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

Date approved: November, 2, 1994

Responsible Staff:

Last Change: 2409.11a-2004-4 to 2409.11a_22.42-22.45

Superseded Document(s):

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

22.46: Adds direction on pistol butt defect, and clarifies the defect deduction process and describes cross grain material on crook, pistol butt, and sweep defects. Additional examples in exhibits have also been added.

22.46b: Revises and recodes to this section the direction on crook and sweep, which was previously coded to sections 22.47-22.47b.

22.47: Recodes to this section the direction on knots, which was previously coded to section 22.48. Establishes knot size limit, revises the knot deduction guide, and clarifies the knot deduction process.

24.48: Change the caption and recodes to this section the direction on other defects, which was previously coded to section 22.49.

22.48a: Establishes this code and adds direction for defect deductions for spiral grain defect.

22.48b: Establishes this code and revises and relocates to this section the direction on char, which was previously coded to section 22.42f.

22.48c: Adds direction for defect deductions for foreign material.

22.48d: Establishes this code and relocates to this section the direction on wormhole defect, which was previously coded to 22.49.

22.51b: Adds direction regarding the calculation of defect volume for anticipated recovery between checks, if the segment is determined to be merchantable after the full deduction is applied; adds direction regarding the calculation of defect volume if weather checks spiral and 6-foot lumber recovery cannot be achieved.

Table of Contents

22.46 - Crook, Pistol Butt, and Sweep

Use a length deduction or length deduction with percent method for crook, pistol butt, and sweep defect.

22.46a - Crook and Pistol Butt Defect

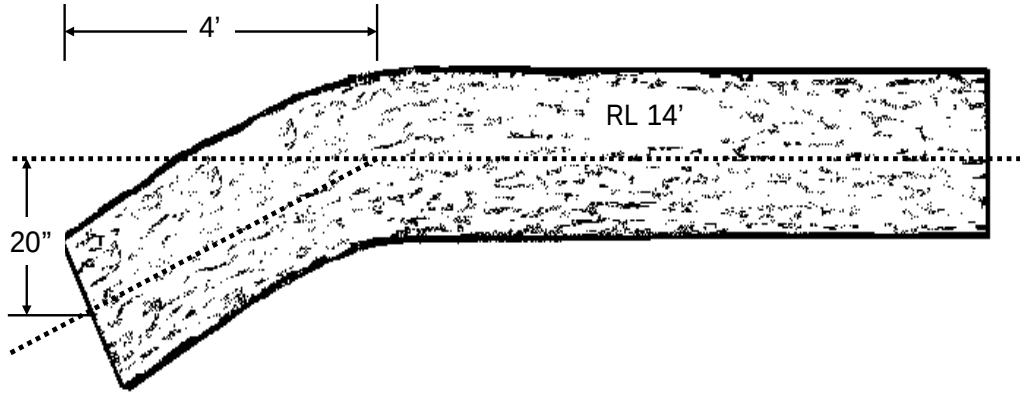
When a log has an abrupt curve or bend, the defect is called crook. When crook is present in the butt end of the log, the defect is called pistol butt defect. Deductions are made for void, cross grain and any portion that will not produce 6-foot lumber recovery on either side of the crook.

Cross grain material is defined as grain deviation that exceeds 3 inches per foot from straight. Measure grain deviation by projecting a straight line down the center of the segment starting from the longest straight portion. Measure the distance between the projected straight line and the centerline of the crook portion for the length affected. If the deviation exceeds 3 inches per foot it is considered cross grain and the entire length affected by crook is deducted using a length deduction.

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

22.46a - Exhibit 01

Crook: Length Deduction for Cross Grain



In exhibit 01, 4 feet of length is affected by crook. Grain deviation measures 20 inches in 4 feet, or 5 inches in 1 foot, which exceeds 3 inches per foot. Due to cross grain, the length deduction is the full 4 feet.

Given:

Recorded log length = 14 feet
Gross volume = 19.6 ft^3
Grain deviation exceeds 3 inches per foot
Defect length = 4 feet

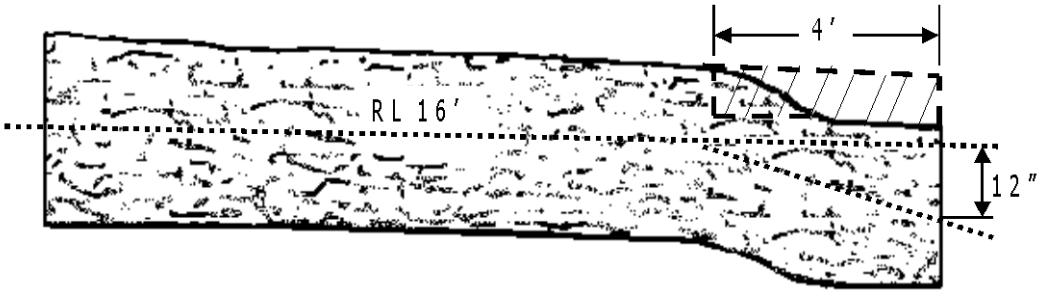
Determine defect volume:

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

$$= \frac{4}{14}\ x\ 19.6 = .2857\ x\ 19.6 = 5.6\ \ ft^3$$

22.46a - Exhibit 02

Crook: Length Deduction for Void



In exhibit 02, 4 feet of length is affected by crook. Grain deviation measures 12 inches in 4 feet, or 3 inches in 1 foot, which does not exceed the allowable deviation. Void and loss due to manufacturing process affects 25 percent of 4 feet. Length deduction of 25 percent of 4 feet is taken for void.

Given:

Recorded log length = 16 feet
Gross volume = 38.6 ft^3
Grain deviation does not exceed 3 inches per foot
Defect length = 25 percent of 4 feet.

Determine defect percent:

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

$$= \frac{4}{16}\ x\ .25 = .0625x100 = 6.25\%$$

Determine defect volume:

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

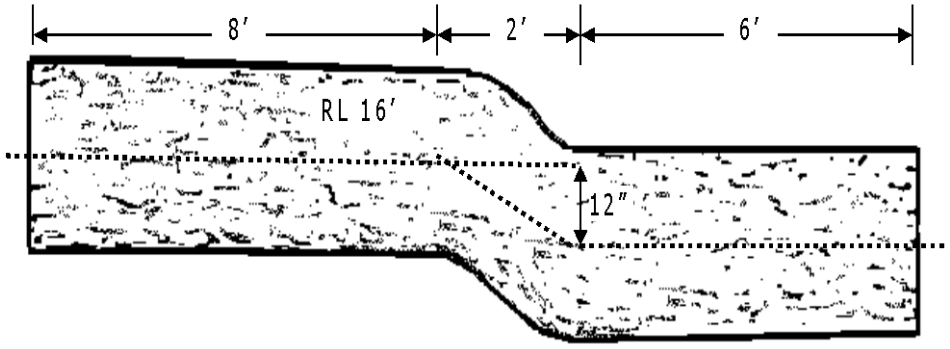
$$= 38.6\ x\ .0625 = 2.4\ \ ft^3$$

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

$$= \frac{4}{16}\ x\ 38.6 = .25\ x\ 38.6 = \ 9.7\ \ ft^3$$

22.46a - Exhibit 03

Crook: Length Deduction for Cross Grain



In exhibit 03, 2 feet of length is affected by crook. Grain deviation for the affected 2 feet measures 12 inches, or 6 inches in 1 foot, which exceeds 3 inches per foot. A 6-foot portion and an 8-foot portion remain on either side of the crook and are parallel to, or on the same plane, as each other. The length deduction is the full 2-foot portion containing cross grain. If the remaining portions on either side of the defect would not produce 6-foot lumber recovery or were not parallel and on the same plane, the deduction would include those portions.

Given:

Recorded log length = 16 feet
Gross volume = 25.3 ft^3
Grain deviation exceeds 3 inches per foot
Defect length = 2 feet

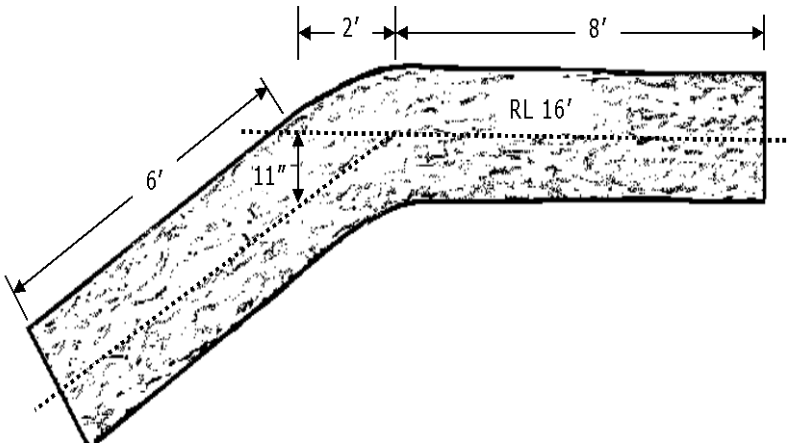
Determine defect volume:

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

$$= \frac{2}{16}\ x\ 25.3 = .125\ x\ 25.3 = 3.2\ \ ft^3$$

22.46a - Exhibit 04

Crook Length Deduction for Cross Grain and Portion Not on the Same Plane



In exhibit 04, 2 feet of length is affected by crook. Grain deviation for the affected 2 feet measures 11 inches, or 5.5 inches in 1 foot, which exceeds 3 inches per foot. A 6-foot portion and an 8-foot portion remain on either side of the crook but since they are not parallel to, or not on the same plane as each other, the defect deduction includes the 6-foot portion. The length deduction is 8 feet; 2 feet for cross grain and 6 feet for the portion not on the same plane.

Given:

Recorded log length = 16 feet
Gross volume = 46.2 ft^3
Grain deviation exceeds 3 inches per foot
Defect length = 8 feet

Determine defect volume:

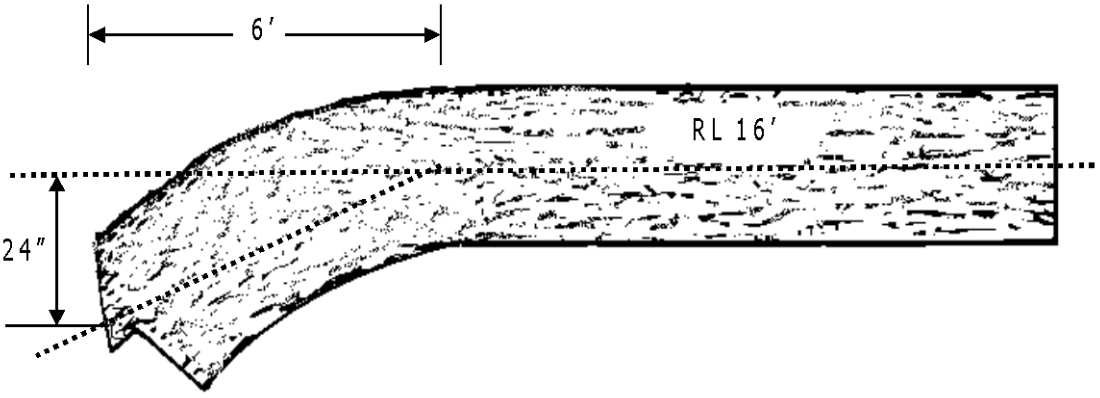
$$Defect\ \ volume\,(\ ft^3\,) = \frac{defect\ \ length}{segment\ \ length}\ x\ \ gross\ \ volume$$

$$= \frac{8}{16}\ x\ 46.2 = .5\ x\ 46.2 = 23.1\ ft^3$$

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

22.46a - Exhibit 05

Crook: Pistol Butt Defect



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

Given:

Recorded log length = 16 feet
Gross volume = 24.0 ft^3
Grain deviation exceeds 3 inches per foot
Defect length = 6 feet

Determine defect volume:

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

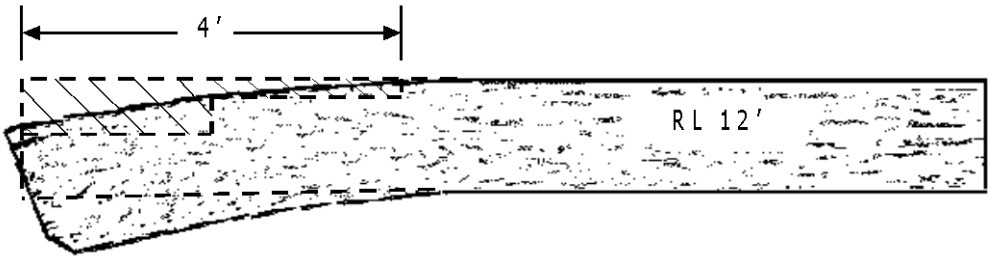
$$= \frac{6}{16}\ x\ 24.0 = .375\ x\ 24.0 = 9.0\ \ ft^3$$

22.46b - Sweep

Sweep is a gradual curve or bend, which can affect a short length or extend continuously through a segment or log. Deductions are made for void and the portion of the log that will not produce standard length lumber in the manufacturing process.

22.46b - Exhibit 01

Sweep: Length With Percent Deduction



In exhibit 01, 4 feet of length is affected by sweep. Void and loss due to manufacturing process affects 20 percent of 4 feet. Length deduction of 20 percent of 4 feet is taken for void.

Given:

Recorded log length = 12 feet
Gross volume = 19.0 ft^3
Defect length = 20 percent of 4 feet

Determine defect percent:

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

$$= \frac{4}{12}\ x\ 20 = .06666x100 = 6.66\%$$

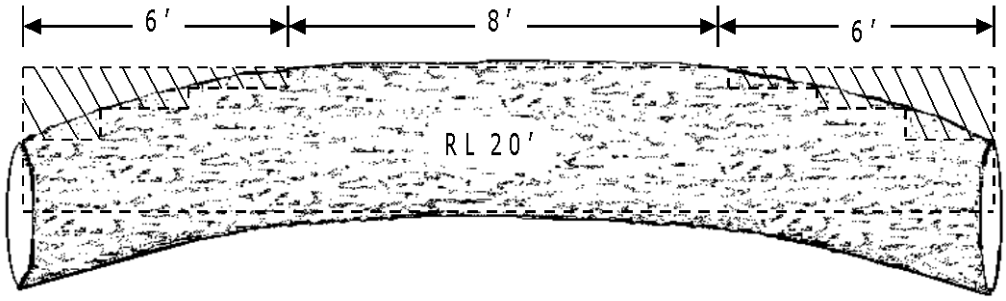
Determine defect volume:

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

$$= 19.0\ x\ .06666 = 1.3\ \ ft^3$$

22.46b - Exhibit 02

Sweep: Length With Percent Deduction



The exhibit 02 illustrates a 20-foot log with sweep affecting 6 feet on each end. Void and loss due to manufacturing process affects 25 percent of the affected length. A length deduction of 25 percent of 12 feet is taken.

Given:

Recorded log length = 20 feet
Gross volume = 35.5 ft^3
Defect length = 25 percent of 12 feet

Determine defect percent:

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

$$= \frac{12}{20}\ x\ 25 = .15x100 = 15\%$$

Determine defect volume:

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

$$= 35.5\ x\ .15 = 5.3\ \ ft^3$$

22.47 - Knots

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

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

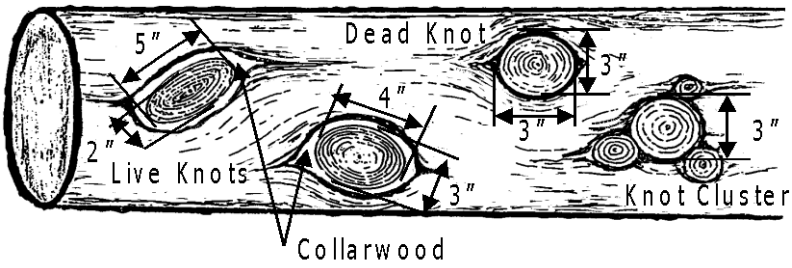
Live and dead knots are considered oversize in all species when they exceed the maximum knot size limit for the diameter ranges shown below. Maximum knot sizes are based on the small end diameter of the affected log or segment.

Knot Size Limit		
Small End Diameter	Maximum Live	Maximum Dead
5" to 10"	2"	1"
11" to 20"	3"	2"
21" & up	4"	3"

Knots are measured at the surface of the log and size is determined by averaging the narrow and wide measurements of the hardened area of the knot showing growth rings, excluding the collarwood surrounding the knot, as shown in exhibit 01.

22.47 - Exhibit 01

Determining Knot Size



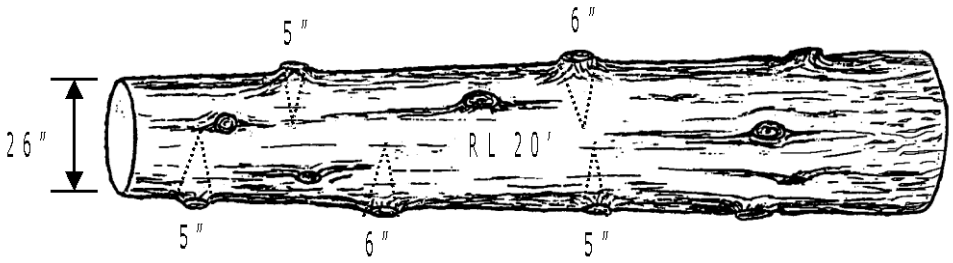
The diameter deduction method is most commonly used to deduct for oversize knots on the log surface and for oversize knots in knot whorls or knot clusters. When oversize knots affect the entire surface of the log, use the following Knot Deduction Guide to deduct the volume affected. Oversize knots may occur on less than four faces of the log or on a portion of the log length. In these cases, use the diameter deduction with percent method to reduce the defect volume by deducting only for the area affected with oversize knots. A few scattered oversize knots on a log do not create a volume loss.

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

Reduce the defect volume if the entire log surface or length is not affected.

22.47 - Exhibit 02

Mostly Live Oversize Knots



Given:

Recorded log length = 20 feet
Small end diameter = 26 inches
Large end diameter = 30 inches
Gross volume = 86.0 ft^3
Mostly live oversize knots affect entire log surface

Determine net volume and defect volume:

Using the Knot Deduction Guide, a 3-inch diameter deduction is indicated
Reduced small end diameter = 26 - 3 = 23 inches
Reduced large end diameter = 30 - 3 = 27 inches
Net volume (23 inches x 27 inches x 20 feet) = 68.6 ft^3

Defect volume (ft^3) = *gross volume - net volume*
= *86.0 - 68.6 = 17.4* ft^3

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

22.47 - Exhibit 03

Mostly Dead Oversize Knots

Given:

Recorded log length = 20 feet
Small end diameter = 17 inches
Large end diameter = 19 inches
Gross volume = 35.5 ft^3
Mostly dead oversize knots affect two faces, 50 percent, for 6 feet

Determine net volume and defect volume:

Using the Knot Deduction Guide, a 2-inch diameter deduction is indicated
Reduced small end diameter = 17 - 2 = 15 inches
Reduced large end diameter = 19 - 2 = 17 inches
Net volume (15 inches x 17 inches x 20 feet) = 28.0 ft^3

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

$$= \frac{6}{20}\ x\ .50 = .15x100 = 15\%$$

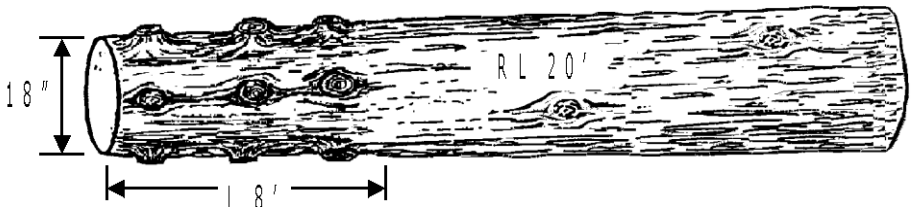
Defect volume (ft^3)= gross volume net volume x defect percent in decimals

$$= 35.5 - 28.0 = 7.5\ x\ .15 = 1.1\ ft^3$$

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

22.47 - Exhibit 04

Live Oversize Knots in Knot Whorls



Given:

Recorded log length = 20 feet
Small end diameter = 18 inches
Large end diameter = 19 inches
Gross volume = 37.4 ft^3
Live oversize knots in whorls affect three faces, 75 percent, for 8 feet

Determine net volume and defect volume:

Using the Knot Deduction Guide, a 2-inch diameter deduction is indicated
Reduced small end diameter = 18 - 2 = 16 inches
Reduced large end diameter = 19 - 2 = 17 inches
Net volume (16 inches x 17 inches x 20 feet) = 29.7 ft^3

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

$$= \frac{8}{20}\ x\ .75 = .3x100 = 30\%$$

Defect volume (ft^3) = gross volume - net volume x defect percent in decimals

$$= 37.4 - 29.7 = 7.7\ x\ .3 = 2.3\ ft^3$$

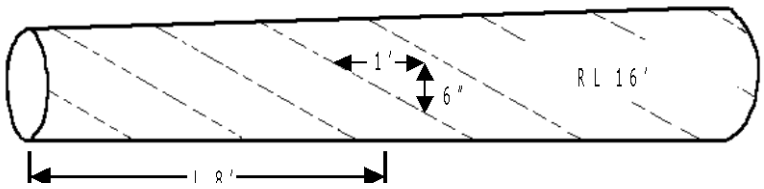
22.48 - Other Defects

22.48a - Spiral Grain

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

22.48a - Exhibit 01

Spiral Grain



In exhibit 01, spiral grain affects the entire log. Measure grain distortion in the center of the log.

Given:

Recorded log length = 16 feet
Small end diameter = 23 inches
Large end diameter = 25 inches
Gross volume = 50.4 ft^3
Grain distortion is 6" per foot

Determine defect volume:

3" diameter deduction (grain distortion)
Reduced small end diameter = 23 - 3 = 20 inches
Reduced large end diameter = 25 - 3 = 22 inches
Net volume (20 inches x 22 inches x 16 feet) = 38.6 ft^3

$$Defect\ \ volume\,(\ \ ft^3) = gross\ volume - net\ volume$$
$$= 50.4 - 38.6 = 11.8\ \ ft^3$$

22.48b - Char

Char results when fire scorches wood and causes a change in the chemical composition. Char is usually included as part of the deduction for fire scar. When char is not associated with a fire scar, consider using the diameter deduction method for the length affected.

22.48c - Foreign Material

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

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

2. If the foreign material can be readily removed, remove the material or have it removed. If the foreign material cannot be readily removed, make a length deduction for the length affected in even two foot multiples. If the remaining portion of the log does not meet contract log length minimums after deductions, cull the log. If the extent of the foreign material in the log is questionable, the log may be culled.

22.48d - Wormholes

Wormholes are common defects in logs cut from standing dead trees (snags and fire or insect killed), and from some downed timber. Various sized worms can enter the bole of the tree through the bark or through damaged and rotted areas on the tree's surface and can leave holes on the surface and into the sapwood area of dead and dying trees. The holes vary in size and depth. In some cases, the larger worms bore into the heartwood area of the tree. The sizes of holes caused by woodborers (flathead, roundhead, and grub worms), can vary depending on the type of worm or insect creating the damage. Holes can range in size from 1/16th inch to over 1/2 inch. Holes can go directly into the tree (perpendicular), or there may be cross-galleries (parallel) throughout the bole of the tree.

When making deductions for wormholes, only those areas on the log's surface and/or log end(s) that show massed wormholes exceeding 1/16th inch in size must be considered. Massed wormholes are defined as wormholes located on the log end(s) which are 4 inches or less apart in any direction, and/or on the log surface which are 6 inches or less apart in any direction.

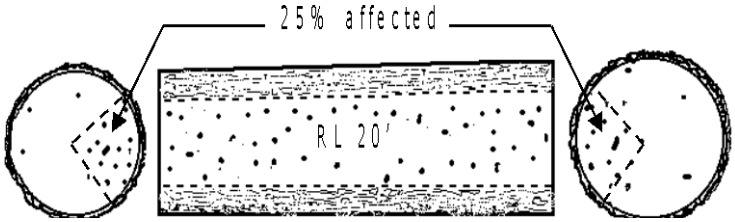
If wormholes on a log end are considered to be massed, and the extent of defect within the log cannot be determined, assume the penetration of defect to be one-half the segment length.

When wormholes are found in connection with saprot, catfaces, or scars, the measurement of defect must also include any deduction for wormholes.

When massed wormholes are found in the sapwood area, determine the average depth of penetration on the log end(s). Use the appropriate deduction method for the area affected.

22.48d - Exhibit 01

Length With Percent Deduction for Massed Wormholes



In exhibit 01, wormholes are 4 inches or less apart on the log end and 6 inches or less apart on the log surface. About 25 percent of the end area is estimated to be affected with massed wormholes. Length deduction of 25 percent of 20 feet is taken for massed wormholes.

Given:

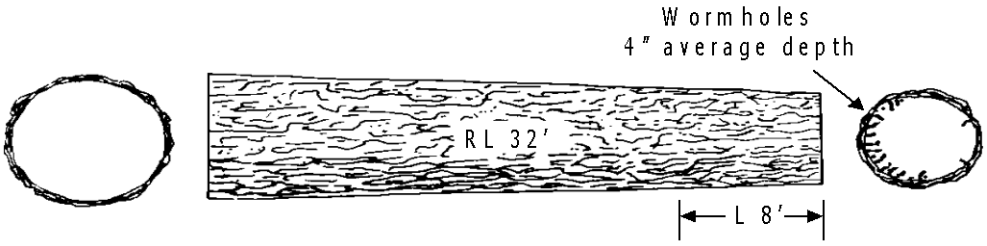
Recorded log length = 20 feet
Gross volume = 50.7 ft^3
Defect affects 25 percent of the end area for 20 feet

Determine defect volume:

$$Defect\ \ volume\ (\ ft^3) = gross\ volume\ x\ defect\ percent$$
$$= \ 50.7\ x\ 0.25 = 12.675 = 12.7\ ft^3$$

22.48d - Exhibit 02

Diameter Deduction With Percent for Massed Wormholes



In exhibit 02, about 50 percent of the sapwood area on the log end is affected with massed wormholes. The extent of defect cannot be determined therefore the defect length is one-half the segment length.

Given:

Recorded log length = 32 feet
Segment lengths = 16 feet
Small end diameter = 23 inches
Large end diameter = 28 inches
Midpoint diameter = 26 inches
Gross small end segment volume = 52.6 ft^3
Wormholes = 4 inch average depth, affects 50 percent of log circumference
Defect length = 8 feet

Determine net volume and defect volume:

4 inches (wormholes) x 2 = 8 inch diameter deduction
Reduced small end diameter = 23 - 8 = 15 inches
Reduced midpoint diameter = 26 - 8 = 18 inches
Net volume (15 inches x 18 inches x 16 feet) = 24.0 ft^3

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

$$= \frac{8}{16}\ x\ .50\ = .25x100 = 25\%$$

Defect volume (ft^3) = gross volume - net volume x defect percent in decimals

$$= 52.6 - 24.0 = 28.6\ x\ .25 = 7.2\ ft^3$$

22.5 - Cull Log Determination

As a first step in assessing defective log segments, determine if the segment is cull. Log segments not meeting contract specifications for primary products are culled, otherwise the segment is scaled as merchantable.

A factor system is used in cull log determination. A key element in the system is the contract merchantable factor, which is stated in Special Condition A2 of the Timber Sale Contract, and applies to sawtimber only.

Merchantable factor = maximum defect x 16 (rounded to nearest .01)

Examples:	One-third sound	One-fourth sound
	(1 - 1/3) x 16	(1 - 1/4) x 16
	2/3 x 16 = 10.67	3/4 x 16 = 12.0

The other key element in the factor system is the defect factor. A defect factor is determined for each individual defect and added together. The defect factors apply to segments of any length and are added together for use on segments with multiple defects. The defect factor is compared to the contract merchantable factor for a given segment. If the defect factor exceeds the contract merchantable factor, the segment is culled.

Defect factor tables are found in chapter 60 for perimeter defects such as sap rot and weather checks; and internal defects such as rot, heart check, shake and pitch ring.

The merchantable factor, which is based on a 16-foot log, can be computed for any equivalent board foot net scale in percent of gross scale, and applies to sawtimber only.

22.51 - Cull Determination for Segments with a Single Defect Extending Through the Length of the Segment

22.51a - Interior Defects

Take two measurements to determine the defect factor for segments with an interior defect extending through the segment. The squared area method is the basis for determining the defect factor for interior defects. These measurements are taken:

1. The small end segment diameter.

2. The average defect dimensions.

When the defect extends through the length of the segment, determine the defect factor as shown in exhibit 01.

22.51a - Exhibit 01

Example Merchantability Determination: Cull Segment

Given:

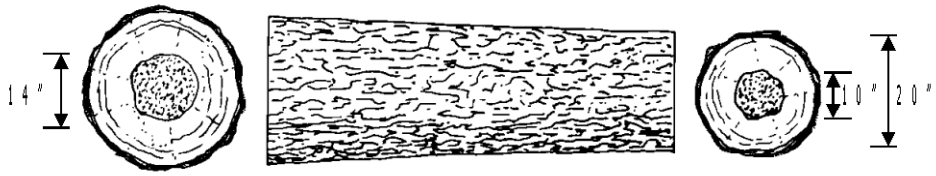
Small end diameter = 10 inches
Small end defect size = 6 inches square
Large end defect size = 8 inches square
Contract merchantable factor = 10.67

$$Average\ \ defect\ \ size = \frac{6+8}{2} = \frac{14}{2} = 7\ inches$$

Referring to the interior defect factor table (App. 6) in chapter 60, for a 10-inch diameter segment with a squared defect that averages 7 inches, it shows a defect factor of 18.67. This exceeds the contract merchantable factor of 10.67 so the segment is cull.

22.51a - Exhibit 02

Example of Merchantability Determination: Merchantable Segment



Given:

Small end diameter = 20 inches
Small end defect size = 10 inches square
Large end defect size = 14 inches square
Contract merchantable factor = 10.67

$$Average\ \ defect\ \ size = \frac{(10+14)}{2} = \frac{24}{2} = 12\ \ inches$$

Referring to the interior defect factor table (App. 6) in chapter 60, for a 20-inch diameter segment with a squared defect that averages 12 inches, it shows a defect factor of 10.29. This is less than the contract merchantable factor of 10.67 so the segment is merchantable.

22.51b - Perimeter Defects

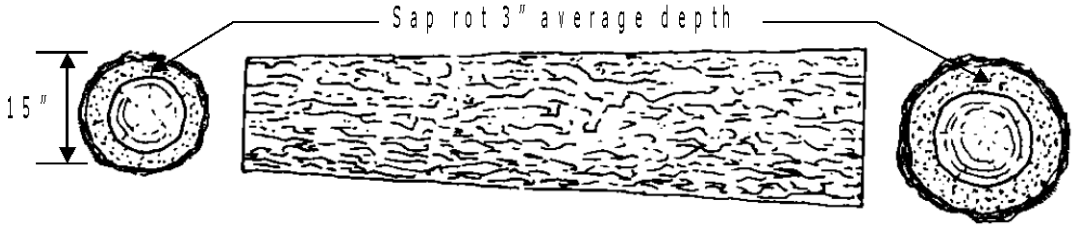
Sap rot and weather checks are perimeter defects. Two measurements are needed to determine the defect factor. These measurements are taken:

1. The small end diameter of the segment.

2. Diameter deduction in inches due to defect.

22.51b - Exhibit 01

Example Merchantability Determination: Perimeter Defect, Cull Segment



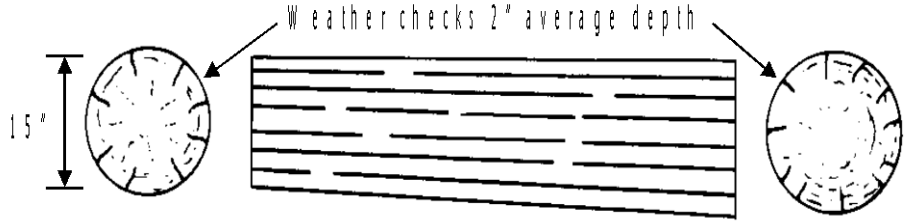
Given:

Small end diameter = 15 inches
Sap rot average 3 inches in depth
Diameter reduction = 6 inches
Contract merchantable factor = 10.67

Referring to the perimeter defect factor table (App. 7) in chapter 60, a 6-inch diameter deduction on a 15-inch diameter segment, has a defect factor of 11.43. This exceeds the contract merchantable factor of 10.67, so the segment is not merchantable.

22.51b - Exhibit 02

Example Merchantability Determination: Perimeter Defect, Merchantable Segment



Given:

Small end diameter = 15 inches
Weather checks average 2 inches in depth.
Diameter deduction = 4 inches
Contract merchantable factor = 10.67

Referring to the perimeter defect factor table (App. 7) in chapter 60, a 4-inch diameter reduction on a 15-inch diameter segment, has a defect factor of 8.00. This is less than the contract merchantable factor of 10.67, so the segment is merchantable. If the segment is merchantable, apply the following instructions. 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 the defect volume by 50 percent.

22.51c - Shake and Pitch Ring Defect

This section describes cull determination for single and multiple rings. The determination of the defect factor for rings is based on squaring out the ring and replacing the sound core. To determine if a segment with ring defect is cull, the following must be known.

1. Small end diameter of the segment.

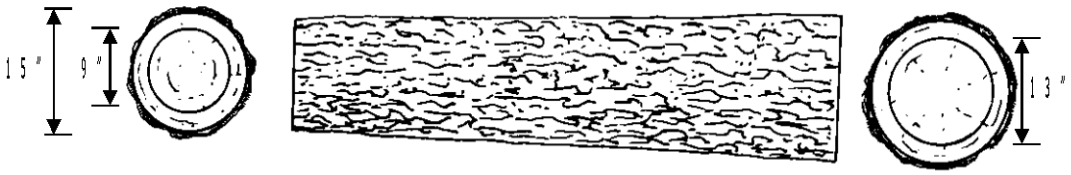
2. The average ring diameter.

3. Total ring taper.

Use the following procedures described in exhibits 01 and 02 for single rings.

22.51c - Exhibit 01

Example Merchantability Determination: Ring Defect, Cull Segment



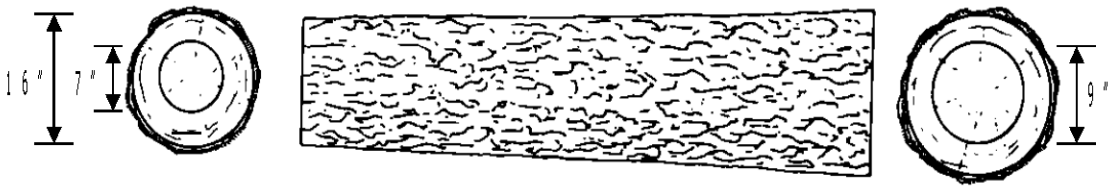
Given:

Small end diameter = 15 inches
Small end ring diameter = 9 inches
Large end ring diameter = 13 inches
Average ring diameter = 11 inches
Core (ring) diameter = 9 inches
Core taper = 4 inches
Contract merchantable factor = 10.67

Referring to the interior defect factor table (App. 6) in chapter 60, for a 15-inch diameter segment with a squared defect that averages 11 inches it shows a defect factor of 17.14. To correct for merchantable volume in the sound core, reference the shake and pitch ring correction table (App. 8) in chapter 60. Using a 9-inch small end ring diameter and a 4-inch taper, the table in Appendix 8 shows 0.73. The corrected defect factor is calculated as: 17.14 x .73 = 12.51.

The corrected defect factor of 12.51 exceeds the contract merchantable factor of 10.67 so the segment is cull.

Example Merchantability Determination: Ring Defect, Merchantable Segment



Given:

Small end diameter = 16 inches
Small end ring diameter = 7 inches
Large end ring diameter = 9 inches
Average ring diameter = 8 inches
Contract merchantable factor = 10.67

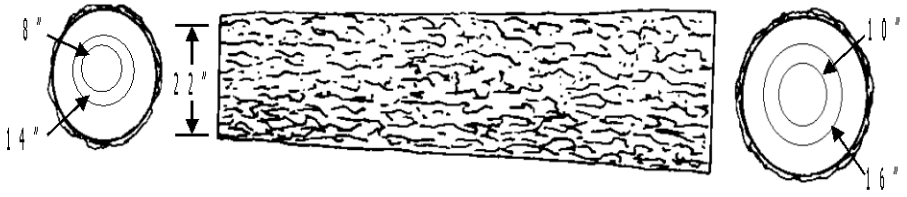
Referring to the interior defect factor table (App. 6) in chapter 60, for a 16-inch diameter segment with a squared defect that averages 8 inches it shows a defect factor of 9.00. Correction for merchantable volume in the sound core is not needed since the defect factor of 9.00 is less than the contract merchantable factor of 10.67. The segment is merchantable.

22.51d - Multiple Rings

Calculate rings more than 2.5 inches apart separately. The defect factors are added together for comparison to the contract merchantable factor.

22.51d - Exhibit 01

Example Merchantability Determination: Ring Defect, Multiple Rings More Than 2.5 Inches Apart, Cull Segment



Given:

Small end diameter = 22 inches
Small end inner ring diameter = 8 inches
Large end inner ring diameter = 10 inches
Small end outer ring diameter = 14 inches
Large end outer ring diameter = 16 inches

Calculate each ring separately.

Inner ring:

Referring to the interior defect factor table (App. 6) in chapter 60, for a 22-inch diameter segment with a squared defect that averages 9 inches it shows a defect factor of 5.33. To correct for merchantable volume in the sound core, reference the shake and pitch ring correction table (App. 8) in chapter 60. Using an 8-inch small end ring diameter and a 2-inch taper, the table in Appendix 8 shows 0.73. The corrected defect factor for the inner ring is calculated as: 5.33 x .73 = 3.89.

Outer ring:

Referring to the interior defect factor table (App. 6) in chapter 60, for a 22-inch diameter segment with a squared defect that averages 15 inches it shows a defect factor of 13.09. To correct for merchantable volume in the sound core, reference the shake and pitch ring correction table (App. 8) in chapter 60. Using a 14-inch small end ring diameter and a 2-inch taper, the table in Appendix 8 shows 0.59. The corrected defect factor for the outer ring is calculated as: 13.09 x .59 = 7.72.

22.51d - Exhibit 01--Continued

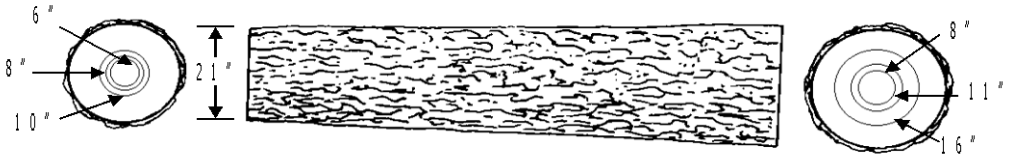
Add defect factors: 3.89 + 7.72 = 11.61. The total defect factor of 11.61 exceeds the contract merchantable factor of 10.67 so the segment is cull.

Use the procedure described in example 2 for multiple rings that are 2.5 inches or less apart.

Calculate multiple rings 2.5 inches or closer together by using the average diameter of the outer ring and replacing a core of the diameter of the inner ring on the large end.

22.51d - Exhibit 02

Example Merchantability Determination: Ring Defect, Multiple Rings 2.5 Inches or Less Apart, Merchantable Segment



Given:

Small end diameter = 21 inches
Inner ring diameters
Small end = 6 inches
Large end = 8 inches
Center ring diameters
Small end = 8 inches
Large end = 11 inches
Outer ring diameter
Small end = 10 inches
Large end = 16 inches
Average diameter of outer ring = 13 inches

Referring to the interior defect factor table (App. 6) in chapter 60 for a 21-inch diameter segment with a squared defect that averages 13 inches it shows a defect factor of 11.20. To correct for merchantable volume in the sound core, reference the shake and pitch ring correction table (App. 8) in chapter 60. Using a 6-inch core (small end diameter of the inner ring) with 10 inches of taper, (the diameter of the large end of the outer ring), the table in Appendix 8 shows 0.87. The corrected defect factor is calculated as: 11.20 x 0.87 = 9.74.

The corrected defect factor of 9.74 is less than the contract merchantable factor of 10.67 so the segment is merchantable.

22.52 - Segments with Multiple Defects

When a defective segment with more than one defect is being assessed as a cull, determine a defect factor for each defect. Add the defect factors for the segment and compare the total to the contract merchantable factor to determine if the segment is cull.

Consider the following items when determining the merchantability of logs with multiple defects:

1. The defect factors listed in the tables in chapter 60 assume the defect runs the length of the segment. When the defect does not run the length of the segment, the defect factor must be reduced proportionally.

The adjustment formula is:

$$Adjusted\ \ defect\ \ factor = \frac{defect\ \ length}{segment\ \ length}\ x\ table\ \ defect\ \ factor$$

2. The defect factors are in fact Scribner volume defect deductions converted to length cuts. Therefore, a length cut is a defect factor. For example, a length cut of 4 feet equals a defect factor of 4.00.

3. The defect factor system is based on a 16-foot segment. However, the defect factors in the tables in chapter 60 apply to segments of any length (up to the 20 foot maximum). Adjust length cuts if the segment being scaled is not 16 feet. The weighting formula is:

$$Length\ \ cut\ \ adjustment = \frac{16\ \ feet}{segment\ \ length}\ x\ length\ \ cut$$

Segments shorter than 16 feet will have a weight greater than 1.0 and segments longer than 16 feet will have a weight less than 1.0. Length factor table V in chapter 60 includes weighted factors for a range of length cuts and segment lengths.

4. The defect factors are additive. Six examples of merchantability assessment of logs with multiple defects are given below:

22.52 - Exhibit 01

Log With Multiple Defects

Given:

Small end diameter = 20 inches
Average interior defect size = 11 inches square
Interior defect length = 12 feet
Length cut for shatter = 4 feet
Contract merchantable factor = 10.67

Referring to the interior defect factor table (App. 6) in chapter 60, for a 20-inch diameter segment with a squared defect that averages 11 inches it shows a defect factor of 8.57. Since the defect does not run the length of the segment, the defect factor must be reduced proportionally. The 4-foot length cut is a factor in itself because the factor system is based on length cuts. Since the segment is 16 feet in length, the length cut is not adjusted.

$$Adjusted\ \ defect\ \ factor = \frac{defect\ \ length}{segment\ \ length}\ x\ table\ \ defect\ \ factor$$

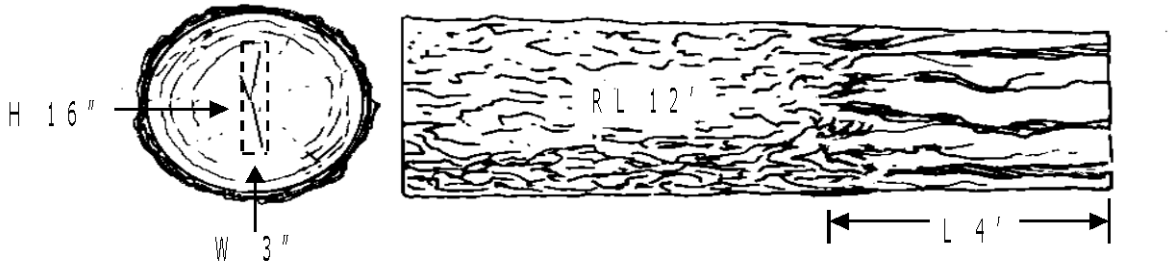
$$= \frac{12\ \ feet}{16\ \ feet}\ x\ 8.57 = 6.43$$

Length cut for shatter = 4.00
Total defect factor = 6.43 + 4.0 = 10.43

The segment is merchantable because the defect factor of 10.43 is less than the contract merchantable factor of 10.67.

22.52 - Exhibit 02

Example Log With Multiple Defects



Given:

Segment length = 12 feet
Small end diameter = 22 inches
Check dimensions = 3 inches by 16 inches by 8 feet
Length cut for shatter = 4 feet
Contract merchantable factor = 10.67

Since the segment length is not 16 feet, adjust the length cut.

$$Length\ \ cut\ \ adjustment = \frac{16}{segment\ \ length}\ x\ length\ \ cut$$

$$= \frac{16}{12}\ x\ 4 = 5.33$$

Determine an equivalent square size for the rectangular defect area to determine the defect factor.

Three inches by 16 inches equals 48 square inches. Referring to the rectangular area table (App. 9) in chapter 60, it shows a square of 7 inches. Referring to the interior defect factor table (App. 6) in chapter 60, for a 22-inch segment with a 7-inch defect size, it shows a factor of 3.39.

Since the heart check does not run the length of the segment, adjust the defect factor.

$$Adjusted\ \ defect\ \ factor = \frac{defect\ \ length}{segment\ \ length}\ x\ table\ \ defect\ \ factor$$

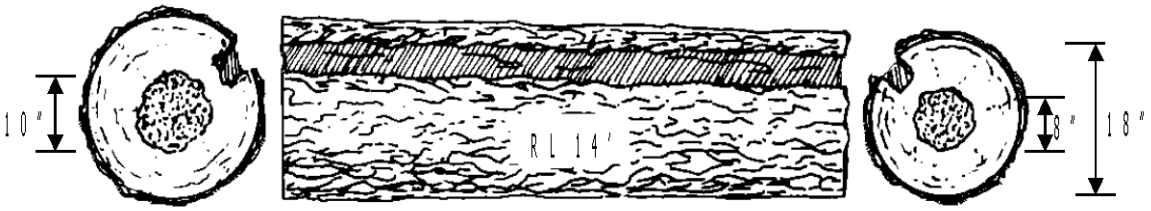
$$= \frac{8}{12}\ x\ 3.39 = 2.26$$

Total defect factor = 5.33 + 2.26 = 7.59

The segment is merchantable because the defect factor of 7.59 is less than the contract merchantable factor of 10.67.

22.52 - Exhibit 03

Example Log With Multiple Defects



Given:

Segment length = 14 feet
Small end diameter = 18 inches
Interior defect dimensions averaged = 9 inches square by 14 feet
Scar dimensions = 3 inches by 4 inches by 14 feet
Contract merchantable factor = 10.67

Referring to the interior defect table (App. 6) in chapter 60, for an 18-inch diameter segment with a squared defect that averages 9 inches it shows a defect factor of 8.38. Since both defects run the length of the segment, no adjustments to the defect factors are required.

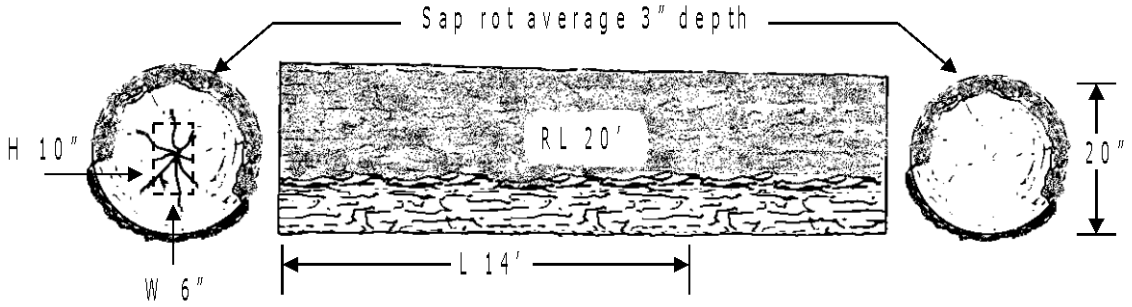
Convert the area affected by the scar to the size of a square to determine the defect factor. Referring to the rectangular area table (App. 9) in chapter 60, with a defect area of 12 square inches (3x4), it shows a square of 3 inches. Referring to the interior defect table (App. 6) in chapter 60, for a 3-inch defect and 18-inch diameter segment, it shows a factor of 1.52.

Total defect factor = 8.38 + 1.52 = 9.90

The segment is merchantable because the defect factor of 9.90 is less than the contract merchantable factor of 10.67.

22.52 - Exhibit 04

Example Log With Multiple Defects



Given:

Segment Length = 20 feet
Small end diameter = 20 inches
Sap rot = 3 inches by 20 feet
(affects 2/3 of log surface)
Spangle = 6 inches by 10 inches by 14 feet
Contract merchantable factor = 10.67

Referring to the perimeter defect factor table (App. 7) in chapter 60, for a 6-inch diameter reduction on a 20-inch segment, it shows a defect factor of 9.71. Since the sap rot affects only two-thirds of the log surface, the factor is adjusted.

Affected area adjustment = 9.71 x .67 = 6.51

Convert the area affected by the spangle to the size of a square to determine the defect factor. Referring to the rectangular area table (App. 9) in chapter 60, with a defect area of 60 square inches (6 x 10), it shows a square of 8 inches. Referring to the interior defect factor table (App. 6) in chapter 60, for an 8-inch defect and a 20-inch diameter segment, it shows a defect factor of 5.14. Since the defect affects only 14 feet of the 20-foot segment, the factor is adjusted.

$$Adjusted\ \ defect\ \ factor = \frac{defect\ \ length}{segment\ \ length}\ x\ table\ \ defect\ \ factor$$

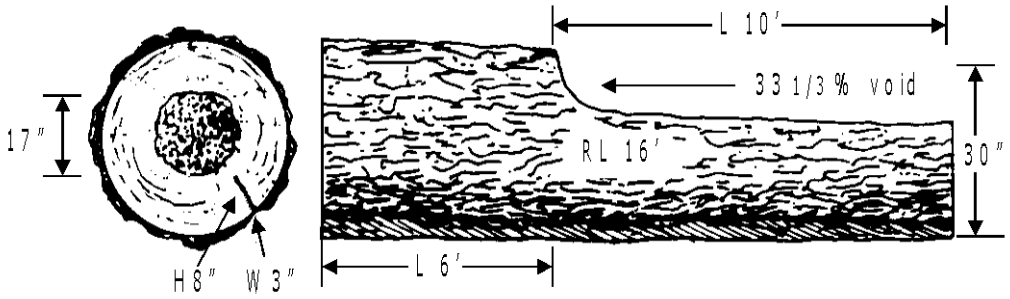
$$= \frac{14}{20}\ x\ 5.14 = 3.60$$

Total defect factor = 6.51 + 3.60 = 10.11

The segment is merchantable because the defect factor of 10.11 is less than the contract merchantable factor of 10.67.

22.52 - Exhibit 05

Example Log With Multiple Defects



Given:

Segment length = 16 feet
Small end diameter = 30 inches
Void = one-third of 10 feet
Rot = 17 inches square by 6 feet
Weather check = 3 inches by 8 inches by 16 feet
Contract merchantable factor = 10.67
Void is one third of 10 feet = 3.33

Referring to the interior defect factor table (App. 6) in chapter 60, for a 30-inch diameter segment with a squared defect that averages 17 inches it shows a defect factor of 8.48. Since the defect does not run the length of the segment, the defect factor must be reduced proportionally. The rot extends only 6 feet into the segment.

$$Adjusted\ \ defect\ \ factor = \frac{defect\ \ length}{segment\ \ length}\ x\ table\ \ defect\ \ factor$$

$$= \frac{6}{16}\ x\ 8.48 = 3.18$$

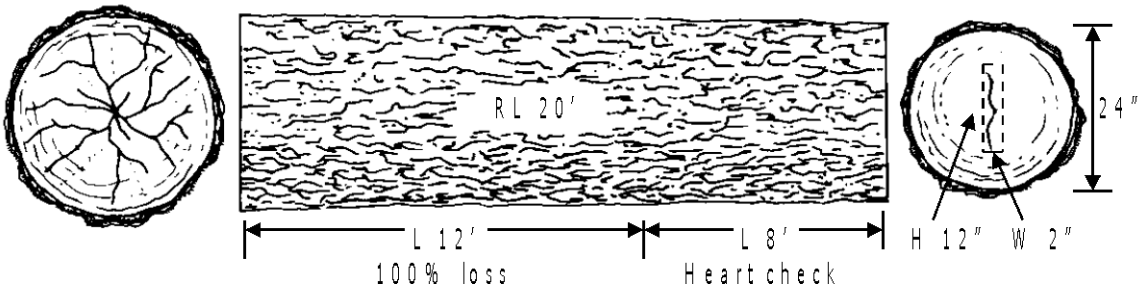
Convert the area affected by the weather check to the size of a square to determine the defect factor. Referring to the rectangular area table (App. 9) in chapter 60, with a defect area of 24 square inches (3 x 8), it shows a square of 5 inches. Referring to the interior defect factor table (App. 6) in chapter 60, for a 5-inch defect and a 30-inch diameter segment, it shows a defect factor of 0.97.

Total defect factor = 3.33 + 3.18 + 0.97 = 7.48

The segment is merchantable because the defect factor of 7.48 is less than the contract merchantable factor of 10.67.

22.52 - Exhibit 06

Example Log With Multiple Defects



Given:

Segment length = 20 feet
Small end diameter = 24 inches
Length cut for spangle = 12 feet
Heart check = 2 inches by 12 inches by 8 feet
Contract merchantable factor = 10.67

Adjust the length cut because the segment length is not 16 feet.

$$Length\ \ cut\ \ adjustment = \frac{16\ \ feet}{segment\ \ length}\ x\ length\ \ cut$$

$$= \frac{16}{20}\ x\ 12 = 9.60$$

Convert the area affected by the heart check to the size of a square to determine the defect factor. Referring to the rectangular area table IX in chapter 60, with a defect area of 24 square inches (2 x 12), it shows a square of 5 inches. Referring to the interior defect factor table VI in chapter 60, for a 5-inch defect and a 24-inch diameter segment, it shows a defect factor of 1.60. Since the defect affects only 8 feet of the 20-foot segment, the factor is adjusted.

$$Adjusted\ \ defect\ \ factor = \frac{defect\ \ length}{segment\ \ length}\ x\ table\ \ defect\ \ factor$$

$$= \frac{8}{20}\ x\ 1.60 = 0.64$$

Total defect factor = 9.60 + 0.64 = 10.24

The segment is merchantable because the defect factor of 10.24 is less than the contract merchantable factor of 10.67.

23 - Quality Control

The purpose of check scaling is to ensure uniformity and accuracy in scaling National Forest timber. Check scale as far as practicable under conditions similar to those under which the original scale was made. Wherever possible, check soon after the original scale and without the scaler's knowledge. (Refer to FSH 2409.15, sec. 24).

Regional Foresters may supplement these standards to allow for difficult scaling situations.

Normally a check scale includes at least 200 short logs (20 feet or less) or at least 100 multiple-segment logs. Sample the species and defect situation as fairly as possible. Individually analyze more complex scaling situations and increase the number of logs check scaled if necessary.

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

1. Gross Scale. A variance of one percent in gross scale is the standard unless otherwise justified.

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

Check scaler's percent defect in logs	Scalers allowable variance
0-10 percent	2 percent
over 10 percent	.2 x percent defect to a maximum of 5 percent