Forest Service Handbook
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Forest Service Handbook 2409.11a – National Forest Cubic Scaling Handbook
Chapter 20 - Cubic Log Scaling Rules

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Approved by: Frederick L. Norbury, Associate Deputy Chief, NFS

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Responsible Staff:

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Superseded Document(s):

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

22.3: Revises defect deduction methods to eliminate percent as a separate deduction method and to use percent in combination with the other four deduction methods.

22.31: Clarifies deduction process when multiple squared area defects occur on the same log end. Revises method to determine midpoint defect dimensions on multi-segment logs.

22.32a: Establishes this code and caption to provide direction and exhibits with examples of length deduction with percent method.

22.33: Revises and recodes to this section the direction on diameter deduction method, which was previously coded to section 22.34.

22.33a: Establishes this code and caption to provide direction and exhibits with examples of diameter deduction with percent method.

22.33b: Establishes this code and caption to provide direction on the deduction process when both sap rot and weather check defects are present.

22.34: Revises and recodes to this section the direction on the ring deduction method, which was previously coded to section 22.35.

22.35: Changes the caption and adds direction for defect deductions on fractional logs.

22.35a: Establishes this code and caption to provide direction on diameter deduction on fractional logs.

22.35b: Establishes this code and caption and revises direction on ring deduction on fractional logs previously coded to 22.35.

22.36: Establishes this code and caption to provide direction for defect deductions on slabs and chunks.

22.36a: Establishes this code and caption to provide direction on diameter deduction on slabs and chunks.

22.41c: Adds direction regarding sap decay deductions.

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22.3 - Defect Deduction Methods

Use all methods with skill and judgment. Develop knowledge of how defects affect the production of boards or veneer through periodic mill visits (sec. 12.1). No formula, method, or rule will take the place of judgment in scaling. There are four defect deduction methods:

1. Squared area
2. Length
3. Diameter
4. Rings

All defect deduction methods may be used combined with percent, which adjusts the deduction when only a portion of the assessed area is defective. A percent of the full deduction is made by reducing the defect volume by the percent affected.

22.31 - Squared Area Deduction Method

Defect showing in one or both log ends can be deducted as if sawn out in squares or rectangles. When multiple squared area defects occur on the same log end, all secondary squared area defect dimensions must be measured at right angles to the primary (largest) defect. Calculate defect volume by this formula:

$$Defect\ volume\ (\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144}$$

Where:

ft^3 = cubic feet
W = width of defect (inches)
*H = height of defect (inches)
L = length of defect (feet)

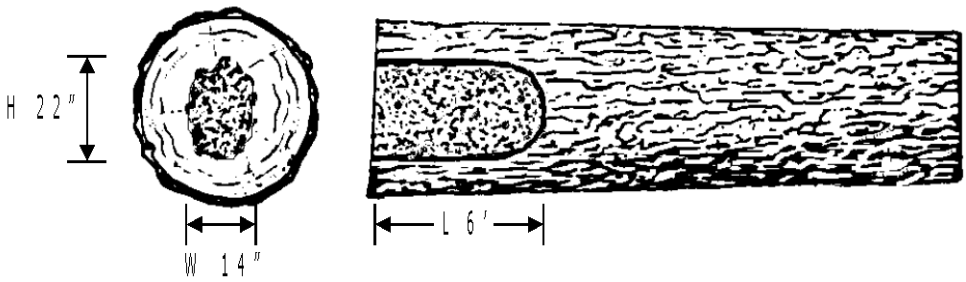
*For defects on the surface of a log, "height" refers to "depth" of the defect.

When defect appears on one end only, use actual defect dimensions for defect calculations. If the defect tapers, such as with butt rots or heart checks, adjust the defect length or reduce the defect volume by using a percent to allow for recoverable volume along the sides of the defect.

Exhibit 01 provides an example of how to determine defect volume when the defect appears in one end of the log. Exhibit 02 is an example of how to determine defect volume when it appears in both ends of a single segment log. Exhibit 03 is an example of determining defect volume when the defect appears in both ends of a two-segment log.

22.31 - Exhibit 01

Defect Showing in One End of Log



Given:

W = 14 inches
H = 22 inches
L = 6 feet

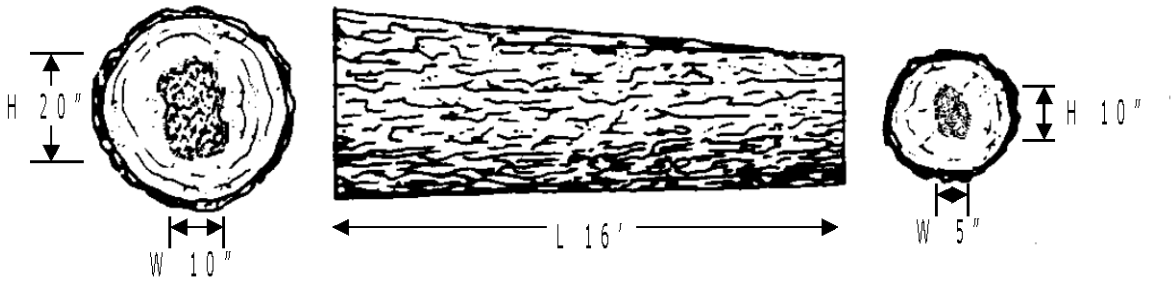
Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144} = \frac{14\ x\ 22\ x\ 6}{144} = \frac{1848}{144} = 12.8\ ft^3$$

When the same defect appears on both ends of a single segment log, determine the average defect width and height. When computing average defect dimensions, round calculations ending in 0.5 to the nearest even whole number. For example, round 6.5 to 6 and 9.5 to 10.

22.31 - Exhibit 02

Defect Showing in Both Ends of Single Segment Log



Given:

Recorded log length	= 16 feet
Small end defect W	= 5 inches
Large end defect W	= 10 inches
Small end defect H	= 10 inches
Large end defect H	= 20 inches
Defect length	= 16 feet

Average defect dimensions:

$$W = \frac{(10+5)}{2} = \frac{15}{2} = 7.5\,(round\ to\ nearest\ even\ whole\ number) = 8\ inches$$

$$H = \frac{(20+10)}{2} = \frac{30}{2} = 15\ inches$$

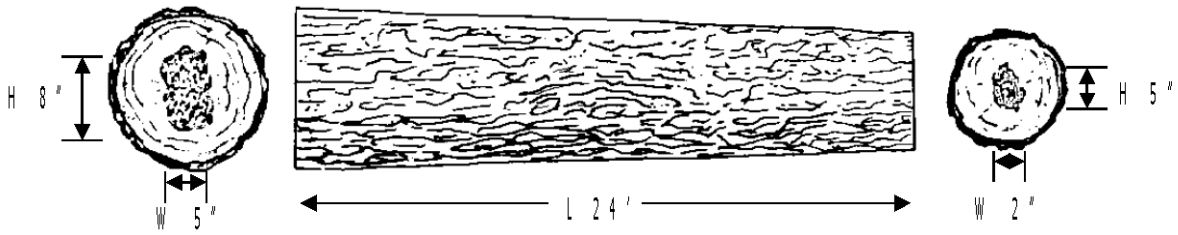
Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144} = \frac{8\ x\ 15\ x\ 16}{144} = \frac{1920}{144} = 13.3\ ft^3$$

When defect appears on both ends of a multi-segment log, defect taper must be calculated prior to determining the average defect dimensions for each segment. The procedure is the same as taper distribution of log diameters on multi-segment logs, (sec. 21.44a - Distribution of Even Taper, and sec. 21.44b - Distribution of Uneven Taper). Taper for width and height dimensions are calculated separately.

22.31 - Exhibit 03

Defect Showing in Both Ends of a Two-Segment Log



Given:

Recorded log length	= 24 feet
Segment lengths	= 12 feet
Small end defect W	= 2 inches
Large end defect W	= 5 inches
Small end defect H	= 5 inches
Large end defect H	= 8 inches
Defect length	= 24 feet

Determine defect dimensions and defect volume:

Use defect taper to determine the defect dimensions at the segment break. Subtract small end defect dimensions from large end defect dimensions. The result is the total taper for both width and height dimensions. If necessary, raise total taper to make it evenly divisible by the number of segments. Divide the total taper by the number of segments and the result is the amount of taper assigned to the top segment. If the log contains more than two segments, subtract the taper assigned to the top segment from the total taper, and then distribute the remaining taper to the other segments following the same procedure.

Width dimensions:

$$W = (5 - 2) = 3 + 1 = 4 \text{ inches}$$

$$\frac{4}{2} = 2 + 2 \text{ (small end dimension)} = 4 \text{ inch width at segment break}$$

Height dimensions:

$$H = (8 - 5) = 3 + 1 = 4 \text{ inches}$$

$$\frac{4}{2} = 2 + 5 \text{ (small end dimension)} = 7 \text{ inch height at segment break}$$

Small End Segment:

Average defect dimensions:

W= $\frac{(4+2)}{2} = 3$ inches

H= $\frac{(7+5)}{2} = 6$ inches

Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144}$$

$$= \frac{3\ x\ 6\ x\ 12}{144} = \frac{216}{144} = 1.5\ ft^3$$

Large End Segment:

Average defect dimensions:

W= $\frac{(5+4)}{2} = 4.5$* or 4 inches

H= $\frac{(8+7)}{2} = 7.5$* or 8 inches

Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144}$$

$$= \frac{4\ x\ 8\ x\ 12}{144} = \frac{384}{144} = 2.7\ ft^3$$

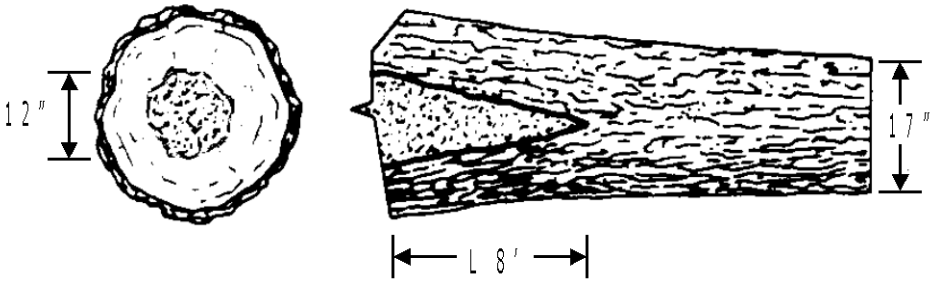
*Round to nearest even whole number.

22.31a - Squared Area as Opposed to Length Cut

When the defect affects a large portion of the end area of a log, a length deduction, rather than squared area, may be the applicable defect deduction method. Use the length deduction method (sec. 22.32) when the measured defect diameter is equal to or exceeds the diameter shown in Appendix 4 - Length Cut Table, Chapter 60.

22.31a - Exhibit 01

Length Deduction Applies



Given:

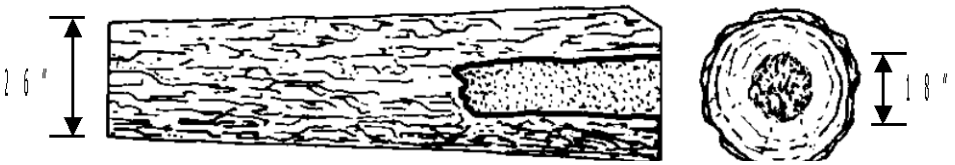
Small end diameter = 17 inches
Large end defect diameter = 12 inches
Defect length = 8 feet
Adjusted defect length = 4 feet

Defect is cone-shaped rot. The defect length is adjusted to allow for recoverable products along the sides of the cone.

Referring to Appendix 4 - Length Cut Table, a 17-inch diameter segment with a measured defect diameter of 12 inches is equal to the defect diameter listed in the table; therefore, a 4-foot length deduction is made.

22.31a - Exhibit 02

Squared Area Deduction Applies



Given:

Small end diameter = 26 inches
Large end defect diameter = 18 inches

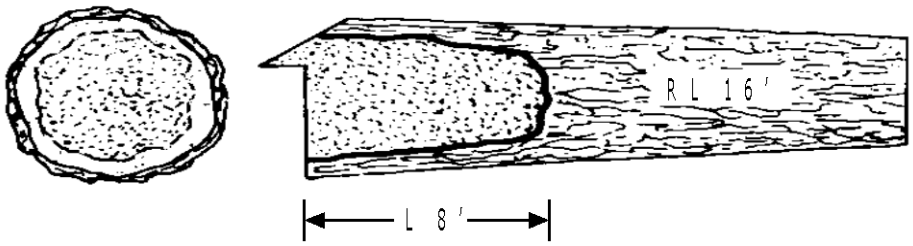
Referring to Appendix 4 - Length Cut Table for a 26-inch diameter segment with an 18-inch defect diameter, the measured defect diameter of 18 inches does not equal or exceed the table value of 21 inches; therefore, the squared area method is used to make the deduction.

22.32 - Length Deduction Method

Use this method to deduct for defects that affect a portion of the log length. Determine the defect percent by dividing the defect length by segment length. Determine defect volume by multiplying the defect percent by the gross volume.

22.32 - Exhibit 01

Defect in Single Segment Log



Given:

Recorded log length = 16 feet
Gross volume = 31.6 ft^3
Defect length = 8 feet

Determine defect percent:

$$Defect\ percent = \frac{defect\ \ length}{segment\ \ length}$$

$$= \frac{8}{16}\ x100 = 50\%$$

Determine defect volume:

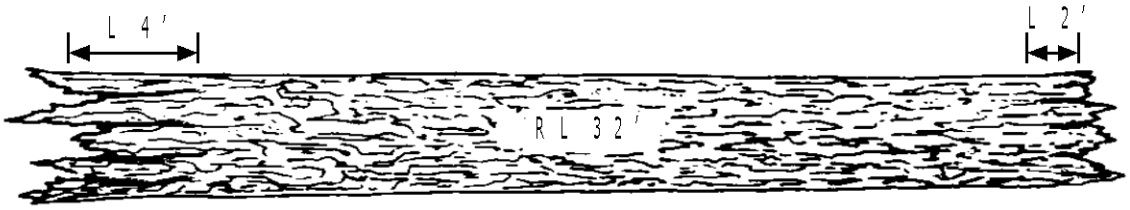
$$Defect\ volume\ (\ ft^3\ ) = gross\ volume\ x\ defect\ \ percent$$

$$= 31.6\ x\ 0.5$$

$$= 15.8\ \ ft^3$$

22.32 - Exhibit 02

Example of Defect In Two-Segment Log



Given:

Recorded log length = 32 feet
Segment lengths = 16 feet
Small end segment gross volume = 39.8 ft^3
Small end segment defect length = 2 feet
Large end segment gross volume = 47.7 ft^3
Large end segment defect length = 4 feet

Determine defect percent:

$$Defect\ percent = \frac{defect\ \ length}{segment\ \ length} x100$$

$$Small\ end\ segment = \frac{2}{16} x100 = 12.5\%$$

$$Large\ end\ segment = \frac{4}{16} x100 = 25\%$$

Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = gross\ volume\ x\ defect\ \ percent$$

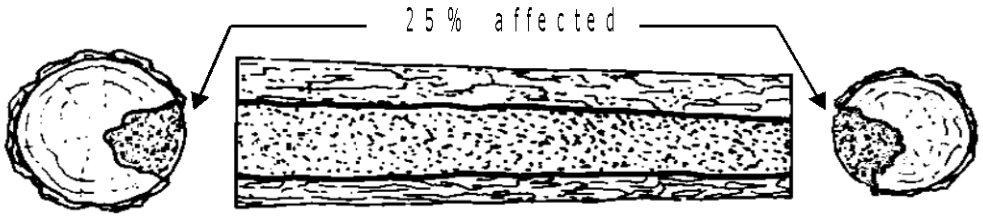
Small end segment = 39.8 x 0.125 = 4.98 = 5.0 ft^3
Large end segment = 47.7 x 0.25 = 11.93 = 11.9 ft^3
Total defect volume (ft^3) = 5.0 + 11.9 = 16.9 ft^3

22.32a - Length Deduction With Percent Method

Use the length deduction method combined with percent when only a portion of the end area is affected. Estimate the percent of the log end area affected in whole percents and the length affected in feet.

22.32a - Exhibit 01

Example Length With Percent Deduction



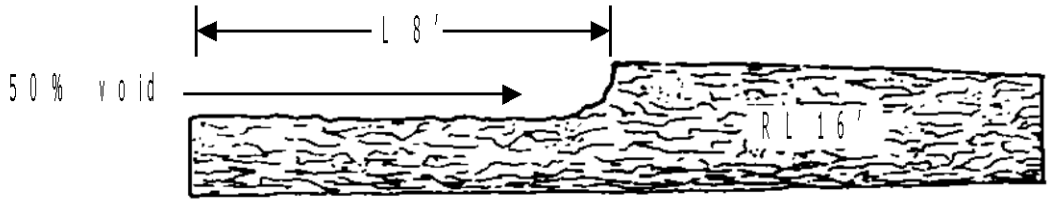
Given:

Gross volume = 65.0 ft^3
Defect affects 25 percent of the end area for the full length.

$$Defect\ volume\ (\ ft^3\ ) = gross\ volume\ x\ defect\ \ percent$$
$$= 65.0\ x\ 0.25 = 16.25 = 16.3\ \ ft^3$$

22.32a - Exhibit 02

Example Length With Percent Deduction



Given:

Recorded log length = 16 feet
Gross volume = 32.6 ft^3
Defect affects 50 percent of 8 feet

Determine defect percent:

$$Defect\ percent = \frac{defect\ length}{segment\ length}\ x\ percent\ end\ area\ affected$$

$$= \frac{8}{16}\ x\ .5 = .25x100 = 25\%$$

Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = gross\ volume\ x\ defect\ percent$$

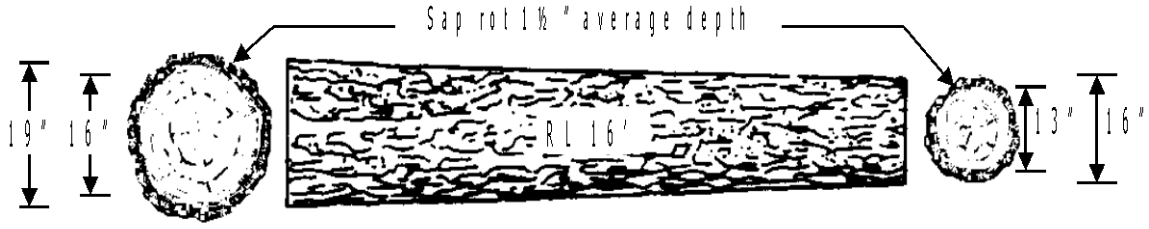
$$= 32.6\ x\ 0.25 = 8.2\ ft^3$$

22.33 - Diameter Deduction Method

Use this method for perimeter defects such as sap rot and weather check. Reduce the gross log diameter based on the average depth of the defect. Defect volume is the difference between gross and net volume.

22.33 - Exhibit 01

Example Diameter Deduction



Given:

Recorded log length = 16 feet
Small end diameter = 16 inches
Large end diameter = 19 inches
Gross volume = 26.9 ft^3
Sap rot = 1.5 inch average depth

Determine net volume and defect volume:

1.5 inches (sap rot) x 2 = 3 inch diameter deduction
Reduced small end diameter = 16 - 3 = 13 inches
Reduced large end diameter = 19 - 3 = 16 inches

$$Defect\ volume = gross\ \ volume - net\ volume$$
$$= 26.9 - 18.5 = 8.4\ \ ft^3$$

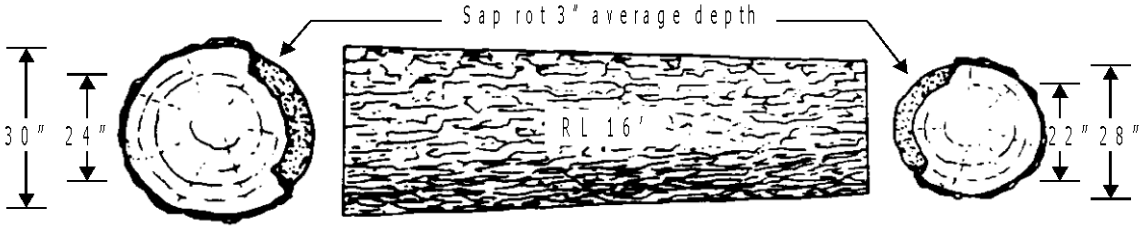
Net volume (13 inches x 16 inches x 16 feet) = 18.5 ft^3

22.33a - Diameter Deduction With Percent Method

Use the diameter deduction method combined with percent when only a portion of the circumference is affected.

22.33a - Exhibit 01

Example Diameter With Percent Deduction



Defect volume (ft^3) = gross volume - net volume x percent circumference affected

= (73.5 - 46.2) x .33 = 9.0 ft^3

Sap rot affects one-third of the circumference. Determine a total sap rot deduction as in exhibit 01, and deduct one-third of the total defect volume.

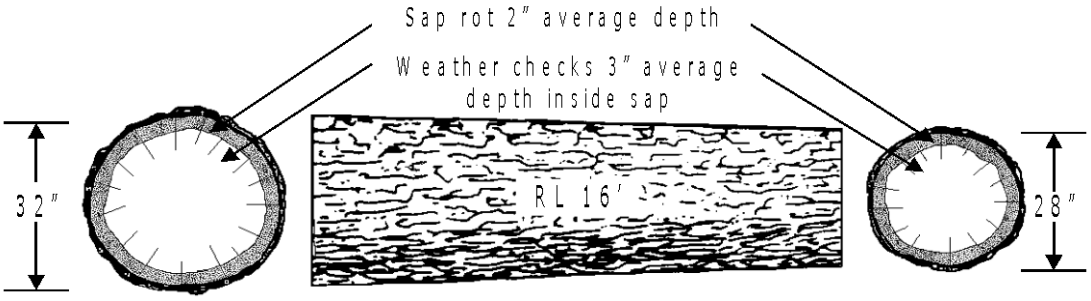
22.33b - Diameter Deduction Method for Logs with Both Sap Rot and Weather Checks

When both sap rot and weather checks are present on the log end(s), and the weather checks extend inside the sap rot, determine the total average depth of both the sap rot and the weather checks. Consider any depth of penetration of weather checks for a deduction. Follow the instructions in section 22.51b to determine if the segment defect factor exceeds the contract merchantable factor. If the segment defect factor exceeds the contract merchantable factor, the segment is not merchantable.

If the segment defect factor does not exceed the contract merchantable factor, apply the following procedure. Measure the average depth of the sap rot plus half the average depth of the weather checks that extend inside the sap rot. Double the measurement to reflect the diameter deduction for the whole log. Measuring half the depth of the weather checks is in lieu of reducing the defect volume by 50 percent as is done on weather check deductions when no sap rot is present.

22.33b - Exhibit 01

Diameter Deduction for Both Sap Rot and Weather Checks



Given:

Recorded log length = 16 feet
Small end diameter = 28 inches
Large end diameter = 32 inches
Gross volume = 78.9 ft^3
Sap rot = 2 inch average depth
Weather checks = 3 inch average depth inside sap rot

Determine segment merchantability:

2 inches (sap rot) + 3 inches (weather checks) x 2 = 10 inch diameter deduction
Reduced small end diameter = 28 - 10 = 18 inches
Reduced large end diameter = 32 - 10 = 22 inches
Net volume (18 inches x 22 inches x 16 feet) = 35.3 ft^3

Defect volume = gross volume - net volume

$= 78.9 - 35.3 = 43.6 \ ft^3$

Defect factor = 10.21
Contract merchantable factor = 10.67

Segment defect factor does not exceed the contract merchantable factor, therefore the segment is merchantable.

Determine net volume and defect volume:

3 inch average depth (weather checks) x .5 (one-half depth) = 1.5 inches
2 inches (sap rot) + 1.5 inches (weather checks) = 3.5 inches
3.5 inches x 2 = 7 inch diameter deduction
Reduced small end diameter = 28 - 7 = 21 inches
Reduced large end diameter = 32 - 7 = 25 inches
Net volume (21 inches x 25 inches x 16 feet) = 46.5 ft^3

Defect volume = gross volume - net volume

$= 78.9 - 46.5 = 32.4 \ ft^3$

22.34 - Ring Deduction Method

Use the ring deduction formula, the squared area or the diameter deduction method to determine defect volume from rings. The deduction method used depends on the type of ring presented: a full ring, a partial ring, a perimeter ring, or multiple rings. Refer to section 22.45 for applicable ring deduction procedures and examples.

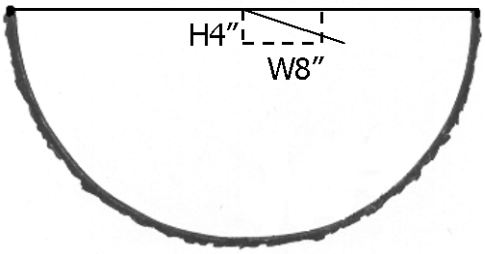
22.35 - Defect Deduction Methods for Fractional Logs

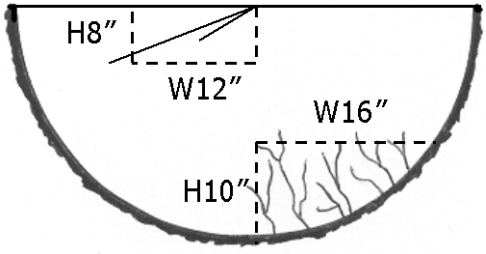
Use the applicable defect deduction method for the defect presented. Apply the cull log determination process as described in section 22.5 after the recorded gross dimensions have been determined.

Use the length deduction method as described in section 22.32.

Use the squared area deduction method as described in section 22.31. In addition, calculate all defect dimensions at right angles to the split side. The "give and take" procedure may also be used in determining defect dimensions.

Fractional Log: Squared Area Deduction





Given:

Recorded log length = 16 feet
Heart check
Small end defect W = 8 inches
Large end defect W = 12 inches
Small end defect H = 4 inches
Large end defect H = 8 inches
Defect length = 16 feet

Break
Large end defect W = 16 inches
Large end defect H = 10 inches
Defect length = 4 feet

Average defect dimensions: Heart check

$$W = \frac{(8 + 12)}{2} = \frac{20}{2} = 10 \text{ inches}$$

$$H = \frac{(4 + 8)}{2} = \frac{12}{2} = 6 \text{ inches}$$

Determine defect volume:

Heart check:

$$\text{Defect volume}\,(ft^3) = \frac{W \times H \times L}{144} = \frac{10 \times 6 \times 16}{144} = \frac{960}{144} = 6.7 \ ft^3$$

Break:

$$\text{Defect volume}\,(ft^3) = \frac{W \times H \times L}{144} = \frac{16 \times 10 \times 4}{144} = \frac{640}{144} = 4.4 \ ft^3$$

$$\text{Total defect volume}\,(ft^3) = 6.7 + 4.4 = 11.1 \ ft^3$$

Use the guidelines in sections 22.35a and 22.35b when the diameter deduction method or the ring deduction method is used on fractional logs.

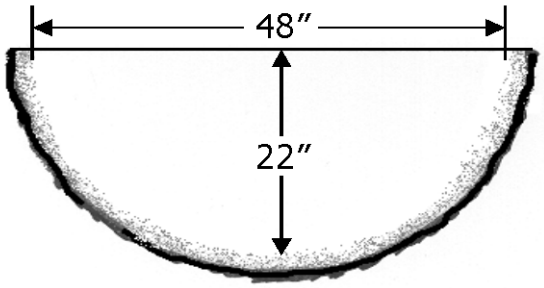
22.35a - Diameter Deduction on Fractional Logs

1. Subtract the net scaling diameter from the gross scaling diameter to determine the diameter deduction.

2. Measure the sound wood inside the defect using the measurement techniques described in section 21.31. Reconstruct the whole log net diameter and determine cubic foot volume using the Cubic Foot Log Volume Appendix 2. Record the diameter that most closely equals one-half the whole log net volume as the fractional log net scaling diameter.

22.35a - Exhibit 01

Diameter Deduction



Given:

Gross measurements = 52" width, 24" height, 16' length
Gross scaling diameter = 35" (Refer to sec. 21.32, ex. 01)
Sap rot = 2 inch average depth

Determine net volume:

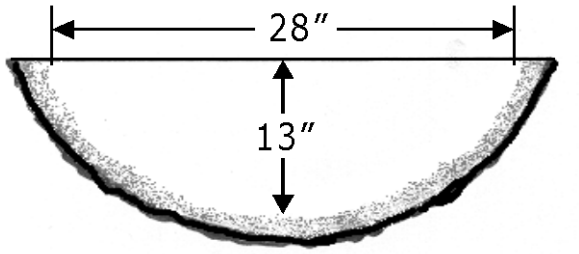
Sound wood measurements = 48" width, 22" height (no defect on split side), 16' length
Double the height - 22" x 2 = 44"
Whole log net diameter = 48"+ 44" = 92 ÷ 2 = 46"
Log taper = 2"
Whole log net volume = 46" x 48" x 16' = 192.9 ft^3
Half volume = 192.9 ÷ 2 = 96.45 ft^3
32" x 34" x 16' = 95.1 ft^3 which most closely equals one-half the whole log net volume
Fractional log net scaling diameter = 32"

Determine defect deduction:

Gross scaling diameter net scaling diameter = diameter deduction
35" - 32" = 3" diameter deduction

22.35a - Exhibit 02

Diameter Deduction



Given:

Gross measurements = 31" width, 14" height, 16' length
Gross scaling diameter = 20" (sec. 21.31, ex. 02)
Sap rot = $1\frac{1}{2}$ inch average depth

Determine net volume:

Sound wood measurements = 28" width, 13" height (no defect on split side), 16' length
Double the height - 13" x 2 = 26"
Whole log net diameter = 28"+ 26" = 54" ÷ 2 = 27"
Log taper = 3"
Whole log net volume = 27" x 30" x 16' = 71.1 ft^3
Half volume = 71.1 ÷ 2 = 35.55 ft^3
19" x 22" x 16' = 36.9 ft^3 which most closely equals one-half the whole log net volume
Fractional log net scaling diameter = 19"

Determine defect deduction:

Gross scaling diameter net scaling diameter = diameter deduction
20" - 19" = 1" diameter deduction

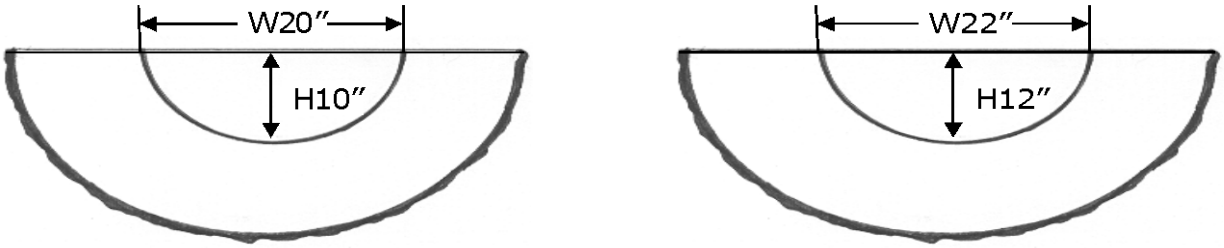
22.35b - Ring Deduction on Fractional Logs

1. Determine fractional log core volume and apply deduction procedures described in section 22.45a to determine defect volume. Use the squared area deduction method to determine defect volume when the ring height measurement is less than 6.0 inches or when the calculated core diameter size is less than minimum contract specifications.

2. Measure the core wood inside the ring using the measurement techniques described in section 21.31. Reconstruct the whole log core diameter and determine cubic foot volume using the Cubic Foot Log Volume Appendix 2. Record the diameter that most closely equals one-half the whole log core volume as the fractional log core diameter. Determine fractional log core volume (unrounded) and multiply by 0.273 to determine defect volume.

22.35b - Exhibit 01

Ring Deduction



Given:

Gross measurements = 52" width, 24" height, 16' length
Gross scaling diameter = 35" (Refer to sec. 21.32, ex. 01)
Ring measurements
- Small end ring W = 20 inches
- Large end ring W = 22 inches
- Small end ring H = 10 inches
- Large end ring H = 12 inches
- Defect length = 16 feet

Average defect dimensions:

$$W = \frac{(20 + 22)}{2} = \frac{42}{2} = 21 \text{ inches}$$

$$H = \frac{(10 + 12)}{2} = \frac{22}{2} = 11 \text{ inches}$$

Determine core dimensions and core volume:

Double the height - 11" x 2 = 22"
Whole log core diameter = 21"+ 22" = 43 ÷ 2 = 21.5" or 21"
Log taper = 3"
Whole log core volume = 21" x 24" = 44.4 ft^3
Half volume = 44.4 ÷ 2 = 22.2 ft^3
14" x 17" x 16' = 21.16 ft^3 which most closely equals one-half the whole log core volume
Fractional log core diameter = 14"

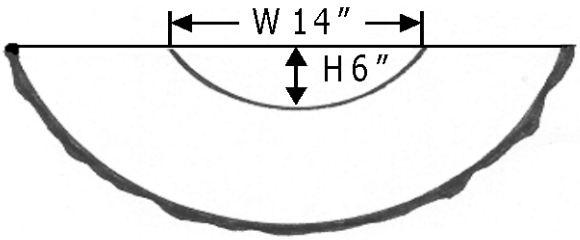
Determine defect volume:

$$Defect\ \ volume\,(\ ft^3\,) = core\ \ volume\ unrounded\ x\ 0.273$$

$$= 21.16152\ x\ 0.273 = 5.8\ \ ft^3$$

22.35b - Exhibit 02

Ring Deduction



Given:

Gross measurements = 31" width, 14" height, 16' length
Gross scaling diameter = 20" (Refer to sec. 21.32, ex. 02)
Ring measurements = 14" width, 6" height, 8' length

Determine core dimensions and core volume:

Double the height - 6" x 2 = 12"
Whole log core diameter = 12"+ 14" = 26" ÷ 2 = 13"
Log taper = 2"
Defect taper = 1" in 8'.
Whole log core volume = 13"x 14" x 8' = 8.0 ft^3
Half volume = 8.0 ÷ 2 = 4.0 ft^3
9" x 10" x 8' = 3.95 ft^3 which most closely equals one-half the whole log core volume
Fractional log core diameter = 9"

Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = core\ volume\ unrounded\ x\ 0.273$$

$$= 3.948696\ x\ 0.273 = 1.1\ \ ft^3$$

22.36 - Defect Deduction Methods for Slabs and Chunks

Use the applicable defect deduction method for the defect presented. Apply the cull log determination process as described in section 22.5 after the recorded gross dimensions have been determined.

Use the length deduction method as described in section 22.32.

Use the squared area deduction method as described in section 22.31

The ring deduction method is inapplicable on slabs and chunks. Use an alternative defect deduction method applicable to the defect presented.

Use the guidelines in section 22.36a when the diameter deduction method is used on slabs and chunks.

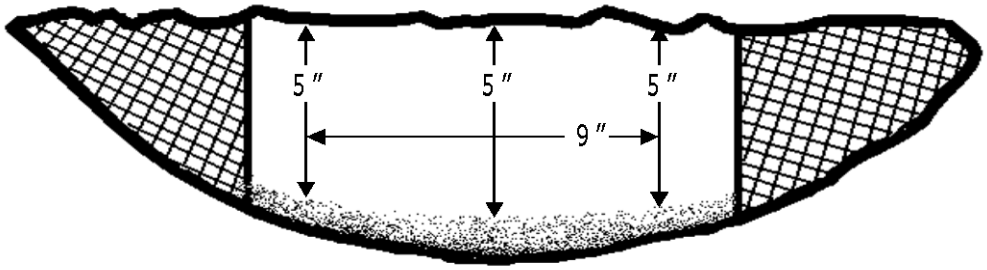
22.36a - Diameter Deduction on Slabs and Chunks

Subtract the net scaling diameter from the gross scaling diameter to determine the diameter deduction.

Measure the sound wood inside the defect using the measurement techniques described in section 21.32. Convert the end area of the sound wood inside the defect to a circular equivalent and net scaling diameter.

22.36a - Exhibit 01

Slab: Diameter Deduction



Given:

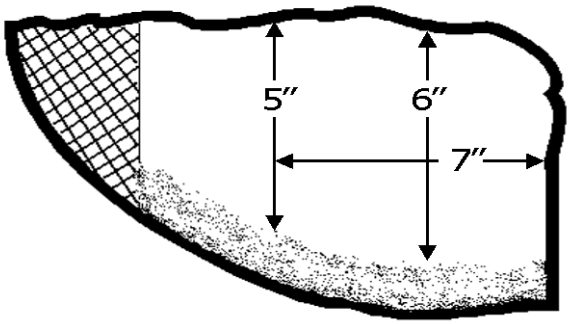
Gross measurements = 5" average height, 12" width
Gross scaling diameter = 8" (Refer to sec. 21.32, ex. 01a)
Sap rot = $1\frac{1}{2}$ inch average depth

Determine defect volume:

Sound wood measurements = 5"+ 5"+5"= 15" ÷ 3 = 5" average height, 9" width
5" + 9" = 14" ÷ 2 = 7"circular equivalent and net scaling diameter

Gross scaling diameter net scaling diameter = diameter deduction
8" - 7" = 1" diameter deduction

Chunk: Diameter Deduction



Given:

Gross measurements = 6" average height, 10" width
Gross scaling diameter = 8" (Refer to sec. 21.32, ex. 01b)
Sap rot = 2 inch average depth

Determine defect volume:

Sound wood measurements:

5" + 6" = 11" ÷ 2 = 5.5 or 5" average height
7" average width
5" + 7" = 12" ÷ 2 = 6" circular equivalent and net scaling diameter

Gross scaling diameter net scaling diameter = diameter deduction
8" - 6" = 2" diameter deduction

22.4 - Applicable Deduction Methods to Use for Common Types of Defects

Use the following guidelines as applicable defect deduction methods for common types of defects.

22.41 - Rots

22.41a - Conk Rot

Use the length deduction or squared area method depending on the severity of defect. Use a length deduction for extensive defect or length with percent deduction if only a portion of the affected length is defective (sec. 22.41e, 22.42b).

22.41b - Heart Rot

Use the squared area deduction method to determine defect volume.

22.41b - Exhibit 01

Example Squared Area Deduction: Heart Rot In Both Ends

Given:

Recorded log length = 16 feet
Small end defect diameter = 5 inches
Large end defect diameter = 7 inches

Determine defect dimensions and defect volume:

Average defect dimensions:

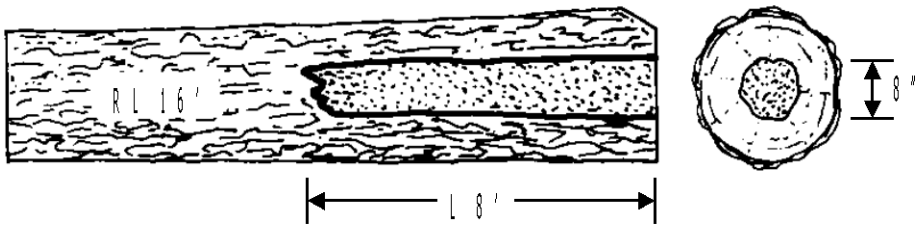
$$\frac{(5+7)}{2} = \frac{12}{2} = 6 \text{ inches}$$

Determine defect volume:

$$\text{Defect volume}\,(\ ft^3\ ) = \frac{W \times H \times L}{144}$$

$$= \frac{6 \times 6 \times 16}{144} = \frac{576}{144} = 4.0\ ft^3$$

Example Squared Area Deduction: Heart Rot In One End



Given:

Recorded log length = 16 feet
Defect diameter = 8 inches
Defect length = 8 feet

Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = \frac{(W\ x\ H\ x\ L)}{144} = \frac{(8\ x\ 8\ x\ 8)}{144} = 3.6\ \ ft^3$$

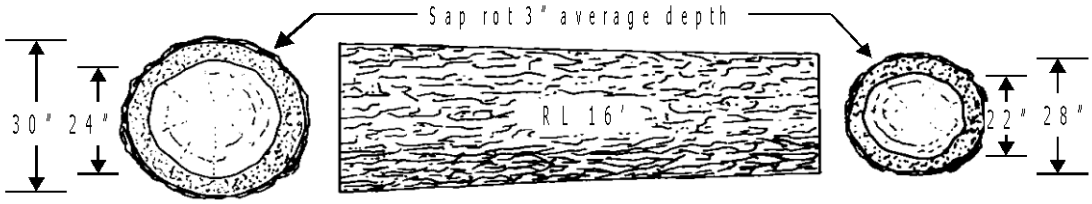
22.41c - Sap Rot

Use the diameter deduction method for sap rot defect. Reduce the gross diameter of the log by the average depth of the sap rot to obtain the net diameter.

The gross diameter measurements shall include the defective sap area when no portion of the sap decay has been sloughed off.

22.41c - Exhibit 01

Sap Rot: Diameter Deduction



Given:

Recorded log length = 16 feet
Small end diameter = 28 inches
Large end diameter = 30 inches
Gross volume = 73.5 ft^3
Sap rot = 3 inch average depth

Determine net volume and defect volume:

3" (sap rot) x 2 = 6 inch diameter deduction
Reduced small end diameter = 28" - 6" = 22 inches
Reduced large end diameter = 30" - 6" = 24 inches
Net volume (22 inches x 24 inches x 16 feet) = 46.2 ft^3

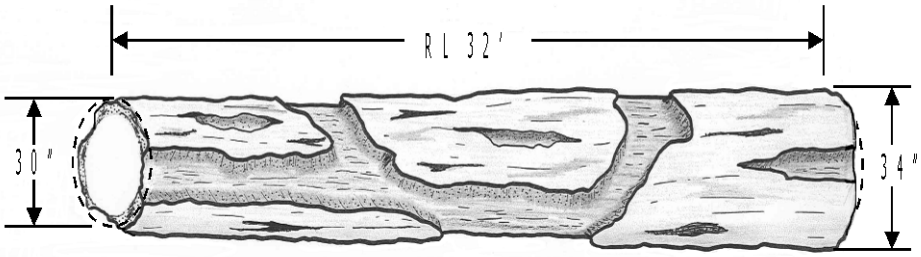
$$Defect\ volume\ (\ ft^3\ ) = gross\ volume - net\ volume$$
$$= 73.5 - 46.2 = 27.3\ ft^3$$

When any portion of the sap decay has been sloughed off apply the following:

1. If 50 percent or more of the sap decay is present on the log, reconstruct the missing defective area and measure the original diameter, as shown in exhibits 02 and 03.

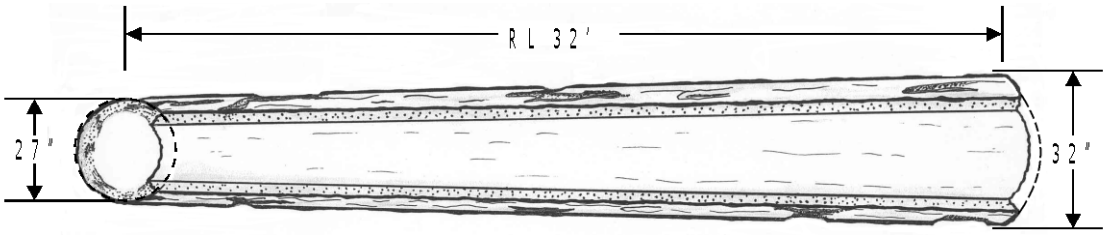
22.41c - Exhibit 02

Sap Rot: Fifty Percent or More Present



22.41c - Exhibit 03

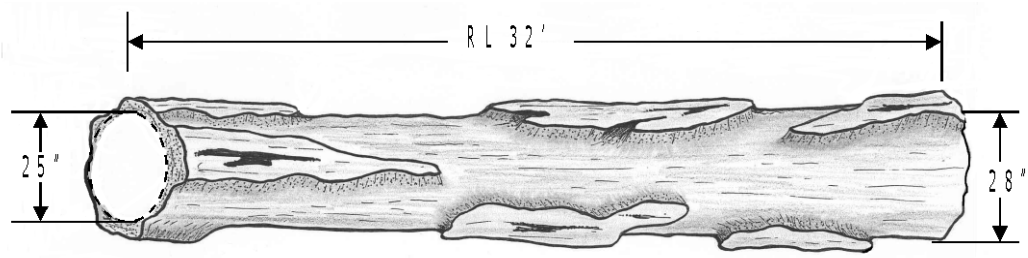
Sap Rot: Fifty Percent or More Present



2. If less than 50 percent of the sap decay is present on the log, the gross diameter measurements shall be taken inside the defective area as shown in exhibits 04 and 05.

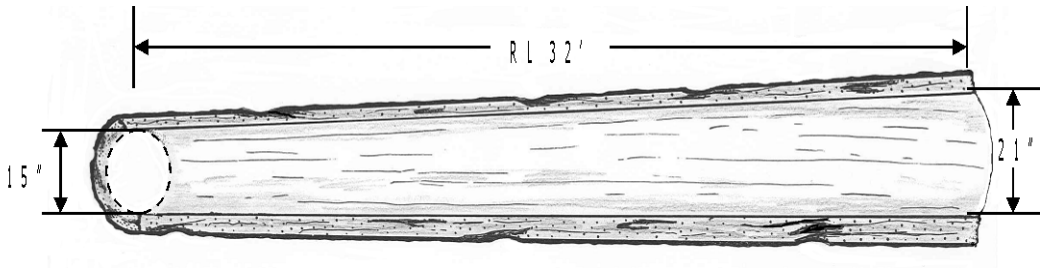
22.41c - Exhibit 04

Sap Rot: Less Than Fifty Percent Present.



22.41c - Exhibit 05

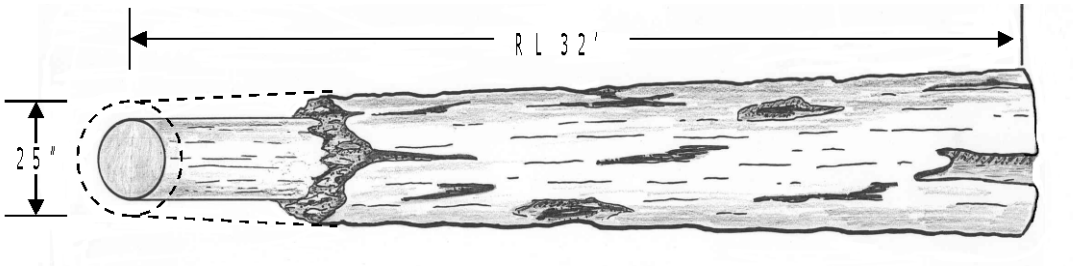
Sap Rot: Less Than Fifty Percent Present



3. If the decayed sap has been sloughed off only around the end area, reconstruct the missing portion and include the decayed sap (void) in the gross diameter measurements as shown in exhibit 06.

22.41c - Exhibit 06

Sap Rot: Sloughed Off Only Around End Area



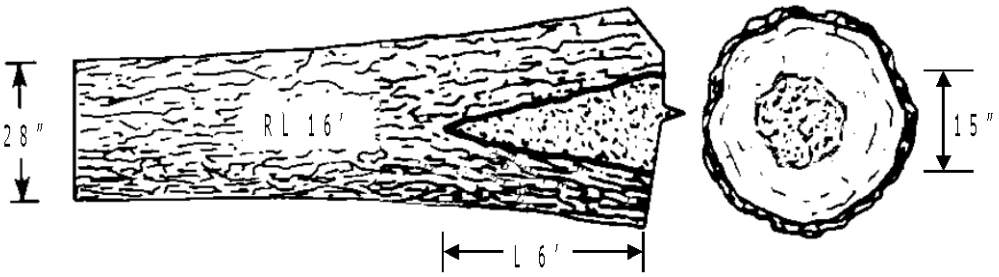
When 50 percent or more of the sap decay is present on the log or if the decayed sap has been sloughed off only around the end area, determine net volume by using the small and large end diameters of the sound wood inside the rotten sapwood. The difference between the gross volume using the outer scaling diameters and the net volume using the inner scaling diameters is the defect volume if no other defects are present.

22.41d - Stump Rot

Stump rot is often called butt rot or ground rot, and is found only in the butt portion of trees, as the name implies. Swelling in the butt may be an indication of the extent of defect length. Stump rot may be blunt or cone-shaped. If the rot is determined to be blunt shaped, determine the defect volume in the same manner as for heart rot (sec. 22.41b).

22.41d - Exhibit 01

Cone-Shaped Stump Rot: Squared Area Deduction



Given:

Recorded log length = 16 feet
Defect diameter = 15 inches
Defect length = 6 feet
Adjusted defect length = 3 feet

Defect is cone-shaped rot. The defect length is adjusted to allow for recoverable products along the sides of the cone.

Determine defect volume:

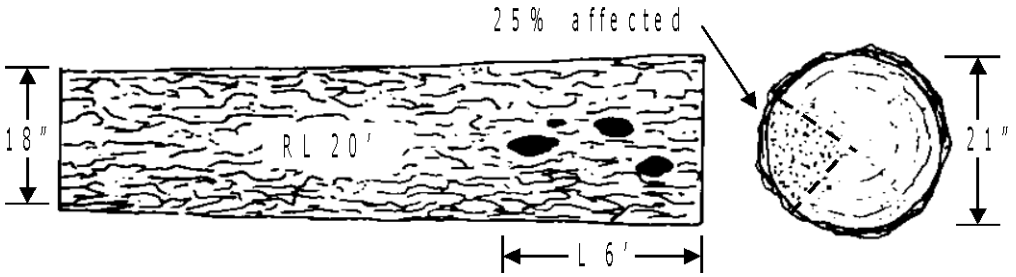
$$Defect\ volume\ (\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144} = \frac{15\ x\ 15\ x\ 3}{144} = \frac{675}{144} = 4.7\ \ ft^3$$

22.41e - Rotten Knots

Rotten knots may indicate interior rot. Rot enters the log through the knots and spreads out in one or both directions. The extent of the defect varies with species, age, and location in the log.

22.41e - Exhibit 01

Rotten Knots With Interior Rot



Length with percent deduction method may be used to determine the defect deduction. Estimate the extent of defect length and percent of log end area affected.

Given:

Recorded log length = 20 feet
Gross volume = 41.7 ft^3
Rot affects 25 percent, allowing for "give" and "take," of the large end area for 6 feet.

Determine defect percent:

$$Defect\ percent = \frac{defect\ length}{segment\ length}\ x\ percent\ end\ area\ affected$$

$$= \frac{6}{20}\ x\ .25 = .075x100 = 7.5\%$$

Determine defect volume:

$$Defect\ volume\ (\ ft^3\ ) = gross\ volume\ x\ defect\ percent$$

$$= 41.7\ x\ .075 = 3.1\ ft^3$$

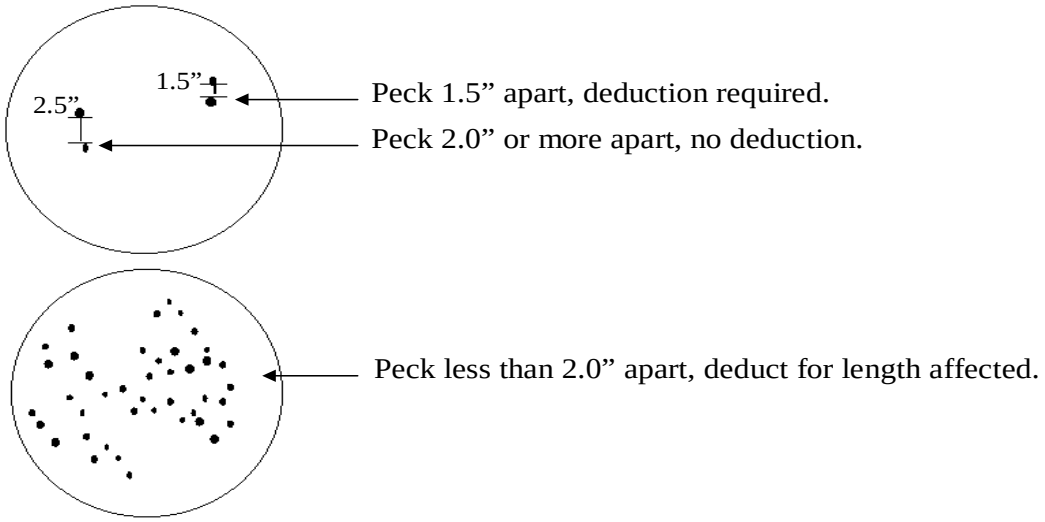
22.41f - Pecky Rot

Studies show that 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 0.2 cubic feet. A 1.0" x 2.0" peck extended through a 16' log will yield 0.2 cubic feet defect.

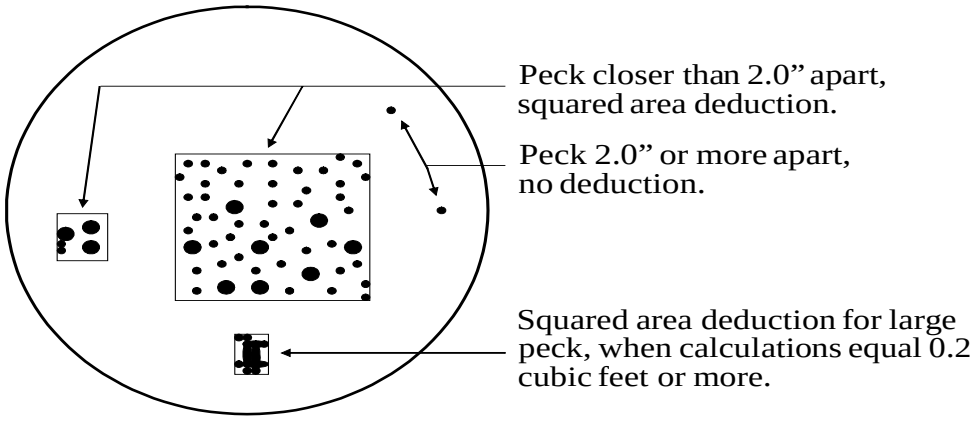
22.41f - Exhibit 01

Example Pecky Rot Arrangements



22.41f - Exhibit 02

Example Pecky Rot Squared Area Method



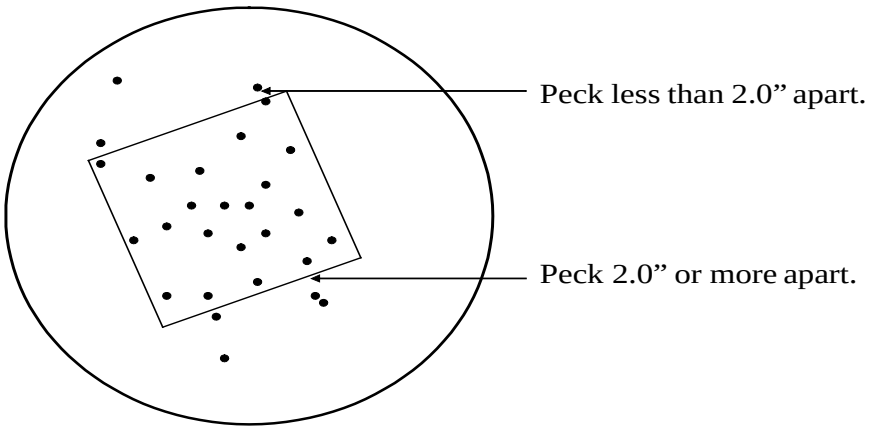
1. Defect Deduction Methods.

2. Calculate largest squared area first; take 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.

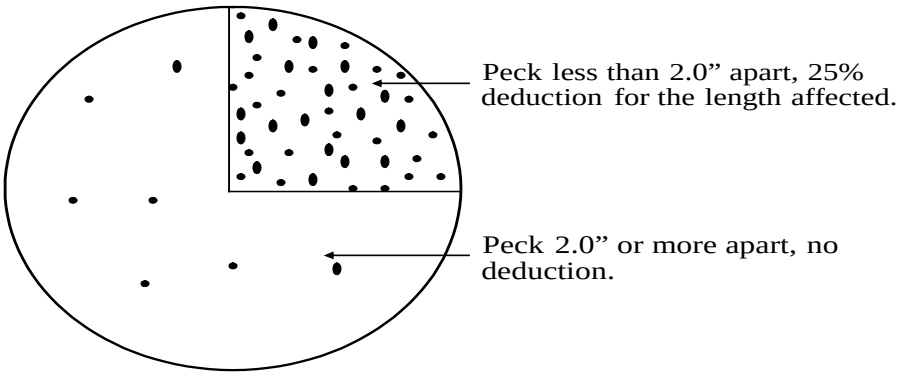
22.41f - Exhibit 03

Example Pecky Rot Give And Take Example



22.41f - Exhibit 04

Pecky Rot Percent Deduction Method



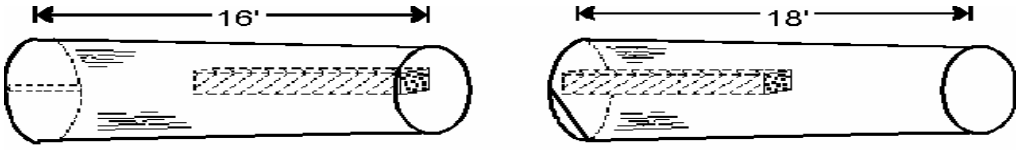
3. Extent of Pecky Rot. In the absence of other indicators, use the following rules to determine extent of pecky rot.

a. Single Segment Logs.

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

22.41f - Exhibit 05

Example Pecky Rot One End, Single Segment Log



Butt Log
Extend defect dimensions (10" x 10") through one - half segment (8').

$$\frac{10" \times 10" \times 8'}{144} = 5.6\ ft^3$$

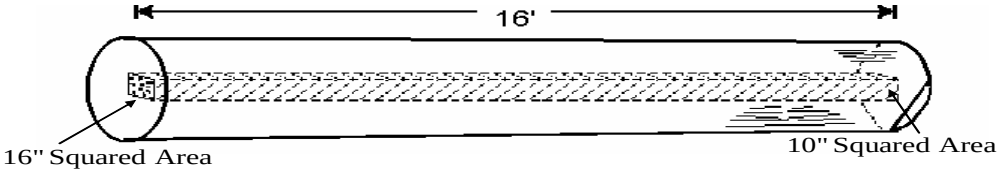
Second Cut
Extend defect dimensions (10" x 10") through one - half segment (9') in even, two foot multiples, rounding whole uneven lengths up to the nearest even foot (10').

$$\frac{10" \times 10" \times 10'}{144} = 6.9\ ft^3$$

(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.

22.41f - Exhibit 06

Example Pecky Rot Both Ends, One Squared Area, Single Segment Log



Extend averaged dimensions (16" x 16" on large end and 10" x 10" on small end), for an average of 13" through the length of the segment (16').

Average Squared Area

$$\frac{16"+10"}{2} = 13"$$

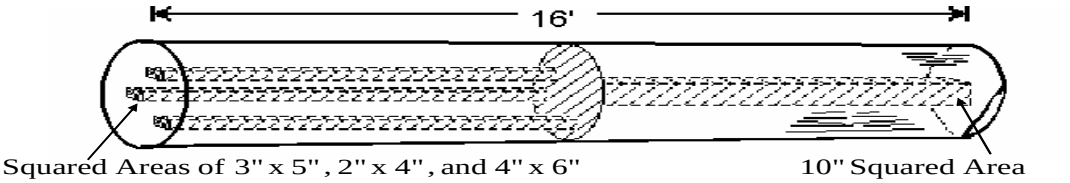
Defect Calculation

$$\frac{13"\times 13"\times 16'}{144} = 18.8\ ft^3$$

(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.

22.41f - Exhibit 07

Example Pecky Rot Both Ends, Multiple Squared Areas, Single Segment Log



Extend defect dimensions (3" x 5", 2" x 4", and 4" x 6") through one - half the segment length (8').

$$\frac{3"\times 5"\times 8'}{144} = 0.8\ ft^3$$

$$\frac{2"\times 4"\times 8'}{144} = 0.4\ ft^3$$

$$\frac{4"\times 6"\times 8'}{144} = 1.3\ ft^3$$

$$\text{Total} = 2.5\ ft^3$$

Extend defect dimensions (10" x 10") through one - half the segment length (8').

$$\frac{10"\times 10"\times 8'}{144} = 5.6\ ft^3$$

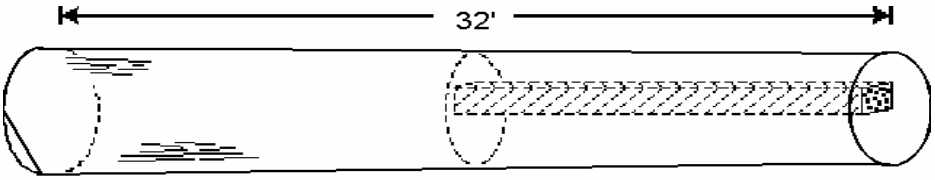
$$\text{Log Total} = 2.5\ ft^3 + 5.6\ ft^3 = 8.1\ ft^3$$

b. Two-Segment Second Cut Logs

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

22.41f - Exhibit 08

Pecky Rot Small End Only, Two-Segment Second Cut Log Example



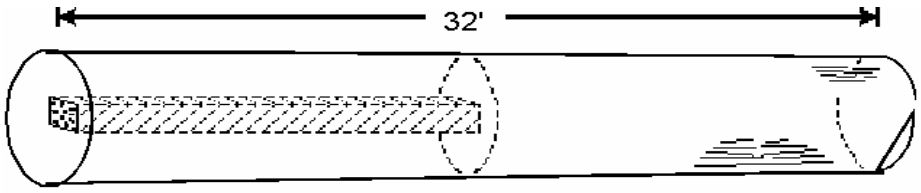
Extend actual dimensions (10" x 10" on small end) through the length of the small end segment (16').

Large End Segment	Small End Segment
No peck deduction	$\frac{10"\times10"\times16'}{144} = 11.1\,ft^3$

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

22.41f - Exhibit 09

Pecky Rot Large End Only, Two-Segment Second Cut Log Example



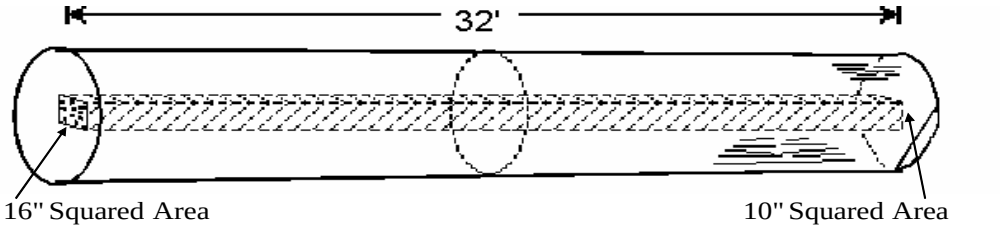
Extend actual dimensions (10" x 10" on large end) through the length of the large end segment (16').

Large End Segment	Small End Segment
$\frac{10"\times10"\times16'}{144} = 11.1\,ft^3$	No peck deduction

(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 and extend through the length of each segment.

22.41f - Exhibit 10

Pecky Rot Both Ends, One Squared Area, Two-Segment Second Cut Log Example



Extend averaged dimensions (16" x 16" on large end and 10" x 10" on small end, for an average of 13" at the mid - point) through the length of each segment (16').

Use 14" defect dimension

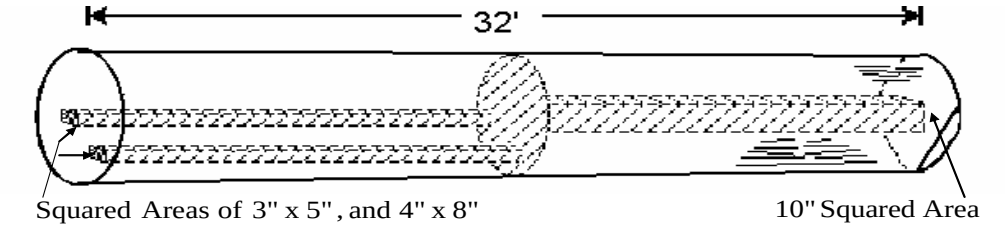
$$\frac{14" \times 14" \times 16'}{144} = 21.8\ ft^3$$

Use 12" defect dimension

$$\frac{12" \times 12" \times 16'}{144} = 16.0\ ft^3$$

(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.

Pecky Rot Both Ends, Multiple Squared Areas, Two-Segment Second Cut Log Example



Extend defect dimensions (3" x 5", and 4" x 8") through entire segment length (16').

Large End Segment

$$\frac{3"\times 5"\times 16'}{144} = 1.7\ ft^3$$

$$\frac{4"\times 8"\times 16'}{144} = 3.6\ ft^3$$

$$\text{Total} = 5.3\ ft^3$$

Extend defect dimensions (10" x 10") through entire segment length (16').

Small End Segment

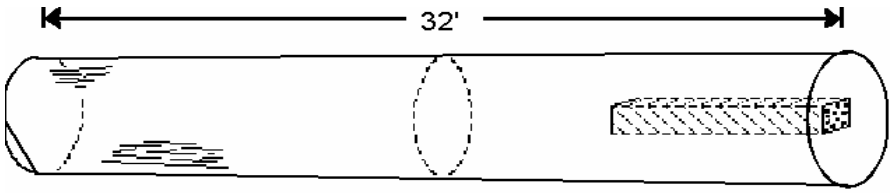
$$\frac{10"\times 10"\times 16'}{144} = 11.1\ ft^3$$

(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.

22.41f - Exhibit 12

Minor Pecky Rot Large End Only, Two-Segment Second Cut Log Example

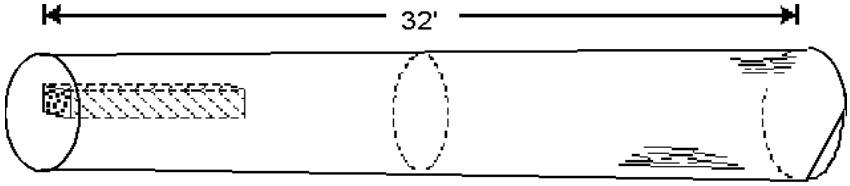


Extend actual dimensions (6" x 6" on large end) through one - half the length of the large end segment (8').

Small End Segment	Large End Segment
No peck deduction	$\frac{6"\times6"\times8'}{144} = 2.0\ ft^3$

22.41f - Exhibit 13

Minor Pecky Rot Small End Only, Two-Segment Second Cut Log Example



Extend actual dimensions (6" x 6" on small end) through one - half the length of the small end segment (8').

Small End Segment	Large End Segment
$\frac{6"\times6"\times8'}{144} = 2.0\ ft^3$	No peck deduction

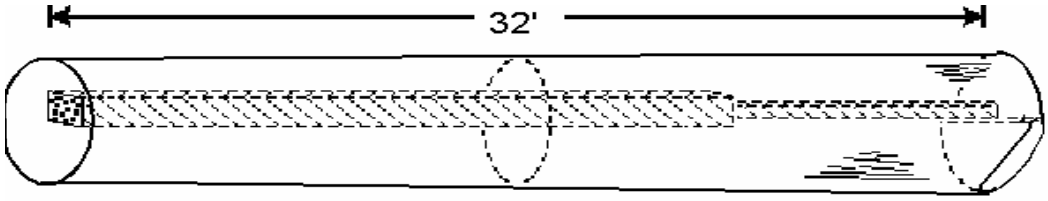
c. Two-Segment Butt Logs

(1) Merchantable Butt Logs

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

22.41f - Exhibit 14

Pecky Rot Both Ends, Merchantable Two-Segment Butt Log Example



Extend actual dimensions (10" x 10" on small end) 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), through one - half the length of the butt (large) end segment.

Small End Segment

$$\frac{10"\times10"\times16'}{144} = 11.1\ ft^3$$

Butt (Large) End Segment

$$\frac{10"\times10"\times8'}{144} = 5.6\ ft^3$$

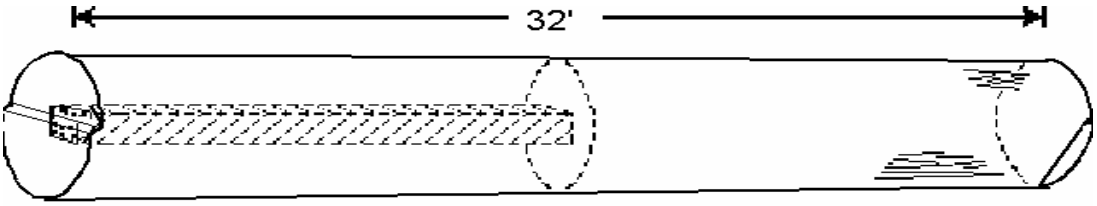
$$\frac{4"\times5"\times8'}{144} = 1.1\ ft^3$$

$$\text{Total} = 6.7\ ft^3$$

(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.

22.41f - Exhibit 15

Pecky Rot Large End Only, Merchantable Two-Segment Butt Log Example



Extend actual dimensions of 10" x 10" on butt (large) end through the length of the butt (large) end segment (16').

Butt (Large) End Segment

$$\frac{10"\times10"\times16'}{144} = 11.1\ ft^3$$

Small End Segment

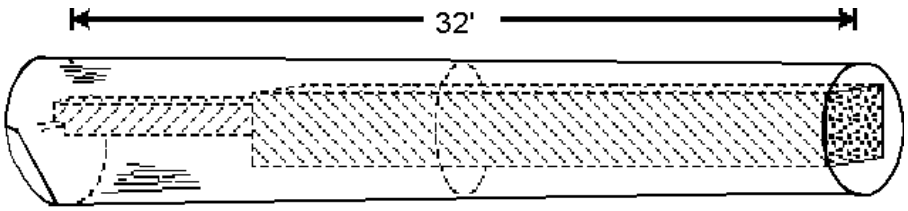
No peck deduction

(2) Cull Segments, Butt Logs

(a) When the small end is affected by deductible peck, calculate the defect factor. If the defect factor exceeds the contract merchantable factor, cull the small end segment and one-half the length of the butt (large) end segment. Extend the actual dimensions 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 a defect factor for each defect [include culled one-half butt (large) end segment factor], and then add them together. If the added defect factors are greater than the contract merchantable factor, cull the butt (large) end segment.

22.41f - Exhibit 16

Pecky Rot Both Ends (Cull Small End Segment), Two-Segment Butt Log Example



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), through the remaining length of the butt (large) end segment (8').

Butt (Large) End Segment

$$\frac{10" \times 10" \times 8'}{144} = 5.6\ ft^3$$

(plus one - half segment cull)

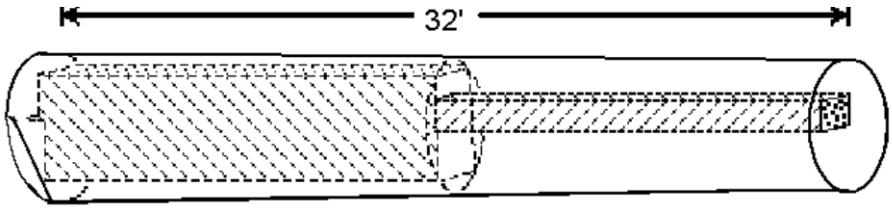
Small End Segment

Cull

(b) When the large end segment is affected by deductible peck, calculate the defect factor. If the defect factor exceeds the contract merchantable factor, cull the large end segment only. Extend the actual dimensions of any deductible peck showing on the small end through the length of the segment.

22.41f - Exhibit 17

Pecky Rot Both Ends (Cull Large End Segment), Two-Segment Butt Log Example



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

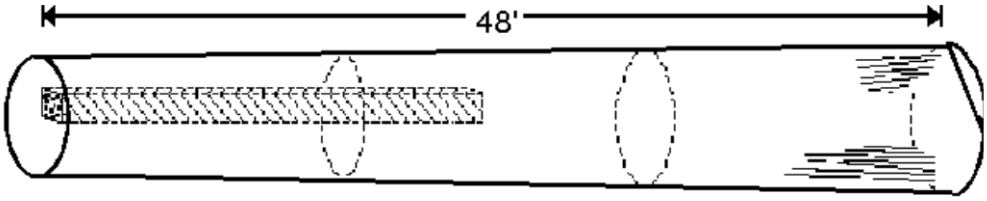
Butt (Large) End Segment	Small End Segment
Cull	$\frac{10" \times 10" \times 16'}{144} = 11.1 ft^3$

d. Three-Segment Second Cut Logs

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

22.41f - Exhibit 18

Pecky Rot Small End Only, Three-Segment Second Cut Log Example



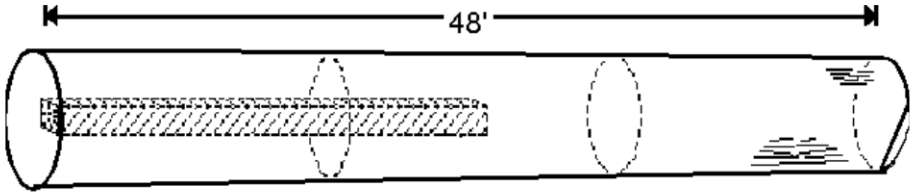
Extend actual dimensions (10" x 10" on small end) through small end segment (16'), and one - half of middle segment (8').

Small End Segment	Middle Segment	Large End Segment
$\frac{10" \times 10" \times 16'}{144} = 11.1 ft^3$	$\frac{10" \times 10" \times 8'}{144} = 5.6 ft^3$	No peck deduction

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

22.41f - Exhibit 19

Pecky Rot Large End Only, Three-Segment Second Cut Log Example



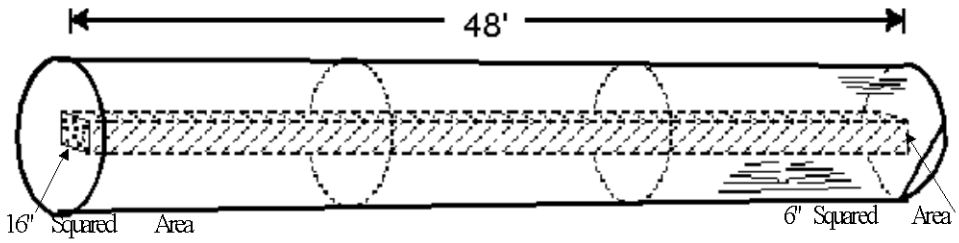
Extend actual dimensions (10" x 10" on large end) through the length of the large end segment (16') and one-half the length of the middle segment (8').

Large End Segment	Middle Segment	Small End Segment
$\frac{10" \times 10" \times 16'}{144} = 11.1 ft^3$	$\frac{10" \times 10" \times 8'}{144} = 5.6 ft^3$	No peck deduction

(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.

22.41f - Exhibit 20

Pecky Rot Both Ends, One Squared Area, Three-Segment Second Cut Log Example

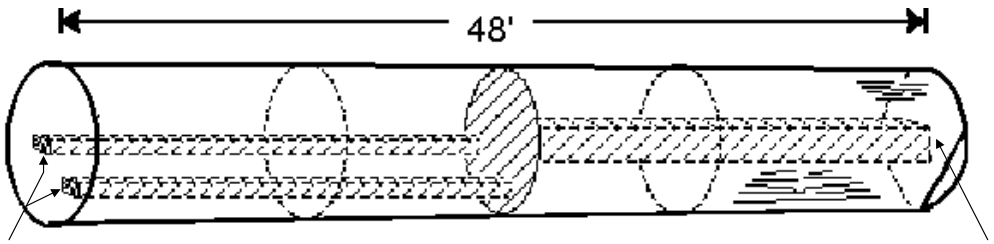


Average squared dimension for each segment and extend through the length of each segment.

Large End Segment	Middle Segment	Small End Segment
$\frac{14" \times 14" \times 16'}{144} = 21.8 ft^3$	$\frac{12" \times 12" \times 16'}{144} = 16.0 ft^3$	$\frac{8" \times 8" \times 16'}{144} = 7.1 ft^3$

(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.

Pecky Rot Both Ends, Multiple Squared Areas, Three-Segment Second Cut Log Example



Squared Areas of 3" x 5", and 4" x 6" 16" Squared Area

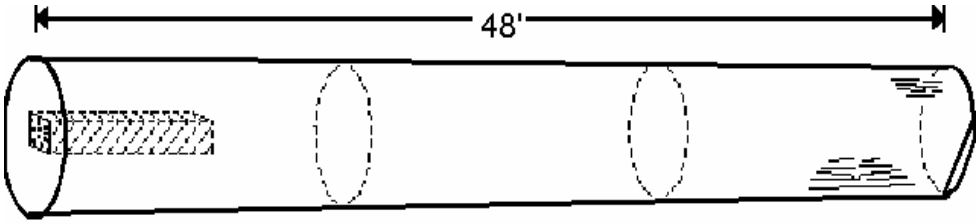
Extend the actual dimensions of each deductible squared area through the length of each end segment and one - half the length of the middle segment.

Large End Segment	Middle Segment	Small End Segment
$\frac{3"\times5"\times16'}{144} = 1.7\ ft^3$	$\frac{16"\times16"\times8'}{144} = 14.2\ ft^3$	$\frac{16"\times16"\times16'}{144} = 28.4\ ft^3$
$\frac{4"\times6"\times16'}{144} = 2.7\ ft^3$	$\frac{3"\times5"\times8'}{144} = 0.8\ ft^3$	
$\text{Total} = 4.4\ ft^3$	$\frac{4"\times6"\times8'}{144} = 1.3\ ft^3$	
	$\text{Total} = 16.3\ ft^3$	

(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.

Minor Pecky Rot One End Only, Three-Segment Second Cut Log Example



Extend actual dimensions (6" x 6" on large end) through one - half the length of the large end segment (8').

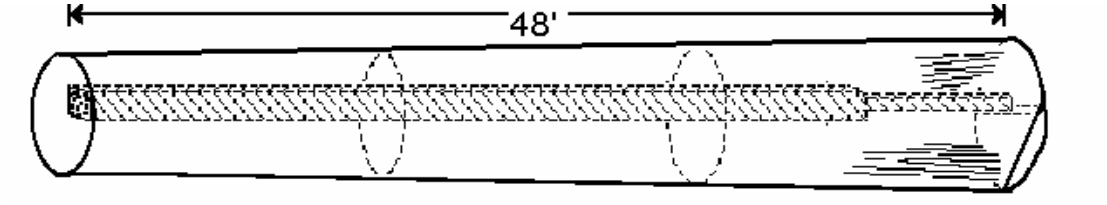
Large End Segment	Middle Segment	Small End Segment
$\frac{6"\times6"\times8'}{144} = 2.0\,ft^3$	No peck deduction	No peck deduction

e. Three-Segment Butt Logs

(1) Merchantable Butt Logs

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

Pecky Rot Both Ends, Merchantable Three-Segment Butt Log Example



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

Small End Segment

$$\frac{10"\times10"\times16'}{144} = 11.1\,ft^3$$

Middle Segment

$$\frac{10"\times10"\times16'}{144} = 11.1\,ft^3$$

Butt (Large) End Segment

$$\frac{10"\times10"\times8'}{144} = 5.6\,ft^3$$

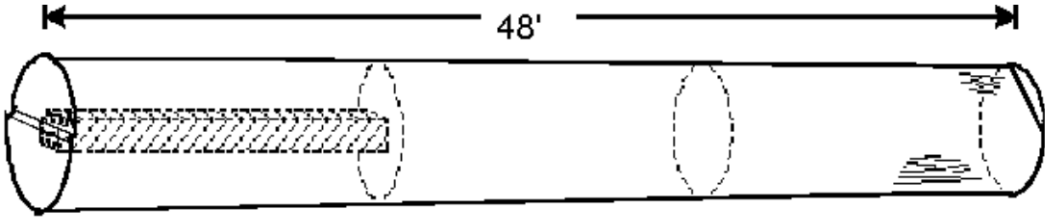
$$\frac{4"\times5"\times8'}{144} = 1.1\,ft^3$$

$$\text{Total} = 6.7\,ft^3$$

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

22.41f - Exhibit 24

Pecky Rot Large End Only, Merchantable Three-Segment Butt Log Example



Extend actual dimensions (10" x 10" on butt end) through the length of the butt (large) end segment (16').

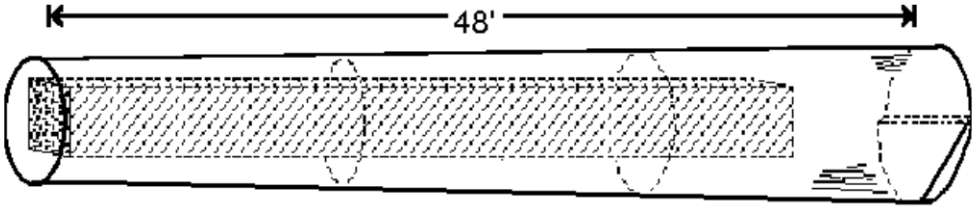
Butt (Large) End Segment	Middle Segment	Small End Segment
$\frac{10" \times 10" \times 16'}{144} = 11.1 ft^3$	No peck deduction	No peck deduction

(2) Cull Segments, Butt Logs

(a) When the small end is affected by deductible peck, calculate the defect factor. If the defect factor exceeds the contract merchantable factor, cull the small end segment, middle segment, and one half the length of the butt (large) end segment.

22.41f - Exhibit 25

Pecky Rot Small End Only, Three-Segment Butt Log With Cull Example



Cull small end segment (16'), middle segment (16'), and one-half the length of the butt (large) end segment (8').

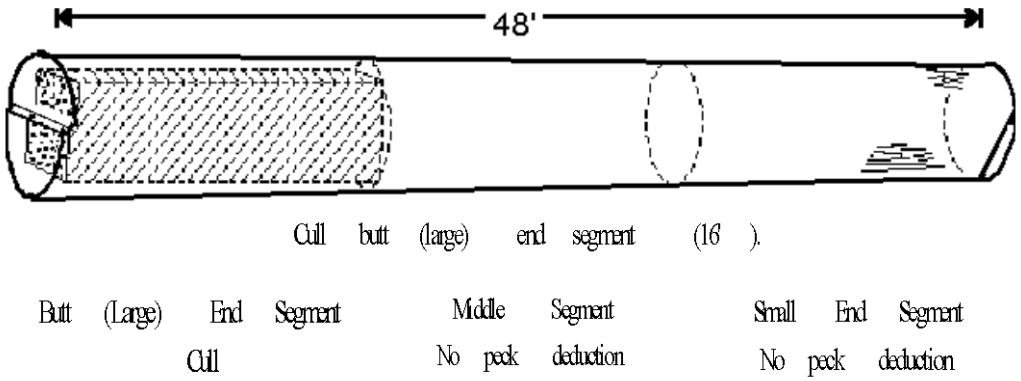
Small End Segment	Middle Segment	Butt (Large) End Segment
Cull	Cull	One-half (50%) Cull

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, calculate the defect factor. If the defect factor exceeds the contract merchantable factor, cull the butt (large) end segment only.

22.41f - Exhibit 26

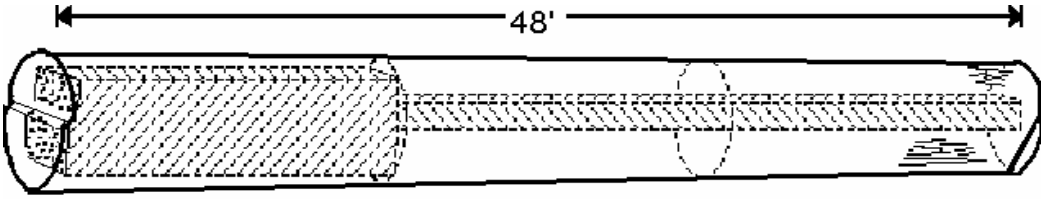
Pecky Rot Large End Only, Three-Segment Butt Log With Cull Example



(c) When both ends are affected by deductible peck, calculate the defect factor for the butt (large) end. If the defect factor exceeds the contract merchantable factor, cull the butt (large) end segment only. Calculate and extend the actual dimensions of any deductible peck on the small end through the length of the small end and middle segments.

22.41f - Exhibit 27

Pecky Rot Both Ends, Three-Segment Butt Log With Cull Example



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

Butt (large) End Segment	Middle Segment	Small End Segment
Cull	$\frac{10" \times 10" \times 16'}{144} = 11.1\, ft^3$	$\frac{10" \times 10" \times 16'}{144} = 11.1\, ft^3$