

**Forest Service Handbook  
National Headquarters - Washington Office  
Washington, DC**

**Forest Service Handbook 2409.11 – National Forest Log Scaling Handbook  
Chapter 10 – Theory and Principles of Scaling**

**Amendment:** 2409.11-2006-1

**Effective date:** October 30, 2006

**Duration:** This amendment is effective until superseded or removed.

**Approved by:** Gregory Smith, For Joel Holtrop, Deputy Chief

**Date approved:** April 20, 2006

**Responsible Staff:**

**Last Change:** Amendment No. 7

**Superseded Document(s):** Entire Handbook, Title Page thru 247

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

**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:

**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 is 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.

**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.

**Forest Service Handbook 2409.11 – National Forest Log Scaling Handbook**

**Chapter 10 – Theory and Principles of Scaling**

**Amendment:** 2409.11-2006-1

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**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.

**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 do not perform to standard from District Ranger to Contracting 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.

**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.

**Forest Service Handbook 2409.11 – National Forest Log Scaling Handbook**

**Chapter 10 – Theory and Principles of Scaling**

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**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 outdated 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.

**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.

**Table of Contents**

<b>11 - Theory of Scaling .....</b>	<b>6</b>
<b>12 - General Principles of Forest Service Scaling .....</b>	<b>6</b>
<b>13 - Commercial Units Used .....</b>	<b>6</b>
<b>14 - Authorized Log Rules .....</b>	<b>7</b>
<b>15 - Species Identification .....</b>	<b>9</b>
<b>16 - Product or Piece Specifications.....</b>	<b>9</b>
<b>17 - Log Measurements .....</b>	<b>9</b>
<b>17.1 - Log Lengths .....</b>	<b>9</b>
<b>17.11 - Maximum Scaling Lengths .....</b>	<b>9</b>
<b>17.12 - How To Measure Lengths.....</b>	<b>10</b>
<b>17.13 - Length in Long Logs .....</b>	<b>12</b>
<b>17.14 - Scaling 8 1/2-Foot Tie Logs .....</b>	<b>13</b>
<b>17.15 - Scaling Odd-Length Logs.....</b>	<b>14</b>
<b>17.16 - Scaling Short, Even-Length Logs.....</b>	<b>14</b>
<b>17.17 - Log Volumes, Board Feet .....</b>	<b>14</b>
<b>17.18 - Length Determination of Forked Logs .....</b>	<b>14</b>
<b>17.2 - Trim Allowance.....</b>	<b>16</b>
<b>17.21 - Special Trim Provision.....</b>	<b>16</b>
<b>17.3 - Log Diameters.....</b>	<b>16</b>
<b>17.31 - Diameter Determination of Crotched and Irregularly Shaped Logs.....</b>	<b>18</b>
<b>17.32 - Diameter Determination for Caliper Scaling .....</b>	<b>20</b>
<b>17.33 - Determining Butt Logs .....</b>	<b>20</b>
<b>17.4 - Taper in Long Logs .....</b>	<b>21</b>
<b>17.41 - Distribution of Even Taper .....</b>	<b>21</b>
<b>17.42 - Distribution of Uneven Taper.....</b>	<b>22</b>
<b>17.43 - Taper in Butt Logs.....</b>	<b>23</b>
<b>17.5 - Measurements for Contract Specifications .....</b>	<b>24</b>
<b>18 - Scaling Cylinder In Logs .....</b>	<b>24</b>

## **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 under-run) 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**

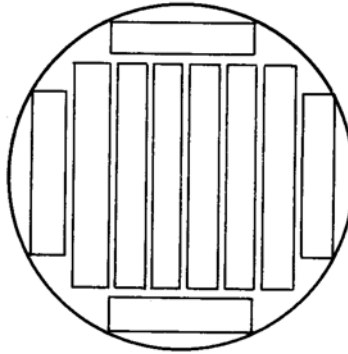


Table II in the appendix shows the Scribner Decimal C rule volume of even- and uneven-length logs from 4 to 20 feet.

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 frustum) 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:

$$V = \frac{A+a}{2} \times L$$

Where V = Volume in cubic feet (ft<sup>3</sup>)

A = Large-end cross-section area (ft<sup>2</sup>)

a = Small-end cross-section area (ft<sup>2</sup>)

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.

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.

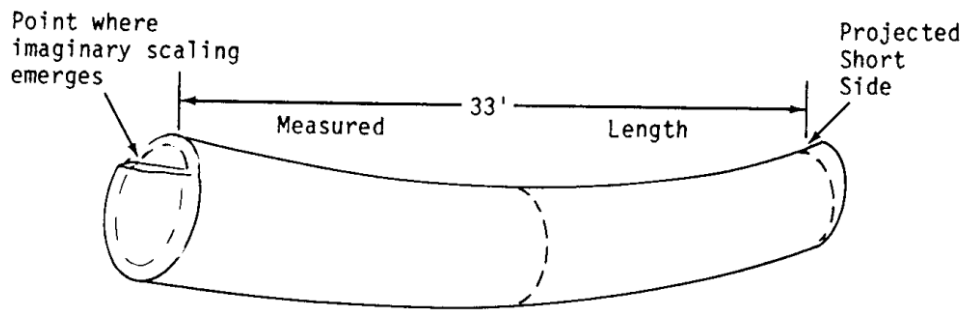
For stump cuts, measure lengths from a point at which the scaling cylinder emerges. For other cuts, make length measurements from the short side.

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.**



17.12 - Exhibit 01-Continued  
Length Measures  
Figure b.

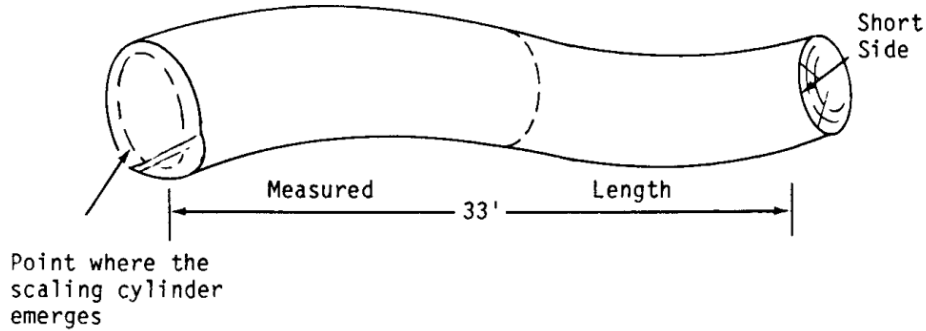


Figure c.

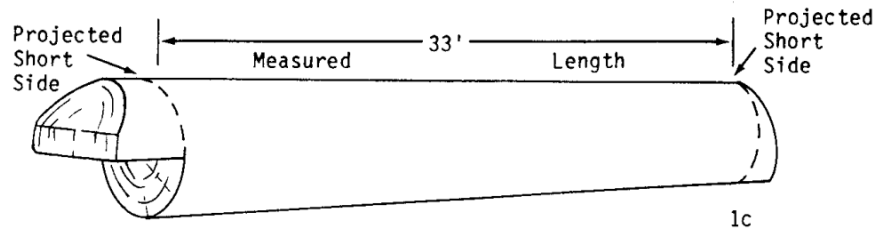
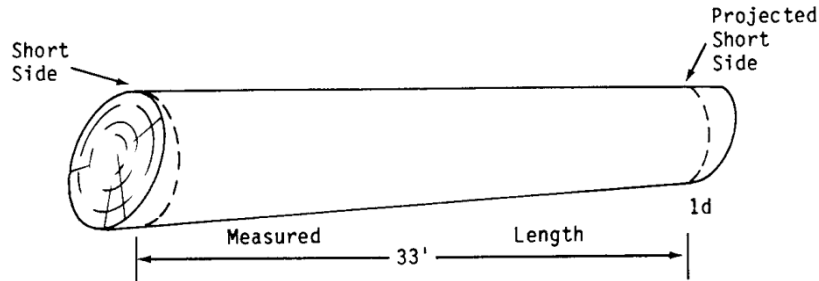


Figure d.



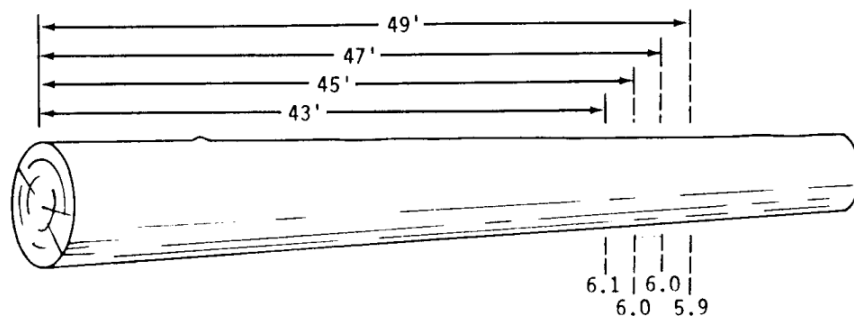
According to timber sale contract provision B6.82, Presentation for Scaling (FS-2400-6 - 4/04):

"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.

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**

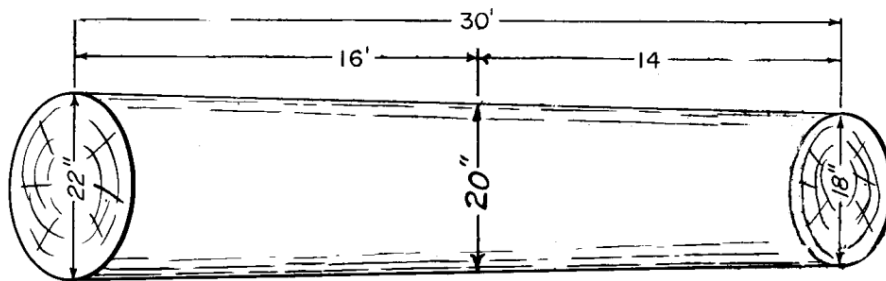
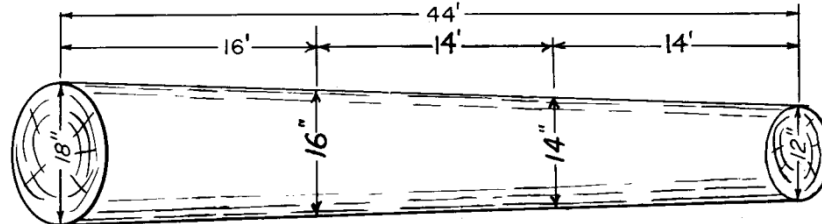


Exhibit 02 illustrates a 44-foot log divided into one 16-foot segment (large end) and two 14-foot segments.

**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.

### 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 11, 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

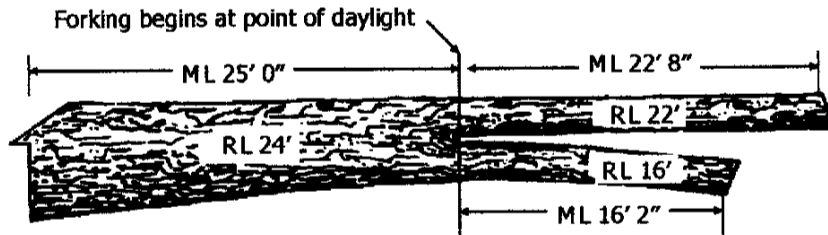


Figure b - Forked Log With One Substandard Fork

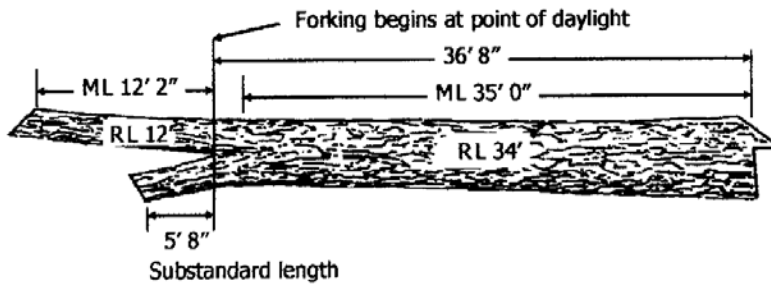


Figure c - Forked Log With A Substandard Fork at Butt End

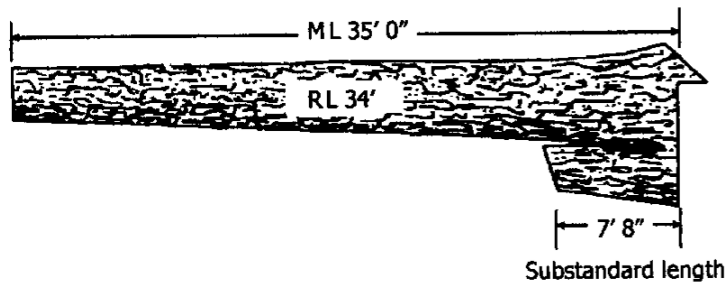
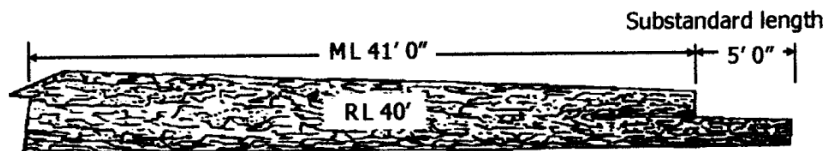


Figure d - Forked Log With a Substandard Fork at Top End



## **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**

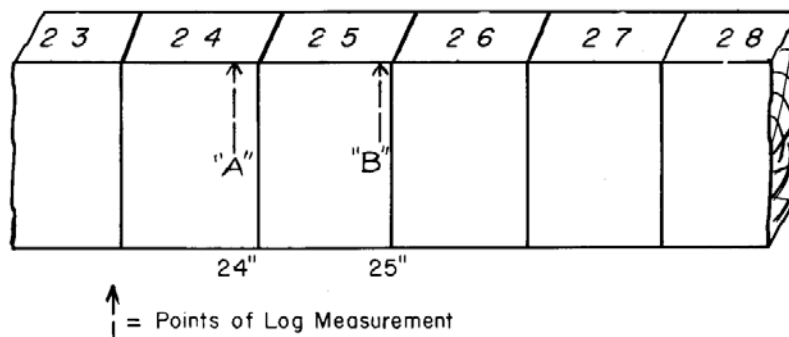
Scaling requires accurate measurement of log diameters. Common tools used to measure diameters are scale sticks, steel tapes, and sliding calipers. The steel tape is the primary tool used to obtain the diameter of log ends in most regions, the scale stick is used to a lesser degree in other regions. 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,  $(A + B) \div 2$ , 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.

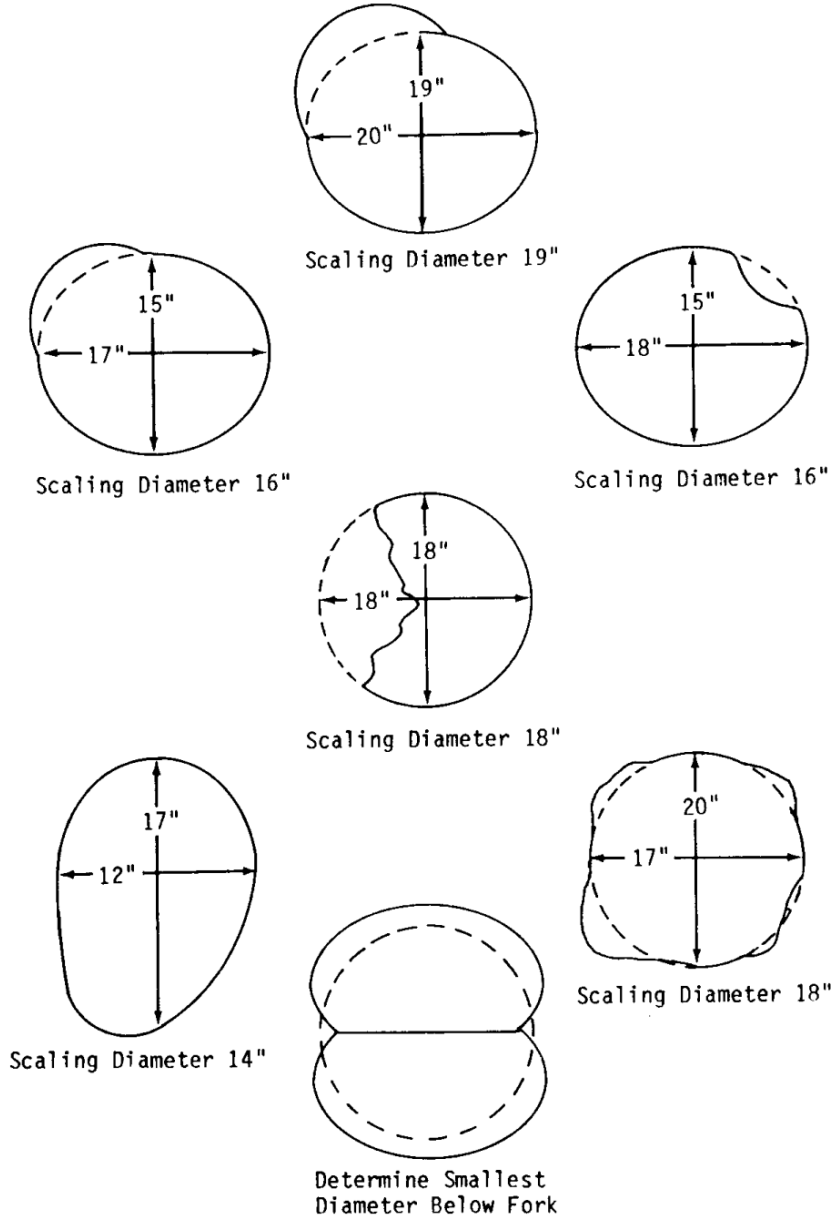
The diameter measurement is exactly that specified in the contract and not a diameter class. For example, a contract which lists the minimum diameter as 6 inches will be considered to be 6.0 inches. Take a single measurement across the short axis of the log. After establishing the assumed bucking point,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

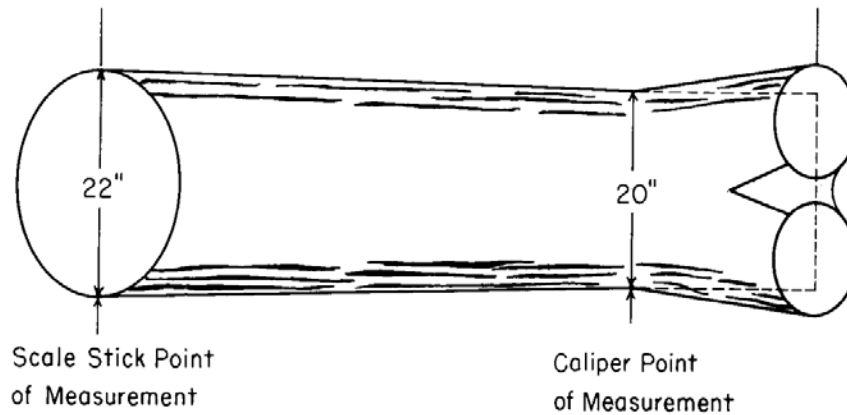
### **17.31 - Diameter Determination of Crotched and Irregularly Shaped Logs**

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**



**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**

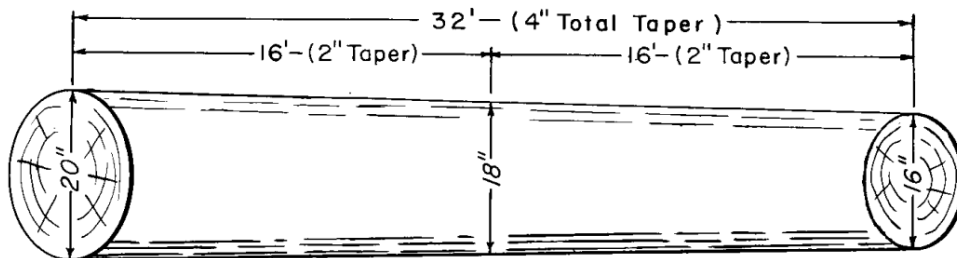


Exhibit 02 illustrates a 46-foot log with end measurements of 16 and 22 inches (6 inches total taper or 2 inches per segment). Scale it as one 14-foot segment with a diameter of 16 inches (2 inches taper); one 16-foot segment with a diameter of 18 inches (2 inches taper); one 16-foot segment with a diameter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

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

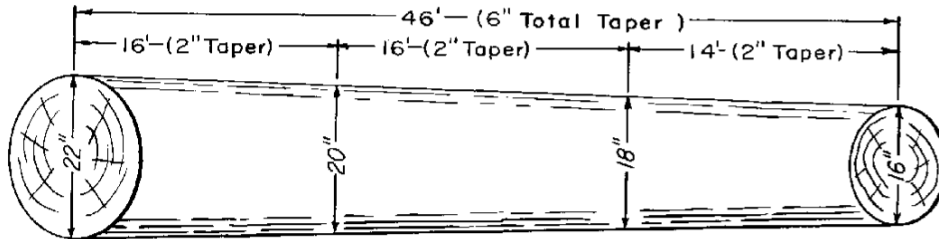


Table III in the appendix chapter shows Scribner Decimal C volumes of long logs, 22 to 48 feet, for various total tapers.

**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**

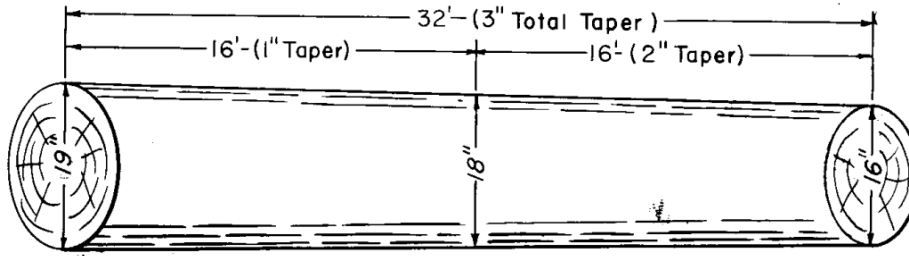
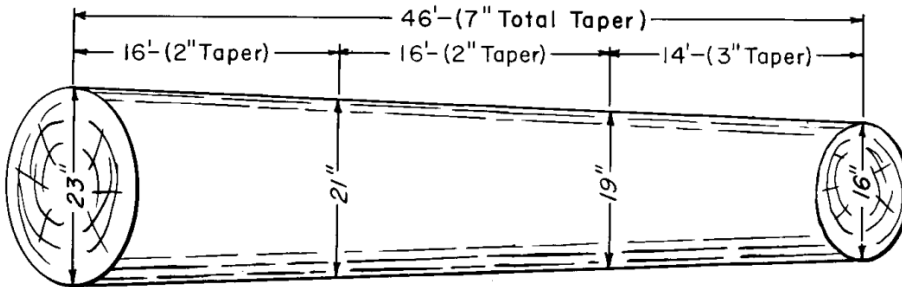


Exhibit 02 illustrates a 46-foot log with end measurements of 16 and 23 inches (7 inches total taper). Scale it as one 14-foot segment with a diameter of 16 inches (3 inches taper); one 16-foot segment with a diameter of 19 inches (2 inches taper); one 16-foot segment with a diameter of 21 inches (2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

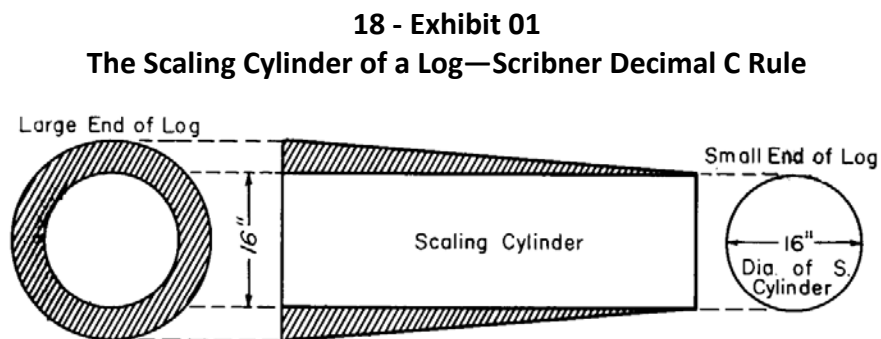
As described in section 16, the timber sale contract establishes the specifications for scaling the products. The Contracting Officer is responsible for determining whether or not the material presented for scaling is in accordance with the terms of the contract.

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, excessive 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

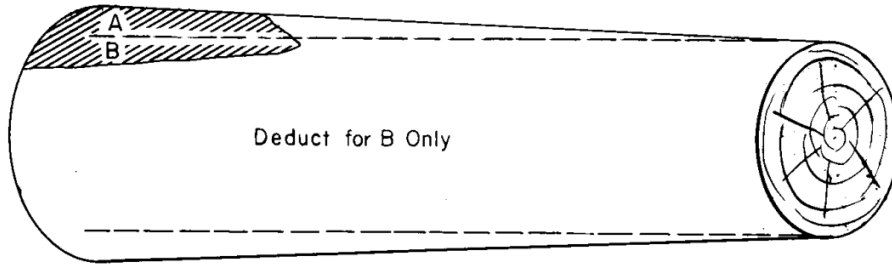
The scaling cylinder for the Scribner Decimal C rule is an imaginary cylinder extending the scaling length of the log with a diameter equal to the measured or small end of the log (ex. 01). Volumes given by the rule are the gross board-foot contents of this cylinder.



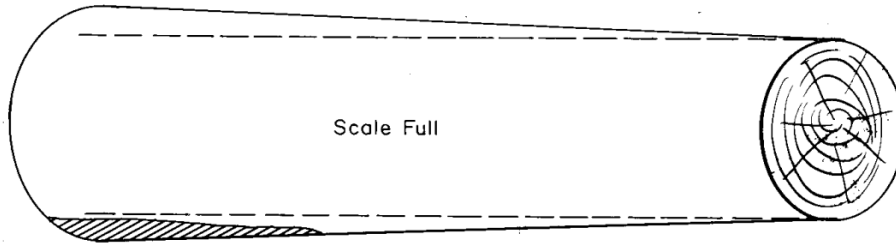
To visualize the scaling cylinder in a perfectly round log, picture the log in a giant lathe rotated against a knife until the entire log is peeled to the size of the small-end diameter. The cylinder of wood left is the scaling cylinder of that log. The part peeled off is outside the scaling cylinder.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

**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.