	512
18	240	288	336	384	432	480	528	576
20	266⅔	320	373⅓	426⅔	480	533⅓	586⅔	640
18 by 18	270	324	378	432	486	540	594	648
20 by 20	333⅓	400	466⅔	533⅓	600	666⅔	733⅓	800
22 by 22	403⅓	484	564⅔	645⅓	726	806⅔	887⅓	968
24 by 24	480	576	672	768	864	960	1, 056	1, 152
26 by 26	563⅓	676	788⅔	901⅓	1, 014	1, 126⅔	1, 239⅓	1, 352
28 by 28	653⅓	784	914⅔	1, 045⅓	1, 176	1, 306⅔	1, 437⅓	1, 568
30 by 30	750	900	1, 050	1, 200	1, 350	1, 500	1, 650	1, 800

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Appendix 13 (continued) - Board-foot Contents of Standard Lumber and Timber Sizes

End dimensions (inches)	Volume (board feet) according to length in feet—					
	28	32	34	36	38	40
8 by 8	149⅓	170⅔	181⅓	192	202⅔	213⅓
10	186⅔	213⅓	226⅔	240	253⅓	266⅔
12	224	256	272	288	304	320
14	261⅓	298⅔	317⅓	336	354⅔	373⅓
10 by 10	233⅓	266⅔	283⅓	300	316⅔	333⅓
12	280	320	340	360	380	400
14	326⅔	373⅓	396⅔	420	443⅓	466⅔
16	373⅓	426⅔	453⅓	480	506⅔	533⅓
12 by 12	336	384	408	432	456	480
14	392	448	476	504	532	560
16	448	512	544	576	608	640
14 by 14	457⅓	522⅔	555⅓	588	620⅔	653⅓
16	522⅔	597⅓	634⅔	672	709⅓	746⅔
18	588	672	714	756	798	840
16 by 16	597⅓	682⅔	725⅓	768	810⅔	853⅓
18	672	768	816	864	912	960
20	746⅔	853⅓	906⅔	960	1,013⅓	1,066⅔
18 by 18	756	864	918	972	1,026	1,080
20 by 20	933⅓	1,066⅔	1,133⅓	1,200	1,266⅔	1,333⅓
22 by 22	1,129⅓	1,290⅔	1,371⅓	1,452	1,532⅔	1,613⅓
24 by 24	1,344	1,536	1,632	1,728	1,824	1,920
26 by 26	1,577⅓	1,802⅔	1,915⅓	2,028	2,140⅔	2,253⅓
28 by 28	1,829⅓	2,090⅔	2,221⅓	2,352	2,482⅔	2,613⅓
30 by 30	2,100	2,400	2,550	2,700	2,850	3,000

Appendix 14 - Board-foot Contents of Railroad Ties

[To nearest whole board foot, with no deduction for kerf]

End dimensions (inches)	Length (feet)		
	6½ [1]	8 [2]	8½
6 by 6	20	24	26
6 by 7	23	28	30
6 by 8	26	32	34
7 by 7	27	33	35
7 by 8	30	37	40
7 by 9	----	42	45

[1] Narrow gage railroad.
[2] Standard gage railroad.

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Appendix 15 - Factors for Computing Scribner Decimal C Log Volumes

For logs 1' through 20' in length
Revised 7/1/72

	DIA.	FACTOR
1' thru 15'	1	0.000
	2	0.143
	3	0.390
	4	0.676
	5	1.070
	6	1.160*
	7	1.400*
	8	1.501*
	9	2.084*
	10	3.126*
	11	3.749*
16' thru 20'	6	1.249*
	7	1.608*
	8	1.854*
	9	2.410*
	10	3.542*
	11	4.167*
	12	4.900
	13	6.043
	14	7.140
	15	8.880
	16	10.000
	17	11.528
	18	13.290
	19	14.990
	20	17.499
	21	18.990

DIA.	FACTOR
22	20.880
23	23.510
24	25.218
25	28.677
26	31.249
27	34.220
28	36.376
29	38.040
30	41.060
31	44.376
32	45.975
33	48.990
34	50.000
35	54.688
36	57.660
37	64.319
38	66.731
39	70.000
40	75.240
41	79.480
42	83.910
43	87.190
44	92.501
45	94.990
46	99.075
47	103.501
48	107.970
49	112.292
50	116.990
51	121.650
52	126.525
53	131.510
54	136.510

DIA.	FACTOR
55	141.610
56	146.912
57	152.210
58	157.710
59	163.288
60	168.990
61	174.850
62	180.749
63	186.623
64	193.170
65	199.120
66	205.685
67	211.810
68	218.501
69	225.685
70	232.499
71	239.317
72	246.615
73	254.040
74	261.525
75	269.040
76	276.630
77	284.260
78	292.501
79	300.655
80	308.970
81	317.360
82	325.790
83	334.217
84	343.290
85	350.785
86	359.120
87	368.380

DIA.	FACTOR
88	376.610
89	385.135
90	393.380
91	402.499
92	410.834
93	419.166
94	428.380
95	437.499
96	446.565
97	455.010
98	464.150
99	473.430
100	482.490
101	491.700
102	501.700
103	511.700
104	521.700
105	531.700
106	541.700
107	552.499
108	562.501
109	573.350
110	583.350
111	594.150
112	604.170
113	615.010
114	625.890
115	636.660
116	648.380
117	660.000
118	671.700
119	683.330
120	695.011

SPECIAL NOTE: Log diameters 6" - 11" have separate factors for log lengths 1' - 15', and 16' - 20".

Appendix 16 - Scribner Decimal C Recorded Lengths and Segment Lengths

Maximum 6"Trim per Segment

Measured Length (Ft. & In.)	Recorded Length (Ft)	Segment Length(s) (Ft)		
		top	2nd	3rd
8'0" - 8'6"	8	8		
8'7" - 9'6"	9	9		
9'7" - 10'6"	10	10		
10'7" - 11'6"	11	11		
11'7" - 12'6"	12	12		
12'7" - 13'6"	13	13		
13'7" - 14'6"	14	14		
14'7" - 15'6"	15	15		
15'7" - 16'6"	16	16		
16'7" - 17'6"	17	17		
17'7" - 18'6"	18	18		
18'7" - 19'6"	19	19		
19'7" - 20'6"	20	20		
20'7" - 22'0"	21	10	11	
22'1" - 23'0"	22	10	12	
23'1" - 24'0"	23	11	12	
24'1" - 25'0"	24	12	12	
25'1" - 26'0"	25	12	13	
26'1" - 27'0"	26	12	14	
27'1" - 28'0"	27	13	14	
28'1" - 29'0"	28	14	14	
29'1" - 30'0"	29	14	15	
30'1" - 31'0"	30	14	16	
31'1" - 32'0"	31	15	16	
32'1" - 33'0"	32	16	16	

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Appendix 16 (continued) - Scribner Decimal C Recorded Lengths and Segment Lengths

33'1" - 34'0"	33	16	17	
34'1" - 35'0"	34	16	18	
35'1" - 36'0"	35	17	18	
36'1" - 37'0"	36	18	18	
37'1" - 38'0"	37	18	19	
38'1" - 39'0"	38	18	20	
39'1" - 40'0"	39	19	20	
40'1" - 41'0"	40	20	20	
41'1" - 42'6"	41	13	14	14
42'7" - 43'6"	42	14	14	14
43'7" - 44'6"	43	14	14	15
44'7" - 45'6"	44	14	14	16
45'7" - 46'6"	45	14	15	16
46'7" - 47'6"	46	14	16	16
47'7" - 48'6"	47	15	16	16
48'7" - 49'6"	48	16	16	16
49'7" - 50'6"	49	16	16	17
50'7" - 51'6"	50	16	16	18
51'7" - 52'6"	51	16	17	18
52'7" - 53'6"	52	16	18	18
53'7" - 54'6"	53	17	18	18
54'7" - 55'6"	54	18	18	18
55'7" - 56'6"	55	18	18	19
56'7" - 57'6"	56	18	18	20
57'7" - 58'6"	57	18	19	20
58'7" - 59'6"	58	18	20	20
59'7" - 60'6"	59	19	20	20
60'7" - 61'6"	60	20	20	20