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

Amendment: 2409.11a-2004-4

Effective date: November 17, 2004

Duration: This amendment is effective until superseded or removed.

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

Date approved: November 2, 2004

Responsible Staff:

Last Change: 2409.11a-2004-3 to 2409.11a_22.3-22.41.

Superseded Document(s):

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

22.44a: Revises the method to determine midpoint defect dimensions on multi-segment logs.

22.44b: Revises the direction on determining check dimensions.

22.44c: Changes the caption from weather checks to spangle and recodes the direction previously coded to 22.46, to this section.

22.44d: Establishes this code and relocates and revises direction previously coded to 22.44c, to this section. Adds direction on how to assess logs for cull determination prior to reducing the calculated defect volume, and adds direction regarding the calculation of defect volume when weather checks are present in logs.

22.45a: Revises direction regarding the method to determine midpoint defect dimensions on multi-segment logs.

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22.42 - Voids

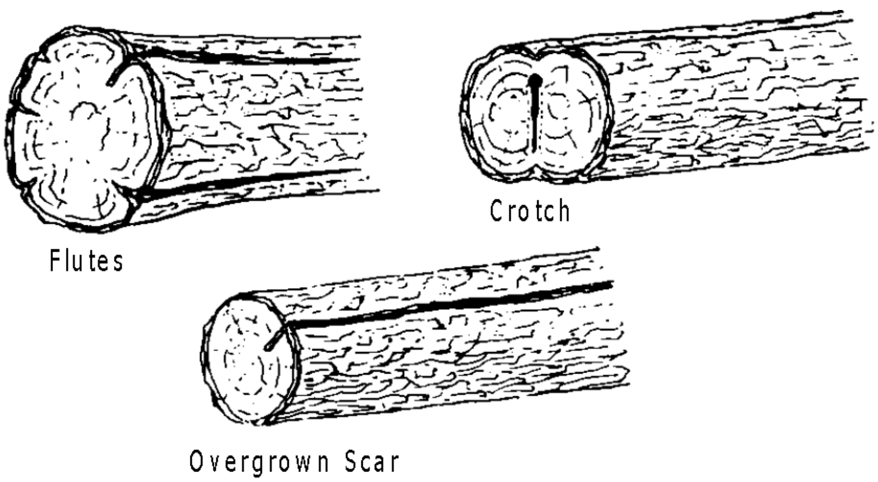
When wood fiber is absent from a log, the defect is called a void. Gouges, scars, stump pull, cat face, and bark seams are examples of voids. The squared defect deduction method is typically used to deduct voids.

22.42a - Bark Seam

A loss of wood fiber occurs from a bark seam. Bark seams typically occur on logs having flutes, crotch, overgrown scars, or cankers as shown below. Use the squared area deduction method to determine the defect volume.

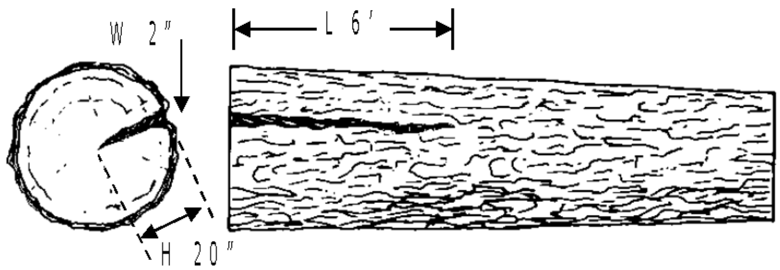
22.42a - Exhibit 01

Logs With Flutes, Crotch, And Overgrown Scars



22.42a - Exhibit 02

Bark Seam Associated With an Overgrown Scar Example



Given:

W = 2 inches
H = 20 inches
L = 6 feet

Determine defect volume:

$$Defect\ volume\ (ft^3) = \frac{(W \times H \times L)}{144} = \frac{(2 \times 20 \times 6)}{144} = \frac{240}{144} = 1.7\ ft^3$$

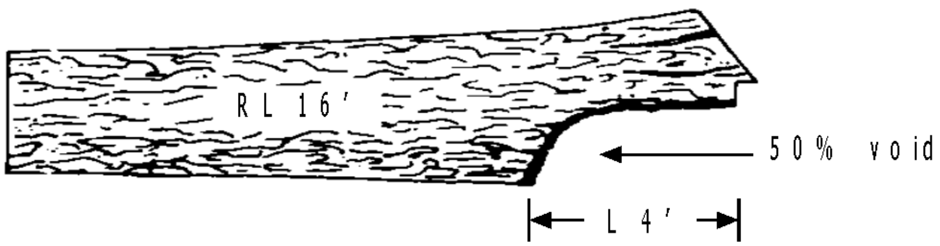
Note: When multiple bark seams are present, determine defect dimensions by squaring at right angles to each other.

22.42b - Cat Face/Fire Scar

Cat face and fire scars are usually found in the lower portion of butt logs. This defect may be accompanied by rot, char and/or wormholes. Make deductions by using the length with percent deduction method.

22.42b - Exhibit 01

Fire Scar



Determine the length of log affected by the scar and the percent of end area affected. If char is present, include it in the deduction for void.

Given:

Recorded log length = 16 feet
Gross volume = 78.9 ft^3
Void and char affects 50 percent of 4 feet

Determine defect percent:

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

$$= \frac{4}{16}\ x\ .5 = .125x100 = 12.5\%$$

Determine defect volume:

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

$$= 78.9\ x\ .125 = 9.9\ ft^3$$

22.42c - Lightning Scar

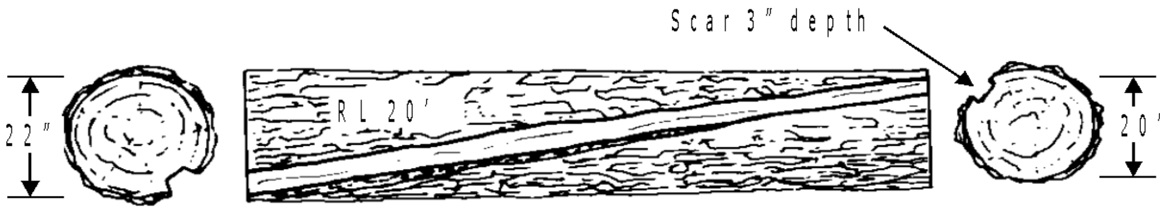
This defect usually spirals around the log and requires special consideration for 6-foot lumber recovery within the affected area.

Use the diameter deduction method when the lightning scar spirals tightly around the log not allowing 6-foot lumber recovery. The diameter with percent deduction method can be used when a lightning scar affects one or more faces of the log and 6-foot lumber can be produced within the affected area. Use the squared area method for straight or nearly straight lightning scars.

Exhibit 01 shows a lightning scar affecting two faces, or 50 percent of the circumference of the log. Determine the depth of defect and full log diameter deduction. Deduct one-half of the total defect volume for the percentage of log affected. Consider additional recoverable volume included in the defective area that is capable of producing 6-foot length lumber and adjust the defect volume by a percent for that area.

22.42c - Exhibit 01

Lightning Scar



Given:

Recorded log length = 20 feet
Small end diameter = 20 inches
Large end diameter = 22 inches
Gross volume = 48.2 ft^3
Lightening scar = 3 inch depth, affects 50 percent of the surface of the log

Determine net volume and defect volume:

3" (scar) x 2 = 6 inch diameter deduction
Reduced small end diameter = 20 - 6 = 14 inches
Reduced large end diameter = 22 - 6 = 16 inches
Net volume (14 inches x 16 inches x 20 feet) = 24.7 ft^3

$$Defect\ volume\ (ft^3) = gross\ volume - net\ volume\ x\ percent\ of\ surface\ affected$$
$$= (48.2 - 24.7)\ x\ 0.5 = 11.8\ ft^3$$

It is estimated that an additional 50 percent of the affected area will produce 6-foot length lumber. Adjust the defect volume by 50 percent.

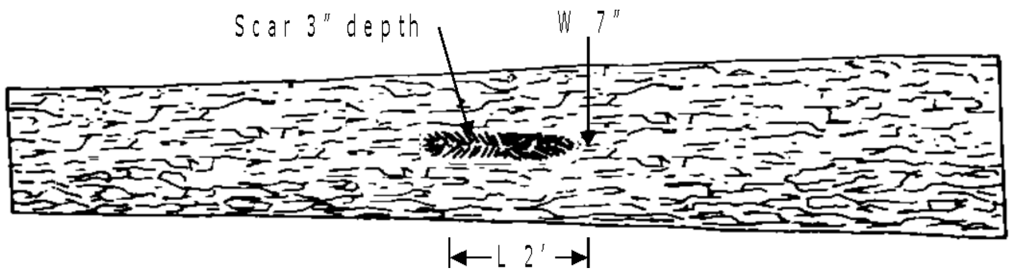
Adjusted defect volume (ft^3) = defect volume x percent product recovery
= 11.8 x 0.50 = 5.9 ft^3

22.42d - Other Scar

Objects scraping against a tree often cause wounds that leave a scar. Use the squared area or length with percent deduction methods for this type of defect.

22.42d - Exhibit 01

Scar: Squared Area Deduction



Given:

W = 7 inches
H = 3 inches
L = 2 feet

Determine defect volume:

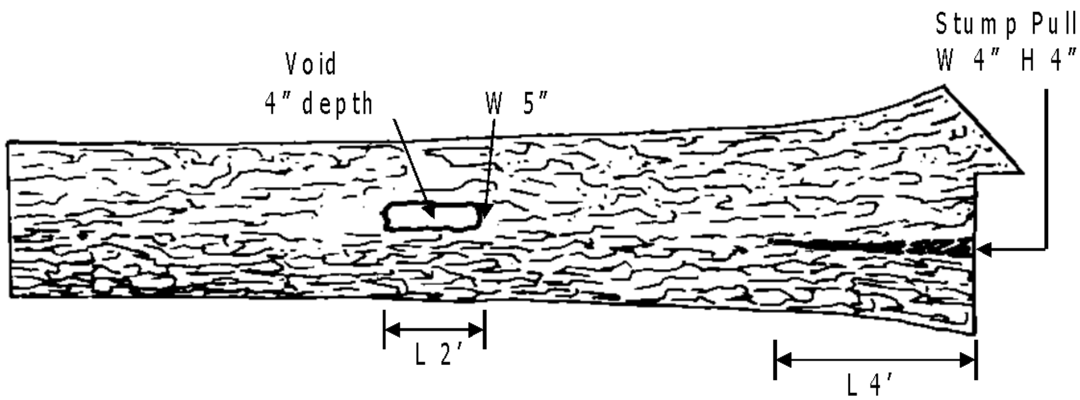
$$Defect\ volume\ (ft^3) = \frac{W\ x\ H\ x\ L}{144} = \frac{7\ x\ 3\ x\ 2}{144} = \frac{42}{144} = 0.3\ \ ft^3$$

22.42e - Other Voids

Voids sometimes result from damage during logging operations or in the movement of logs to the scaling site. Exhibit 01 shows a log with a void on the log surface and stump pull on the butt end.

22.42e - Exhibit 01

Voids: Squared Area Deduction



Given:

Void dimensions - W = 4 inches, H = 5 inches, L = 2 feet
Stump pull dimensions W = 4 inches, H = 4 inches, L = 4 feet

Determine defect volume:

Void:

$$Defect\ volume(\ ft^3\ ) = \frac{(W\ x\ H\ x\ L)}{144} = \frac{(4\ x\ 5\ x\ 2)}{144} = \frac{40}{144} = 0.3\ \ ft^3$$

Stump pull:

$$Defect\ volume(\ ft^3\ ) = \frac{(W\ x\ H\ x\ L)}{144} = \frac{(4\ x\ 4\ x\ 4\ )}{144} = \frac{64}{144} = 0.4\ ft^3$$

Total defect volume (ft3) = 0.3 + 0.4 = 0.7 ft^3

22.43 - Break

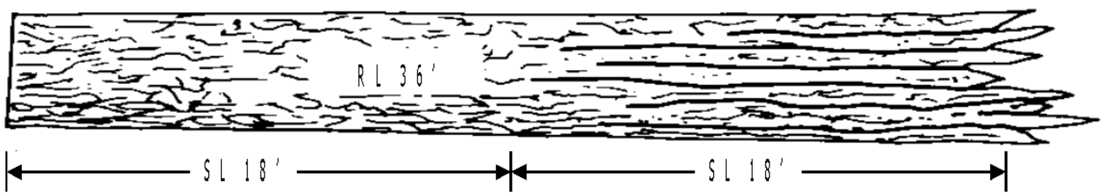
Breakage can occur during felling, yarding, loading, and unloading operations.

22.43a - Mass Breakage

In most situations when mass breakage occurs, the portion of the log affected cannot be mechanically debarked. Deduction should be made for the portion of the log that cannot be utilized due to mass breakage. Determine the defect volume by the length deduction method (sec. 22.32).

22.43a - Exhibit 01

<u>Log With Mass Breakage</u>



The length of the defect is the full length of the large end segment.

Given:

Recorded log length = 36 feet
Segment lengths = 18 feet
Large end segment gross volume = 39.4 ft^3
Defect length = 18 feet

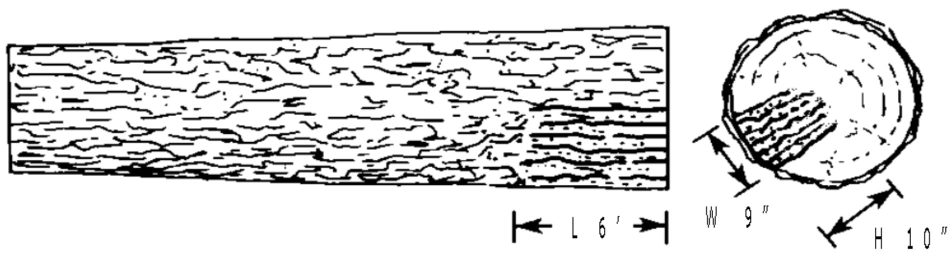
Determine defect volume:

$$Defect\ volume\ (ft^3) = gross\ volume\ x\ defect\ percent$$
$$= 39.4\ x\ 1.00 = 39.4\ ft^3$$

22.43b - Localized Breakage

22.43b - Exhibit 01

Localized Breakage: Squared Area Deduction



If break is localized to a portion of the log, calculate the defect volume by the squared area or use the length with percent deduction method.

Given:

W = 9 inches
H = 10 inches
L = 6 feet

Determine defect volume:

$$Defect\ volume\,(\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144} = \frac{9\ x\ 10\ x\ 6}{144} = \frac{540}{144} = 3.8\ ft^3$$

22.44 - Checks

Use the squared area deduction method to determine defect volume for heart checks or isolated surface checks and the diameter deduction method for weather checks.

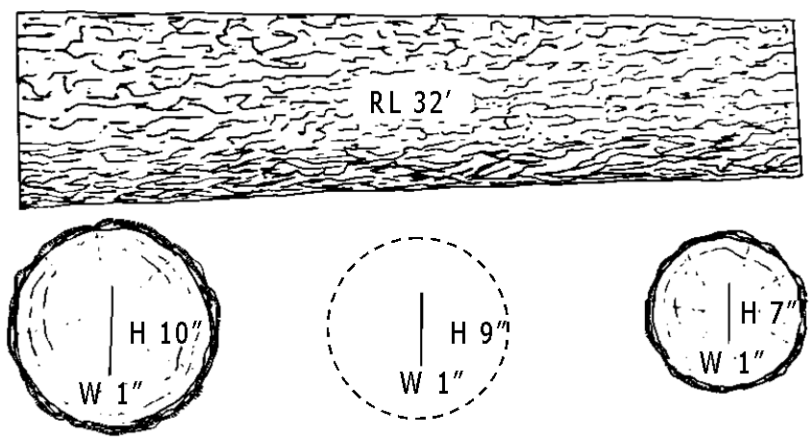
22.44a - Heart Checks

Consider heart checks to run straight through the log without twisting. Use actual defect dimensions when a heart check appears on only one end of a log.

When heart checks appear on both ends of a multi-segment log, taper must be calculated prior to averaging defect dimensions for the segment (sec. 21.44a and sec. 21.44b). Taper for the width and height measurements are calculated separately.

22.44a - Exhibit 01

<u>Log With Heart Check</u>



Given:

Recorded log length = 32 feet
Segment lengths = 16 feet
Small end segment W = 1 inch
Large end segment W= 1 inch
Small end segment H = 7 inches
Large end segment H= 10 inches
Defect length = 32 feet

22.44a - Exhibit 01--Continued

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 the 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, then distribute the remaining taper to the other segments following the same procedure.

Width dimensions:

$$W = 1 \, inch \ width \ at \ segment \ break$$

Height dimensions:

$$H = (10 - 7) = 3 + 1 = 4 \, inches$$

$$\frac{4}{2} = 2 + 7 \, (small \ end \ dimension) = 9 \, inch \ height \ at \ segment \ break$$

Small End Segment:

Average defect dimensions:

W= $\frac{(1+1)}{2} = 1$ inch

H= $\frac{(9+7)}{2} = 8$ inches

Determine defect volume:

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

$$= \frac{1 \ x \ 8 \ x \ 16}{144} = \frac{128}{144} = .9 \ ft^3$$

Large End Segment:

Average defect dimensions:

W= $\frac{(1+1)}{2} = 1$ inch

H= $\frac{(10+9)}{2} = 9.5$* or 10 inches

Determine defect volume:

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

$$= \frac{1 \, x \, 10 \, x \, 16}{144} = \frac{160}{144} = 1.1 \ ft^3$$

**Round to nearest even whole number.*

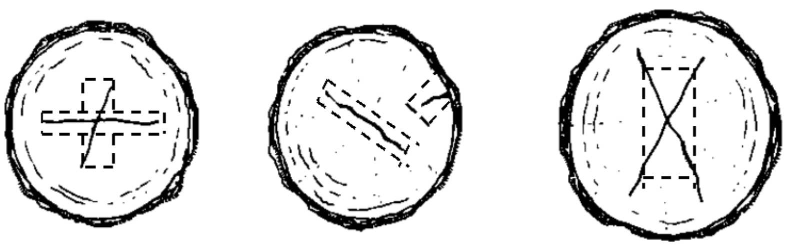
22.44b - Cross-checks

Determine check dimensions and defect volume for each check within the segment.

When determining defect dimensions, measure each check at right angles to each other. See exhibit 01 for an example. The "give and take" procedure (sec. 22.46) may also be used when determining the defect dimension. Avoid deducting for the same area twice by subtracting the width of one check from the height of the other.

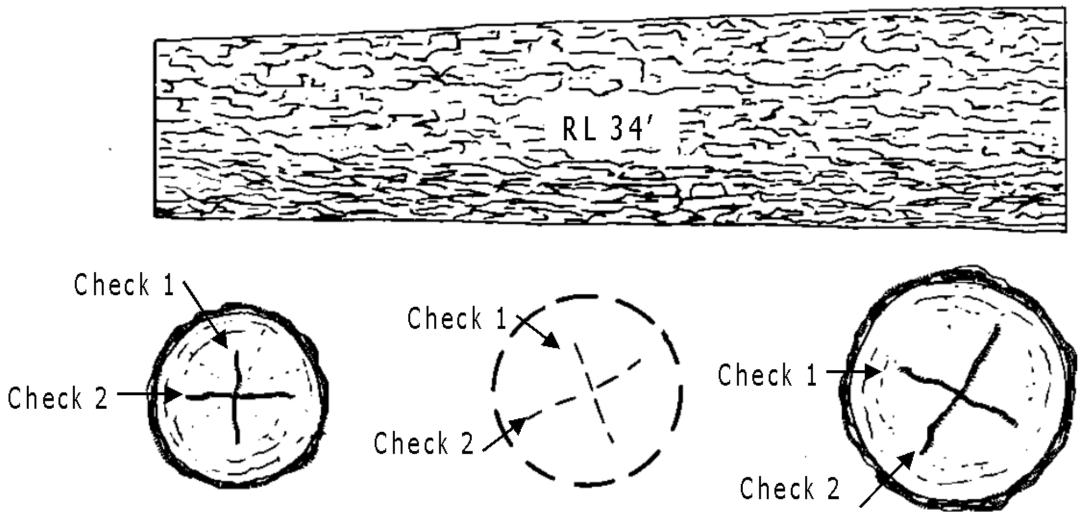
22.44b - Exhibit 01

<u>Determine Defect Dimensions</u>



22.44b - Exhibit 02

Cross-Checks



Given:

Small End	Segment Break	Large End
Check 1: W=2" H=18" Check 2: W=2" H=19"	Check 1: W=2" H=20" Check 2: W=2" H=22"	Check 1: W=2" H=21" Check 2: W=2" H=25"
Recorded log length: 34 feet		

22.44b - Exhibit 02--Continued

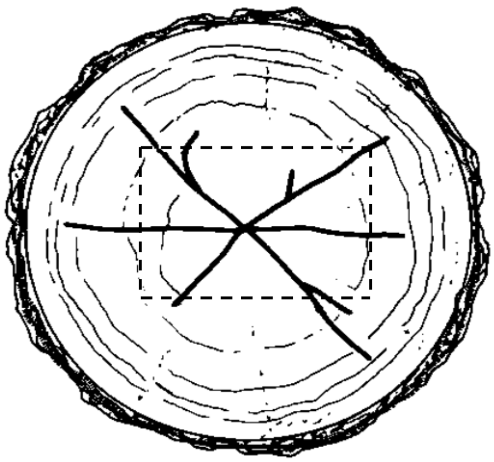
Small End Segment	Large End Segment
Check 1 average dimensions: W = (2 + 2)/2 = 2 inches H = (18 + 20)/2 = 19 inches	Check 1 average dimensions: W = (2 + 2)/2 = 2 inches H = (20 + 21)/2 = 20 inches
Check 2 average dimensions: W = (2 + 2)/2 = 2 inches H = (19 + 22)/2 = 20 inches *H = 20 - 2 = 18 inches	Check 2 average dimensions: W = (2 + 2)/2 = 2 inches H = (22 + 25)/2 = 24 inches *H = 24 - 2 = 22 inches
*Avoid deducting for the same area twice by subtracting the width of check 1 from the height of check 2.	
Length = 16 feet	Length = 18 feet
Defect deduction (W x H x L)/144	Defect deduction (W x H x L)/144
Check 1 $= \frac{(2 \times 19 \times 16)}{144} = \frac{608}{144} = 4.2\ ft^3$	Check 1 $= \frac{(2 \times 20 \times 18)}{144} = \frac{720}{144} = 5.0\ ft^3$
Check 2 $= \frac{(2 \times 18 \times 16)}{144} = \frac{576}{144} = 4.0\ ft^3$	Check 2 $= \frac{(2 \times 22 \times 18)}{144} = \frac{792}{144} = 5.5\ ft^3$
Total = 4.2 + 4.0 = 8.2 ft^3	Total = 5.0 + 5.5 = 10.5 ft^3
Total log defect = 8.2 + 10.5 = 18.7 ft^3	

22.44c - Spangle

When more than two heart checks occur in the end of a log, the defect is called spangle.

22.44c - Exhibit 01

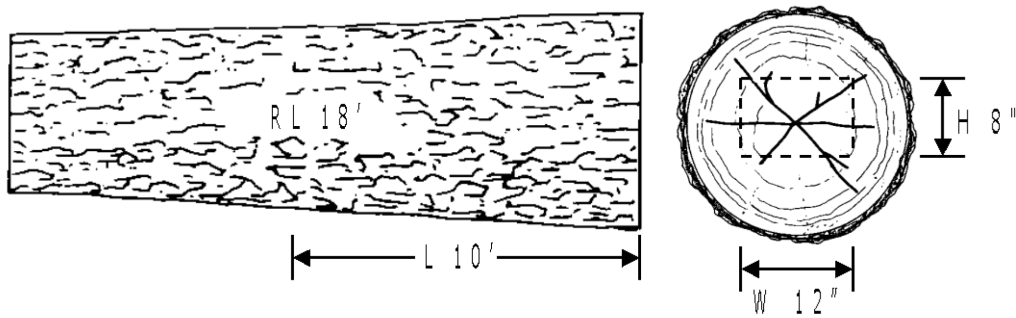
Spangle: Using "Give and Take" Procedure to Measure



Deductions for spangle are usually made using the squared area deduction method unless the defect is extensive which may result in a length deduction (reference length cut App. 4 and 5 in Ch. 60). Use the "give and take" procedure when measuring this type of defect. In exhibit 01, note that areas of recovery appear inside the rectangle. This is offset by the areas of loss from the ends of the checks that are outside the rectangle.

22.44c - Exhibit 02

Spangle: Squared Area Deduction



Given:

W = 8 inches
H = 12 inches
L = 10 feet

Determine defect volume:

$$Defect\ \ volume(\ ft^3\ ) = \frac{(W\ x\ H\ x\ L)}{144} = \frac{(12\ x\ 8\ x\ 10)}{144} = \frac{960}{144} = 6.7\ \ ft^3$$

22.44d - Weather Checks

Volume loss from weather checks can be deducted using the diameter or squared area deduction methods. Weather checks that penetrate the side of the log more than one inch are considered for deduction. Measure the depth of checks on each end of the log to determine the average depth of penetration.

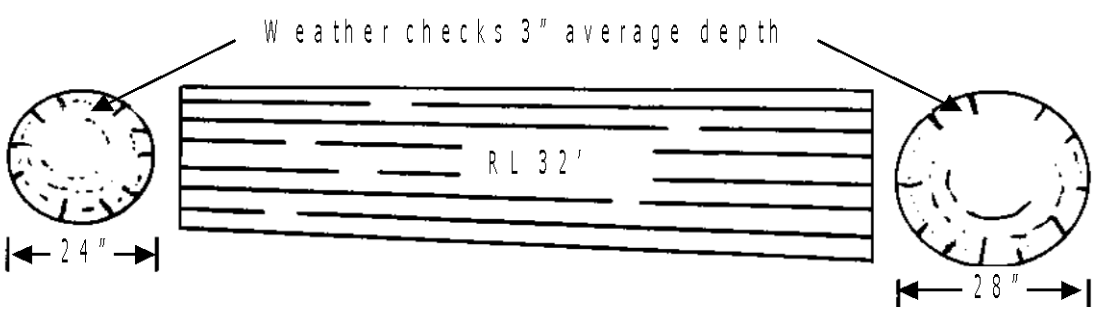
Weather checks in logs cut from green trees are usually twice as deep at the ends than the sides. Use one-half the depth of checks when determining defect volume. Weather checks in logs cut from dead trees are usually the same depth on the sides of the log as they are at the ends. Use the full depth in determining defect volume. When both sap rot and weather checks are present, refer to section 22.34a for the appropriate deduction method.

After the depth of penetration and the deduction is determined, 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. Recovery studies have shown that only 50 percent of the calculated defect volume for weather checks is not recoverable in the manufacturing process, whether the log is from a green or dead tree. Therefore, reduce the calculated defect volume by 50 percent. If the weather checks spiral to the degree that there is no 6-foot lumber recovery between the checks, do not reduce defect volume by 50 percent.

22.44d - Exhibit 01

Weather Checks



22.44d - Exhibit 01--Continued

Given:

Log is from a dead tree.
Recorded log length = 32 feet
Small end diameter = 24 inches
Large end diameter = 28 inches
Small end segment gross volume = 54.6 ft^3
Large end segment gross volume = 63.7 ft^3
Average depth of checks at both ends = 3 inches
Determine defect volume and segment merchantability:
Weather checks 3-inch depth x 2 = 6 inch diameter deduction
Reduced small end diameter 24 - 6 = 18 inches
Reduced large end diameter 28 - 6 = 22 inches
Small end segment net volume (18 inches x 20 inches x 16 feet) = 31.6 ft^3
Large end segment net volume (20 inches x 22 inches x 16 feet) = 38.6 ft^3

Defect volume = gross volume - net volume
Small end segment = 54.6 - 31.6 = 23.0 ft^3
Large end segment = 63.7 - 38.6 = 25.1 ft^3

Small end defect factor = 7.60
Large end defect factor = 7.04
Contract merchantable factor = 10.67
Segment defect factors do not exceed the contract merchantable factor.
Both segments are merchantable.

Determine adjusted volume:

Adjusted defect volume = defect volume x .5 (50 percent adjustment based on recovery studies)
Small end segment = 23.0 x .5 = 11.5 ft^3
Large end segment = 25.1 x .5 = 12.6 ft^3

If the weather checks affect only a portion of the perimeter, 75 percent for example, reduce the defect volume accordingly.

Small end 11.5 ft^3 *x .75 = 8.6* ft^3
Large end 12.6 ft^3 *x .75 = 9.5* ft^3

If weather checks are isolated to a small portion of the perimeter of the log, the defect volume can best be determined by the squared area deduction method (sec. 22.31).

22.45 - Pitch Ring, Shake Ring

22.45a - Full Rings

Use actual ring dimensions. When a ring shows in only one end of the log, the taper of the ring is determined proportional to the log taper and based on the extent of defect length. Use the following formula to calculate the defect volume for rings 6 inches or larger in size.

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

The derivation of the .273 factor in the formula is as follows:

$$Factor = \frac{area\ \ of\ \ square - area\ \ of\ \ circle}{area\ \ of\ \ circle}$$

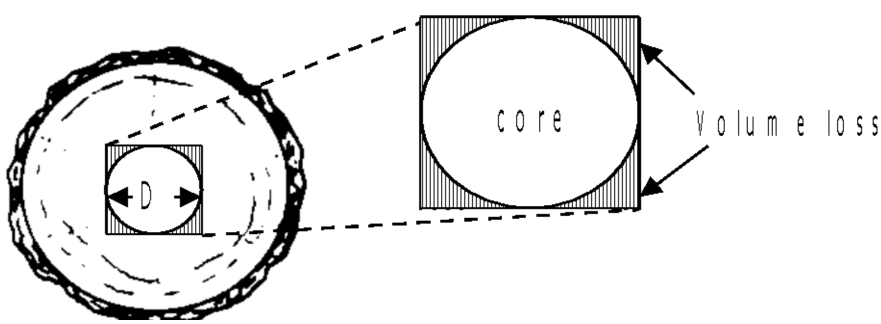
$$= \frac{D^2 - 0.7854\ D^2}{0.7854\ D^2} = 0.273\ \ or\ 27.3\ percent$$

Where: D = Side of the square and the diameter of the inscribed circle.

This factor represents the difference between the area of a square and the area of a circle of the same diameter. The four corners of the square represent 27.3 percent additional volume loss associated with the ring as shown in exhibit 01.

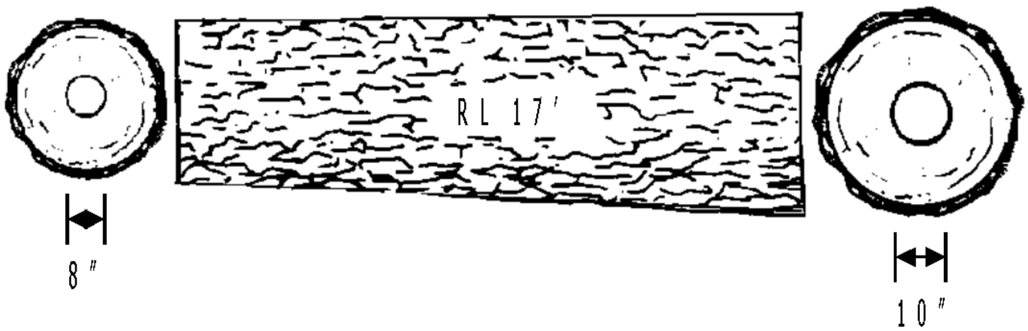
22.45a - Exhibit 01

<u>Volume Loss Due to Ring Defect</u>



22.45a - Exhibit 02

Ring Defect



Given:

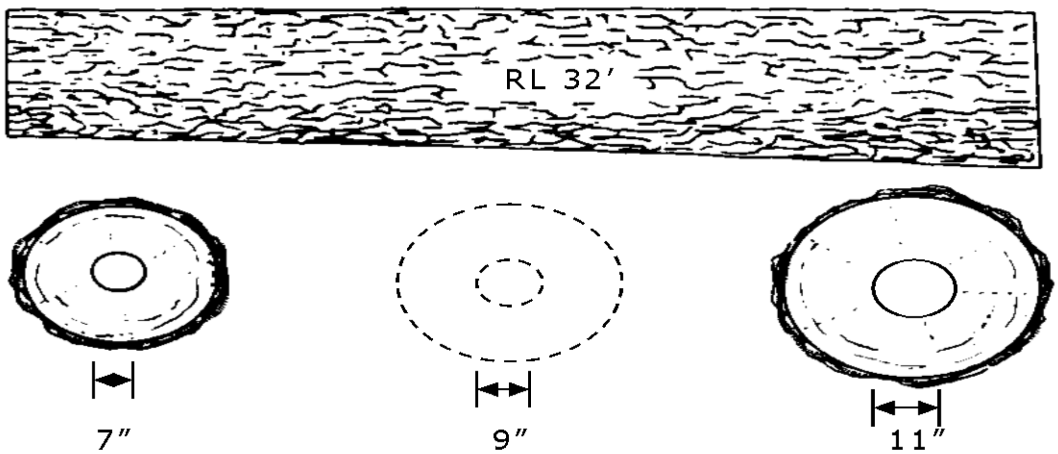
Core dimensions = 8 inches x 10 inches x 17 feet
Core volume unrounded = 7.602873 ft^3

Determine defect volume:

$$Defect\ \ volume(\ ft^3\ ) = core\ \ volume\ unrounded\ \ x\ 0.273$$
$$= 7.602873\ x\ 0.273 = 2.1\ \ ft^3$$

22.45a - Exhibit 03

Pitch Ring 6.0 Inches or Greater



Given:

Recorded log length = 32 feet
Segment lengths = 16 feet
Small end ring diameter = 7 inches
Large end ring diameter = 11 inches

Determine defect dimensions:

Use defect taper to determine the defect dimensions at the segment break. Subtract small end defect dimensions from large end defect dimensions. Subtract small end ring diameter from large end ring diameter. The result is the total ring taper. 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.

$$11 - 7 = 4 \textit{ inches total ring taper}$$

$$\frac{4}{2} = 2 + 7 \textit{ (small end ring diameter)} = 9 \textit{ inch ring at segment break}$$

22.45a - Exhibit 03--Continued

Determine core dimensions and core volume:

Small end segment = 7 inches x 9 inches x 16 feet = 5.67216 ft^3 core volume unrounded
Large end segment = 9 inches x 11 inches x 16 feet = 8.813664 ft^3 core volume unrounded

Determine defect volume:

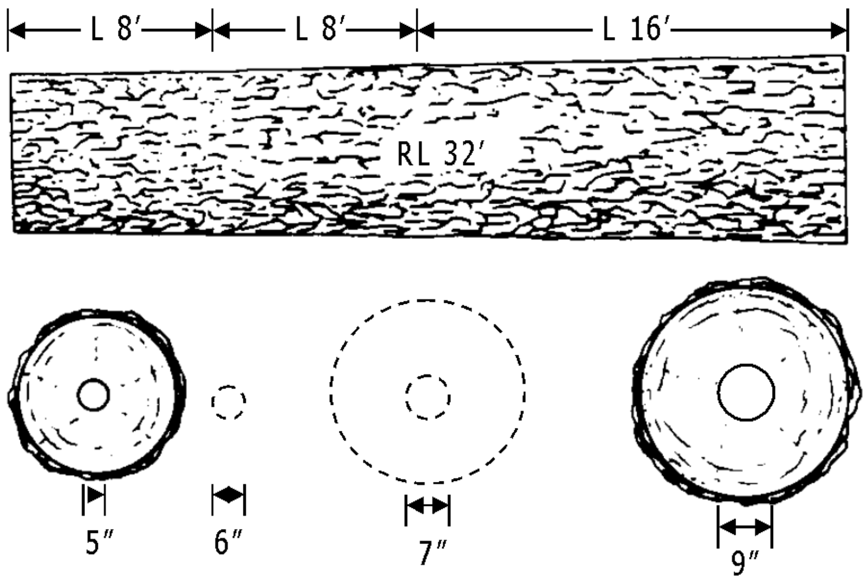
$$Defect\ volume\ (ft^3) = core\ volume\ unrounded\ x\ 0.273$$

Small end segment = 5.67216 x .273 = 1.5 ft^3
Large end segment = 8.813664 x .273 = 2.4 ft^3
Total defect volume (ft^3*) = 1.5 + 2.4 = 3.9* ft^3

Use the squared area method to determine defect volume when the ring diameter is less than 6.0 inches.

22.45a - Exhibit 04

Example of Pitch Ring Less Than 6.0 Inches



Given:

Recorded log length = 32 feet
Segment lengths = 16 feet
Small end ring diameter = 5 inches
Large end ring diameter = 9 inches

Determine defect dimensions:

Use defect taper to determine the defect dimensions at the segment break. Subtract small end defect dimensions from large end defect dimensions. Subtract small end ring diameter from large end ring diameter. The result is the total ring taper. 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.

$$9 - 5 = 4 \text{ inches total ring taper}$$

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

22.45a - Exhibit 04--Continued

Determine defect volume:

Use the square area deduction method for the ring that is less than 6.0 inches in diameter and extends 8 feet in the small end segment:

$$Average\ ring\ dimensions = \frac{(6+5)}{2} = \frac{11}{2} = 5.5 = 6\ inches$$

$$Defect\ \ volume\,(\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144} = \frac{6\ x\ 6\ x\ 8}{144} = \frac{288}{144} = 2.0\ \ ft^3$$

Determine core dimensions and core volume:

For the remainder of the log:

The small end ring diameter is 6.0 inches and extends the remaining 8 feet of segment length.
Adjusted core length = 16 feet - 8 feet = 8 feet for small end segment.
Small end segment = 6 inches x 7 inches x 8 feet = 1.85436 ft^3 core volume unrounded
Large end segment = 7 inches x 9 inches x 16 feet = 5.67216 ft^3 core volume unrounded

Determine defect volume:

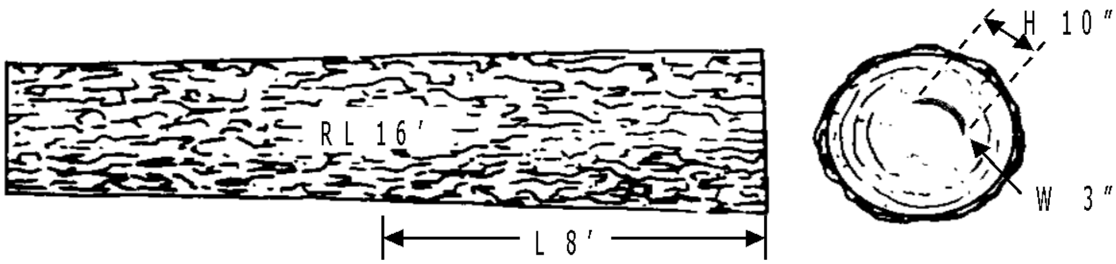
$Defect\ volume\,(\ ft^3\ ) = core\ volume\ unrounded\ \ x\ .273$
Small end segment = 1.85436 x .273 = 0.5 ft^3 *+ 2.0* ft^3 *= 2.5* ft^3
Large end segment = 5.67216 x .273 = 1.5 ft^3
Total defect volume (ft^3*) = 2.5 + 1.5 = 0.7* ft^3

22.45b - Partial Rings

For one-quarter rings or less, use the squared area method with the give and take procedure.

22.45b - Exhibit 01

Partial Rings: One-Quarter or Less



Given:

W = 3 inches
H = 10 inches
L = 8 feet

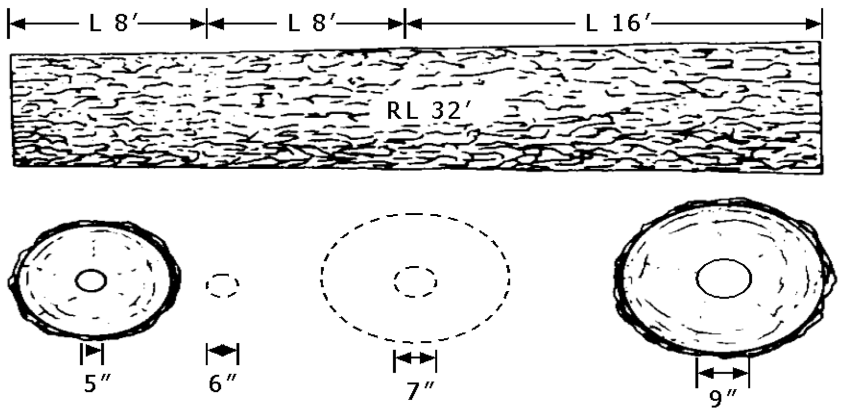
Determine defect volume:

$$Defect\ \ volume\,(\ ft^3\ ) = \frac{W\ x\ H\ x\ L}{144} = \frac{3\ x\ 10\ x\ 8}{144} = \frac{240}{144} = 1.7\ \ ft^3$$

For partial rings greater than one-quarter, calculate the defect volume for a full ring and reduce the defect volume by the percentage of the ring present. For example, if a half ring is present deduct half the defect volume of a full ring.

22.45b - Exhibit 02

Example of Partial Rings: Half Rings



Given:

Recorded log length = 32 feet
Segment lengths = 16 feet
Small end half ring diameter = 7 inches
Large end half ring diameter = 11 inches

Determine defect dimensions:

$$11 - 7 = 4 \text{ inches total ring taper}$$

$$\frac{4}{2} = 2 + 7 \text{ (small end ring diameter)} = 9 \text{ inch ring at segment break}$$

Determine core dimensions and core volume:

Small end segment = 7 inches x 9 inches x 16 feet = 5.67216 ft^3 unrounded
Large end segment = 9 inches x 11 inches x 16 feet = 8.813664 ft^3 unrounded

Determine defect volume:

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

$$\text{Small end segment} = 5.67216\ x\ .273 = 1.5\ ft^3$$

$$\text{Large end segment} = 8.813664\ x\ .273 = 2.4\ ft^3$$

Reduce the defect volume by the percent of ring present, in this example 50 percent.
Adjusted defect volume:

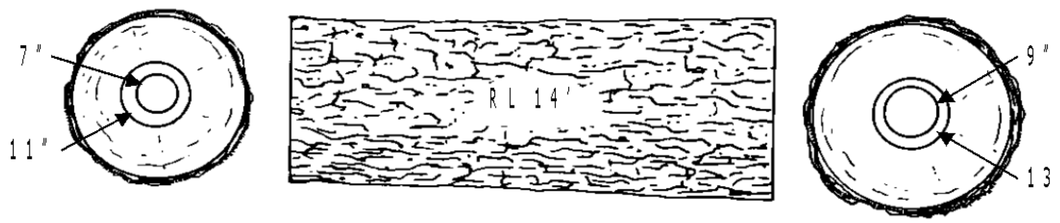
Small end segment = 1.5 x .5 = .8 ft^3
Large end segment = 2.4 x .5 = 1.2 ft^3
Total defect volume (ft^3) = 0.8 + 1.2 = 2.0 ft^3

22.45c - Multiple Rings

When two rings are 2.5 inches or less apart, multiply the unrounded outer ring volume by 1.273 then subtract the volume of the inner core. The factor 1.273 represents the volume of the outer ring plus the volume of the corners of the square for the outer ring.

22.45c - Exhibit 01

Example of Multiple Rings: 2.5 Inches or Less Apart



Given:

Recorded log length = 14 feet
Outer ring diameters
Small end = 11 inches
Large end = 13 inches
Inner ring diameters
Small end = 7 inches
Large end = 9 inches

Determine core dimensions and core volume:

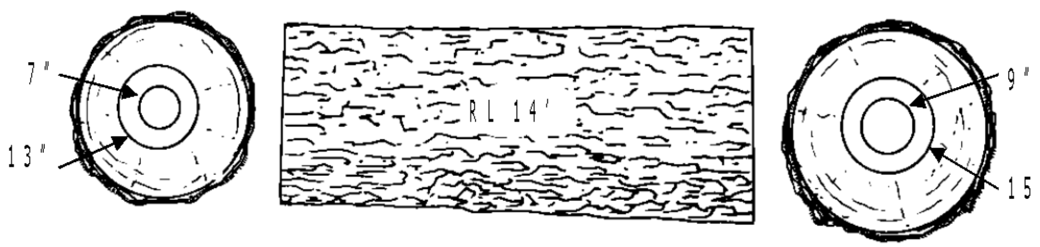
Outer core = 11 inches x 13 inches x 14 feet = 11.07162 ft^3
Inner core = 7 inches x 9 inches x 14 feet = 5.0 ft^3

Determine defect volume:

$$\begin{aligned} \textit{Defect volume} (ft^3) &= \textit{outer core volume unrounded } x\ 1.273 - \textit{inner core volume} \\ &= 11.07162\ x\ 1.273 - 5.0 = 14.1 - 5.0 = 9.1\ ft^3 \end{aligned}$$

22.45c - Exhibit 02

Example of Multiple Rings: Over 2.5 Inches Apart



When two full rings are over 2.5 inches apart, measure diameters of both rings. Compute separately and add deductions together.

Given:

Recorded log length = 14 feet
Outer ring diameters
Small end = 13 inches
Large end = 15 inches
Inner ring diameters
Small end = 7 inches
Large end = 9 inches

Determine core dimensions and core volume:

Outer core = 13 inches x 15 inches x 14 feet = 15.042132 ft^3
Inner core = 7 inches x 9 inches x 14 feet = 4.96314 ft^3

Determine defect volume:

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

Outer ring = 15.042132 x .273 = 4.1
Inner ring = 4.96314 x .273 = 1.4
Total defect volume (ft^3) = 4.1 + 1.4 = 5.5 ft^3

22.45d - Perimeter Rings

Use the diameter deduction method for perimeter rings, rings located 2.5 inches or less from the perimeter of the log. If multiple perimeter rings are less than 2.5 inches apart, use the diameter deduction method to eliminate all perimeter rings.

22.45d - Exhibit 01

Perimeter Ring

Given:

Recorded log length = 14 feet
Small end diameter = 25 inches
Large end diameter = 27 inches
Small end ring diameter = 20 inches
Large end ring diameter = 22 inches
Gross volume = 51.7 ft^3

Determine net volume and defect volume:

Reduced small end diameter = 25 - 5 = 20
Reduced large end diameter = 27 - 5 = 22
Net volume (20 inches x 22 inches x 14 feet) = 33.7 ft^3

$$\textit{Defect volume}\,(ft^3) = \textit{gross volume} - \textit{net volume}$$
$$= 51.7 - 33.7 = 18.0\ ft^3$$