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BY EMAIL

To: Regional Executive Directors

Re: Revision to the *Scaling Manual*

I hereby approve this revision to the *Scaling Manual* and attach a link to the *Scaling Manual* for your use: <http://www.for.gov.bc.ca/hva/manuals/scaling.htm>

This revision provides an update to the manual as follows:

- Links to other publications were updated.
- New method for calculating Sweep Chapter 8, Section 8.6.9
- Updated Chapter 9, Section 9.2.2 and Section 9.5.4
- Changed formatting on Section 14.4.2.2
- Updated forms in Chapter 11 and Chapter 15



The business process remains the same.

This revision is effective the date of this memo. Further amendments or revisions to this manual require my approval.

Murray Stech
Director
Revenue Branch

Attachment

pc: Coast Scaling Advisory Committee
Interior Scaling Advisory Committee

<p>FOR FURTHER INFORMATION OR IF YOU HAVE A CHANGE OF ADDRESS, PLEASE CONTACT:</p> <p>Steve Laberge Technical Scaling Co-ordinator Revenue Branch Ministry of Forests 1st Floor – 1520 Blanshard Street Victoria, BC V8W 3C8 Phone: 356-7673 PROFS userid: Steve.Laberge@gov.bc.ca FAX: 387-5670</p>	MANUAL TITLE	
	Scaling Manual	
	AMENDMENT Amendment No. 1	ISSUE DATE July 1, 2008
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	Judy Laton Manuals Co-ordinator	
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	Murray Stech Director, Revenue Branch	

Please make the following changes to your copy of the above Ministry manual.

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For those who may still wish to purchase a hard copy of the Scaling Manual, it is available for a fee through:

<p>Crown Publication 106 Ontario Street Victoria, BC V8V 1M9 1-877-747-4636 (Toll Free)</p>
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You can also get Scaling Manual information from the Crown Publications, General Publications page:

[Crown Publications](#)

Manual Amendments

The forum to discuss changes will continue to be **Interior Scaling Advisory Committee and the Coast Scaling Advisory Committee** via meetings and conference calls. The preferred protocol with a three month lapse is:

- issue draft amendments,
- organize conference calls with committee or sub-committee to elaborate on assessment,
- ask for written submissions, and
- host committee meeting and finalize.

Future amendments to this manual can be printed from the Internet or purchased from Crown Publications.

Check out the Ministry of Forests “What’s New” page for upcoming amendments and new publication information at:

[What’s New?](#)

This information can also be found in the Scaling Manuals Table of Contents at:

[Scaling Manual](#)

Some of the Elements of Scaling



*Hammer indenting a log
with a timber mark.*



*An interior scaler entering
data into a handheld
computer.*



A loaded truck on a weight scale.



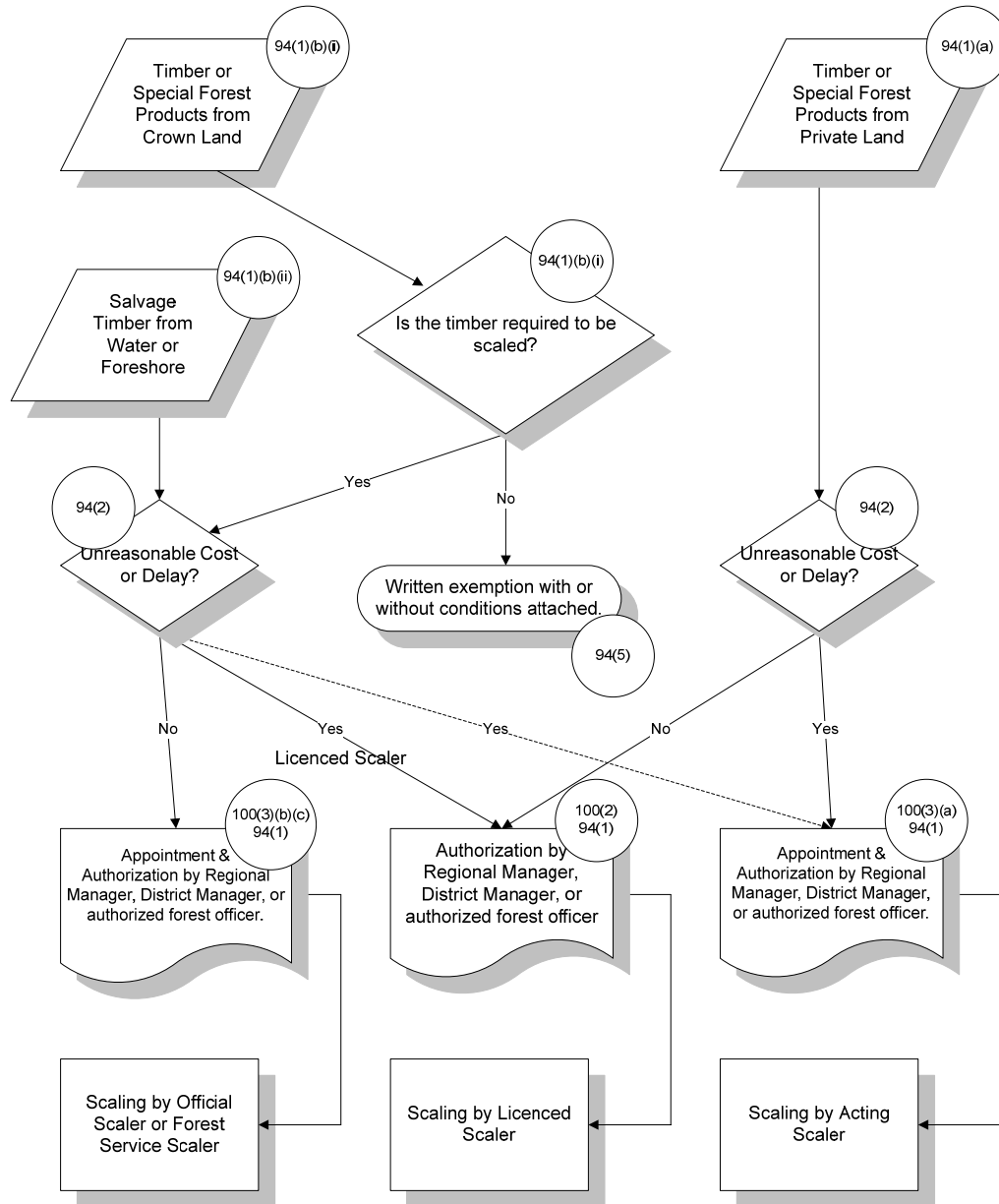
A defective log on a scale site.



A coastal dryland sort.

1.4 Who Can Scale?

This schematic further defines who may be authorized to scale under various circumstances under *Forest Act* subsection 94(1) and 94(2).



The intent underlying subsection 94(1) and 94(2) is to ensure that Crown timber is scaled by the most competent and qualified scaler available.

1.5 Scaling Requirements in British Columbia

If you are going to apply for a timber sale licence, cutting permit or some other licence to harvest Crown timber or harvest timber on private land, it is important that you understand some of the basic scaling requirements in advance.

The following link will take you to the MOFR Revenue Homepage **to an information paper** which explains:

[Scaling Requirements in British Columbia](#)

Record the number 4, not 4, to distinguish it from a 9.

2.1.5 Types of Marks

There are two major types of marks:

- those from Provincial Crown and tenures and Federal Crown reserves,
- those from private and federal lands.

For more information on timber tenures and private marks please go to the Resource Tenures and Engineering Branch website at:

[Tenures and Timber Marks](#)

For a comprehensive list of timber mark types please go to the link below:

[Timber Mark File Types](#)

2.1.5.1 Major Types of Timber Marks

2.1.5.1.1 Forest Licences and Timber Sale Harvesting Licences

Where more than twenty-six (26) cutting permits will be issued, a “mark designate” is assigned; otherwise the mark follows the format of timber sale licences. These designates consist of two letters and a number followed by **three alphanumeric characters**. An example of this is for forest licence A15429, the mark designate is always EK1 followed by three **characters** denoting the applicable cutting permit,

- recorded as EK1123.

2.1.5.1.2 Tree Farm Licence

Tree farm licence marks will appear in a broken circle or broken triangle where the top **two numerals** designates the **tree farm** licence number and the bottom **set of numbers** designates the cutting permit. These marks are recorded with a slash (/) after the two numbers on top,

- recorded as 23/229.

2.1.5.1.3 Timber Sale Licences

Timber sale licences are all issued in the “A” series, which is the letter A followed by five numbers, often with a letter following denoting the cutting permit if no CP designate is assigned. If no cutting permit is required, the mark for licence A12345 would be recorded as: 12345 and the mark for licence X 12345 would be recorded as: <12345. Where cutting permits are required, the designate is attached to the end of the mark,

- recorded as 12345(B).

Other types of timber sale licences can be encountered, but in general they all follow the above format for recording on the tally sheet.

2.1.5.1.4 Timber Licences

Timber licences most often appear as a T and four numbers, for example, T1234. If a timber licence agreement includes a cutting permit, it will have the cutting permit in the form of a letter (the designate). **The designate is the first alpha numeric character, so in this context it would be T1234, then followed by the cutting permit identifier, which could be a single letter** that is to be recorded at the end,

- Recorded as T1234(A).

Since June 2007, a change has occurred in how new timber marks are created for Timber Licences and Woodlot Licences. The new format is TNNNAK where:

- T - represents the file type Timber Licence.
- NNN - 3 alpha numeric mark designate. This is system generated.
- AK - CP identifier supplies by the client. Sometimes this is a single character (the letters I or O cannot be used) and if this is a single character the system will 'pad' it with a zero in front of the cutting permit letter designate.

These new marks can be all alpha characters which is similar to private marks so care much be taken to identify the type of mark that is being recorded.

2.1.5.1.5 Woodlot Licence

Farm Woodlot licences issued under the old *Forest Act* use "FW" on the mark with the number of the woodlot appearing below. Woodlot licences under the present *Forest Act* use a licence number in the "WL" series, and are phasing into the "WO" ([W][Zero]) series. Generally, marks relating to woodlots are recorded as they appear on the log. However, because several changes have been made over the past few years, the mark may appear with the cut permit indicator in the middle. **The marks for Woodlot licences are also systems generated and behave the same way as for a timber licence. There are four alpha characters for the designate, always starting with 'W' and the client supplies the cutting permit identifier which can be a letter or number, but most often a letter. If a single letter is provided by the client the system will 'pad' the identifier with a zero in front of the letter.**

2.1.5.1.6 Occupant Licence to Cut

Licences to cut begin with an “L” followed by five numbers as in L12345. Older licences have two letters followed by three numbers. The first letter is always “Y” and the next letter indicates the region of origin as follows: YC & YW are Williams Lake, YV is Vancouver, YK is Kamloops, YR is Prince Rupert, YN is Nelson, and YG, YH, YE, YD, and YF are all Prince George Forest Region. Some of these historical marks are still in use and so, use historical region codes. This series appears on a hammer mark with the two letters over top of the numbers,

- recorded as YC12345.

2.1.5.1.7 Cash Sale Licences

Cash sale licences are always a “D” or an “A” followed by five numbers. Cash sale timber is “prepaid” and further scaling is not required. Cash sale timber can be scaled for operational needs but returns are not usually required to be submitted. The scaler should confirm the local requirement with the forest district,

- recorded as D12345.

2.1.5.1.8 First Nations Reserves

Timber from First Nations Reserves carries a mark with ID, IN, or IR followed by one, two or three numbers. Z has also been used historically,

- recorded as IR123.

2.1.5.1.9 Road Permits and Rights-of-Way

Old style road permits are assigned with an R, followed by five numbers, the first of which is very commonly zero. **This zero** must not be recorded as the letter O [Ø],

New style road permit marks are associated to all over arching licences. That would be any licence that allows for cutting permits and has a mark designate. The configuration of the road permit mark is the same as for a cutting permit, it is the **licence designate followed by three alpha numeric fields (OR1 – zero, the letter R and a number) depending on how many road marks are required for that licence. One road permit can have many marks. In most instances that will only be one permit of a licence. However, since rates vary between districts, if a licence crosses district boundaries there will be more than one road permit,**

- **old style** recorded as R01234,
- **new style** recorded as BC50R1.

2.1.5.1.10 Christmas Tree Permit

Christmas trees are not normally marked individually with a registered mark because of their small size; rather those in possession of Christmas trees will always carry a copy of their permit, and prominently display the permit number on bundles of trees in transport. The Christmas tree permit begins with the letter C followed by five numbers,

- recorded as C12345.

2.1.5.1.11 Watershed Agreements

Watershed agreement marks all begin with WS and a number, followed by the number of the cutting permit attached to the agreement. For example, the agreement number “1” with a cutting permit number 6,

- recorded as WS1006.

2.1.5.1.12 Free Use Permit

Free use permits, though uncommon, are issued for a number of purposes. Administratively, they are like a cash sale, where the Forest Service determines the volume of timber to be harvested prior to the harvest taking place, and the applicant pays for it at the time of making the application. As with Cash Sales, the scaler should check with the local district staff to determine the scale submission requirements,

- recorded as FUP1234.

2.1.5.1.13 Master Licence to Cut

Master Licences to Cut are administered by the Oil and Gas Commission. These are issued when there is a legal right to occupy Crown land but not to harvest the timber. Some of these circumstances are roads for geophysical exploration, development of well sites or pipelines, mines or oil pits. They are consecutively numbered and consist of three letters and three numbers below the letters,

- recorded as ABC123.

Designates are the Cutting Permit that is attached to a timber mark, usually as the last character of the mark. It is used when the area of the Timber Mark is such that Cutting Permits are needed to designate the area that particular timber is cut from.

2.1.5.1.14 Community Forest Licence

Community Forest Licences all begin with a K, followed by a number, followed by a letter, followed by the cutting permit,

- recorded as K2P100.

2.1.5.2 Marks for Privately Owned Land

2.1.5.2.1 Crown Grant – Exportable and Non-Exportable

Some older exportable marks incorporating combinations of number, letters and special characters are still in use. The most common is two letters followed by three numbers. Recently issued exportable marks issued begin with an E followed by four letters. For older marks, the scaler would expect to see such combinations as AA123, A12 (with crescent or bar) and 1A1 (with crescent) and for newer marks, EABCD. Recently issued non-exportable marks begin with an N followed by four letters and appear as NABCD. Older marks would appear with number and letter combinations such as AZ009, A1, A99, 99A (with crescent beneath) and 99AA. An “H”, followed with the letter H, M, N, P, Q, S, T or Z and three numbers,

- recorded as HS123 or 99A’.

2.1.5.2.2 Letter of Marking Authority – Exportable and Non-Exportable

This is an historic timber mark and has not been issued since 1996. Letters of marking authority are issued to identify minor quantities of logs removed from private lands alienated prior to March 12, 1906. This mark is a series of six letters; the first letter is “L”, indicating that it is a letter of marking authority, and the second letter is “E”, indicating that it is exportable. The following four letters refer to a specific authority. Non-exportable letters of marking authority are the same as the exportable marks except the second letter is an [N], indicating that it is non-exportable. The marks would appear on logs as LNA over BCD,

- recorded as LNABCD as LEABCD.

Exportable timber marks are subject to Federal controls, while non-exportable timber marks are subject to provincial controls. Information on the exportability of timber is available at:

[Economics and Trades Branch](#)

2.2 Log Brands

2.2.1 Scaled Timber Brands

2.2.1.1 Authority

Part 5 of the *Forest Act* provides that:

- timber that has been scaled and will be transported from its place of scaling must first be conspicuously marked with the scaled timber brand which pertains to that scale site,
- the ministry may exempt scaled timber from this requirement where warranted,
- no person shall remove, obliterate, or alter a brand that has been applied to timber,
- the ministry upon application may issue a certificate describing a scaled timber brand upon application of the scale site operator, and may attach conditions concerning use of the brand, and
- the ministry may cancel a scaled timber brand.

It is an offence under the *Forest Act* to fail to apply a scaled timber brand as required or to remove, alter or obliterate a brand that has been applied to timber.

2.2.1.2 Purpose

Scaled timber brands are used to indicate:

- that timber has been scaled,
- where the timber was scaled, and
- the forest district where it was scaled.

Timber consumption patterns see thousands of truckloads of timber being transported around the province each year in both scaled and unscaled forms. The scaled timber brand and load documentation as required by the Forest Service helps ensure all timber is scaled and that scaled timber is not scaled twice.

2.2.1.3 Marking Requirements

Unless exempted by the Ministry of Forests and Range, scale sites may not ship scaled timber from a scale site unless they have been issued a scaled timber brand and that brand is applied to the outgoing timber.

Brands are non-transferable and may not be used except with the written consent of the certificate holder.

The responsibility for physical application of the brand falls jointly upon the holder of the certificate and any person using the brand with the consent of the holder (employees, log truck drivers, etc.). The brand *cannot* be applied to any timber that has not been scaled. Application of a brand to unscaled timber may result in charges under the *Criminal Code of Canada*.

Timber branding information is contained in the [Timber Marking and Transportation Regulation](#).

2.2.2 Requirements of Scalers and Timber Weighers

Scaler's may not assume that timber delivered to a scale site has been previously scaled unless it meets the branding requirements and is accompanied with other supporting documentation as may be required such as the FS 649 Load Description Slip. Where doubt exists as to the scaled status of delivered timber, the scaler or weigh person should place the timber in a secure storage area and contact the local Forest Service office as soon as possible.

2.2.2.1 Format of Scaled Timber Brands

A separate scaled timber brand certificate may be issued for each authorized scale site. The format of the brand is a three character alpha code representing the forest district in which the timber is scaled, and a three or four character alpha-numeric code identifying the scale site where the timber was scaled. Please refer to the map which details Forest Regions and Districts at the website:

[Region and District Map](#)

2.2.2.2 Applying for a Scaled Timber Brand (FS 1308)

Applications for Scale Sites and Scaled Timber Brands and Timber Brand Certificates are available on the [Public Forms Index](#).

2.3 Marine Log Brands

2.3.1 Authority

The *Forest Act* provides for issuing marine log brands on receipt of an application. The Forest Service issues a certificate which describes the marine log brand. Marine log brands are registered by the Registrar of Timber Marks and any given marine log brand will not resemble any other registered log brand.

Marine log brands differ from scaled timber brands in several ways:

- they are meant for timber which will be transported in the ocean,
- their use is optional (unless their use is conditional upon an exemption to using a scaled timber brand),
- they do not indicate where they were scaled,
- there are relatively few marine log brands (less than 50 and generally only one per licensee), and
- marine log brands denote ownership.

2.3.2 Purpose

Like scaled timber brands, marine log brands are taken as proof that timber has been scaled.

The main purpose of a brand is to allow the owner to identify and recover timber lost and subsequently salvaged in the coastal waters.

2.3.3 Marking Requirements

Marine log brands may be applied to timber only after it has been marked with a registered timber mark and scaled. Refer to the [Timber Marking and Transportation Regulation](#) for more information.

2.3.4 Requirements of Scalers

Where beachcombed logs are scaled, a marine log brand takes precedence over any other marks or brands on a log. The scaler must record the marine log brand as the timber mark.

2.3.5 Format of Marine Log Brands

Marine log brands are from one to four letters, often stylized as shown, such as A, AB, ABC, or RC:

A stylized, cursive script representation of the letters 'RC'. The 'R' is large and ornate, with a long, sweeping tail that loops around the 'C'. The 'C' is also stylized, with a thick, curved body and a small, decorative flourish at the top.

2.3.6 Applying for a Marine Log Brand

Persons applying for a marine log brand must complete an application in the form required by the Minister. The application must include a prescribed fee as well as a facsimile of the marine log brand applied for.

Upon confirming the proposed marine log brand does not resemble any other registered log brands, the Registrar of Timber Marks may issue a certificate which describes the marine log brand.

2.4 Log Salvage Identification Marks

2.4.1 Authority

The *Forest Act* also provides for establishing log salvage districts. Within the log salvage district a licence may be granted to operate a receiving station. Permits may also be granted to persons wishing to salvage logs.

In a log salvage district, all logs recovered by log salvors (permit holders) must be returned to the log salvage receiving station.

2.4.2 Purpose

Log salvage identification marks are issued to log salvage permit holders. This mark denotes that the log on which it appears was, at one time, in the possession of the permittee (log salvor).

2.4.3 Marking Requirements

Salvors must hammer indent the mark on the ends of logs as soon as they take possession of the log.

2.4.4 Format of Log Salvage Identification Marks

Log salvage marks are always one to four numbers enclosed in a diamond and are read starting from the top going counter clockwise.



calculation method is described in both the *Gross Measurements Procedures* and in the *Defects and Conventions Chapters* of this manual.

3.2.3 Mechanical Defects

Regardless of how efficiently or carefully the logging process is conducted, it will result in some damage to timber when they are felled, bucked, transported, and handled by various mechanical devices. In many instances, this damage may result in a considerable loss of firm wood and the scaler must be able to recognize and make proper allowances for the various types of mechanical defects. Log storage over long periods can cause defects. An example of this is sap rot in dryland decks and toredo borings in log booms on the water.

It is important to perform a scale as soon as possible after harvesting to avoid the problems of determining whether defects are natural or induced by storage. Normally, damage to timber after delivery to the scale site is not accounted for. It is necessary for the scaler to contact the Forest Service scaling representative for instruction on the correct approach to take in each situation.

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Smalian's Formula

4

4.1 Smalian's Formula

From the inception of cubic scaling the Smalian formula, which calculates logs on the basis of a parabolic frustum, was adopted as the cubic scale rule. This scale requires measurement of the two inside bark diameters and the length.



$$V = \frac{A_1 + A_2}{2} \times L$$

where: **V** is the volume of the log in m³.

A₁ is the area of the small end of the log in m².

A₂ is the area of the large end of the log in m².

L is the length of the log in m.

Figure 4.1 The Smalian Formula.

Smalian's formula states that the volume of a log can be closely estimated by multiplying the average of the areas of the two log ends by the log's length. The units used for the areas and the length must be the same, (e.g., square metres and metres in British Columbia), in order to arrive at the volume in cubic metres.

4.1.1 Smalian's Formula in Detail

Smalian's formula uses the formula for the area of a circle to find A_1 (area of the top end in m²) and A_2 (area of the butt end in m²):

$$A_1 = \frac{\pi T^2}{10000}, \text{ and}$$

$$A_2 = \frac{\pi B^2}{10000}$$

Fully expressed, Smalian's formula becomes:

$$V = \frac{\frac{\pi T^2}{10000} + \frac{\pi B^2}{10000}}{2} L$$

where:

- V = volume of the log in cubic metres,
- π = 3.141 592 (to 7 significant figures or 6 decimal places),
- T = radius of the small end in centimetres (or the diameter in rads as illustrated in Figure 4.5),
- B = radius of the large end in centimetres (or the diameter in rads as illustrated in Figure 4.5), and
- L = length of the log in metres as shown in Figure 4.5.

(Division of the top and butt areas by 10 000 converts square centimetres to square metres. Division of the sum of the top and butt areas by 2 determines the average end area.)

4.2 Log Forms and the Formula

A tree tapers from the base to the tip but the rate of taper is not uniform throughout all parts of the stem. Logs approach the form of truncated cones, neiloids, paraboloids, and occasionally, cylinders. These truncated sections, illustrated in Figure 4.2, are referred to as frustums of the geometric figure they resemble. The scaler can identify the log shapes by noting the position of the average of the diameter at both ends. If the average diameter occurs exactly equidistant from both ends the log form is conoid. If the average diameter is found in the butt half, the form is neiloid, and if in the upper half, the form is **parabolic**.

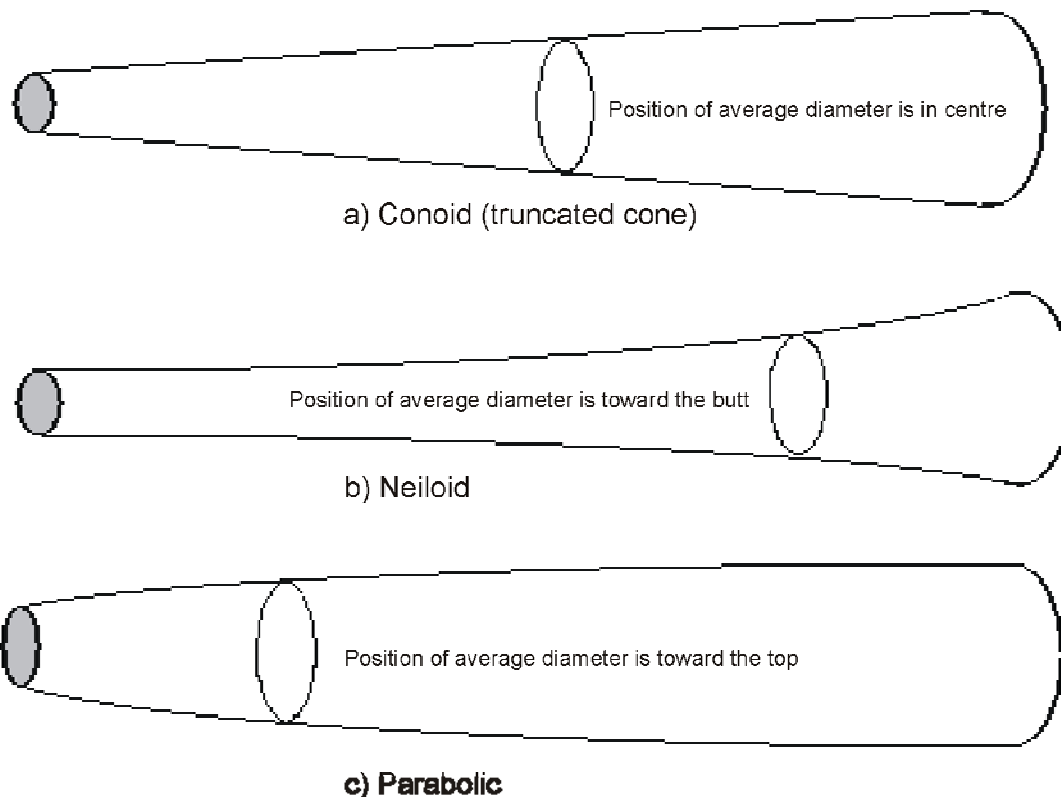


Figure 4.2 Depictions of Three Typical Log Forms.

Smalian's formula arrives at average area by averaging the areas of the top and butt ends of a log. The Smalian formula is the official log scaling rule for the Province of British Columbia because it is practical and works well where logs are bucked prior to scaling.

The effect of bucking is to reduce taper, and experience has shown that where the difference between the top and butt diameters exceeds 30 percent, (where the butt diameter exceeds 150 percent of the top diameter) the use of Smalian's formula is not an accurate reflection of log volume. This is demonstrated in Figure 4.3, where a one cubic metre cylinder is gradually reduced in diameter at one end, becoming a cone, which has a volume of 0.333 m^3 . Calculated with Smalian's formula, the volume is overstated as

4.2.2 Smalian's Formula - Simplified

The fully expressed Smalian's formula described in Section 4.2. contains three constants; " π ", 10 000, and "2". For field use, the formula may be simplified by reducing these constants to one constant, expressed as "C". Smalian's formula is:

$$V = \frac{\pi(T^2 + B^2)}{\frac{10000}{2}} = L$$

By rearranging the terms to consolidate the constants, the formula becomes:



$$V = \left(T^2 + B^2 \right) \frac{\pi}{\frac{10000}{2}} L = 0.0001570796$$

The value of "C" is therefore:



$$C = \frac{\pi}{\frac{10000}{2}} = \frac{3.141592}{\frac{10000}{2}}$$

$$C = 0.0001570796$$

Using the constant "C" provides for Smalian's simplified formula:

$$V = (T^2 + B^2) \times L \times C$$

where: V = the volume of the log in cubic metres,

T = the top radius in centimetres (or the diameter in rads),

B = the butt radius in centimetres (or the diameter in rads),

L = the length in metres, and

C = 0.0001570796 (the constant).

4.2.3 Smalian's Simple Formula - Example Calculation

Using the simplified Smalian's field formula developed in Section 4.2.2 and substituting the log dimensions from Figure 4.5 into the formula, the volume of the log may be calculated in fewer steps than with the long formula demonstrated in Section 4.2.1. Many pocket calculators will not carry this number of decimals, so one may use 1.570796 and divide by 10000 after multiplication.

$$\begin{aligned}
 V &= (T^2 + B^2) \times L \times C \\
 V &= (09^2 + 11^2) \times 9.0 \times 0.0001570796 \\
 V &= (81 + 121) \times 9.0 \times 0.0001570796 \\
 V &= 202 \times 9.0 \times 0.0001570796 \\
 V &= 1818 \times 0.0001570796 \\
 V &= 0.28557071
 \end{aligned}$$

Round the volume of the log to 3 decimal places:

$$\text{Volume} = 0.286 \text{ m}^3$$

4.2.4 The Application of Smalian's Formula

Most scalers derive log volumes from computer software, from the BC Metric Scale Stick, or from the FS 546 Table of the Half Volume of Cylinders in Cubic Decimetres. All of these methods, while still based upon Smalian's formula, save unnecessary arithmetic but scalers must know and be able to use the formula in situations where these tools are not available.

Scalers must be able to demonstrate their knowledge and comprehension of the principles underlying scaling by stating the full version of Smalian's formula and by calculating volumes with either the full or simplified version on the written portion of the Licenced Scaler's Exam.

All persons designing software for scaling purposes must employ Smalian's formula and have the software approved by the Ministry of Forests and Range. Information on approval procedures can be obtained from a regional office of the Forest Service or at:

[MOFR Public Website](#)

5.2 The BC Metric Scale Stick

The BC Metric Scale stick is the fundamental scaling tool. It is used to measure log diameters and lengths; and to calculate volumes and defect deductions. The stick is manufactured in three lengths; 1 m, 1.5 m, and 2 m. The handles of the 1 m and the 1.5 m sticks are in addition to the stick length, whereas the handle is included in the length of the 2 m stick. Scale sticks are also manufactured in left or right handed styles, in a version which is somewhat slimmer than standard sticks, and with a "spud" attached, similar to the American Scribner stick. This spud is used to break out wedges of wood from log ends and knots so they may be examined for rot.

Equipped only with a metric scale stick, an approved tally sheet and a pencil, the licensed scaler can perform the official scale. The stick will allow the scaler to measure log diameters and lengths, slab widths and thicknesses, defect dimensions, knot sizes and twist and to calculate the gross log volume, the defect volume and the net volume and/or net dimensions and grade. It is the principle piece of scaling equipment.

5.2.1 Application of the Scale Stick to Measure Diameters

Smalian's Formula requires a log's top and butt radii and length to calculate a volume. The scale stick is graduated in 2 cm increments called "radius class units" or rads. This design allows the scaler to measure and express a log's diameters in rads and as well as expressing the radii in centimetres. Therefore, in measuring a round object:

A diameter in rads is equal to the radius in centimetres.

5.2.2 Application of the Scale Stick to Measure Widths and Thicknesses

The scale stick is designed primarily for measuring diameters and calculating the volumes of round logs by giving the radius in centimetres. Widths and thickness of three and four sided slabs are also measured in rads but the mathematical correlation is different because radii are not involved. For example, a slab measuring 10 rads by 10 rads represents a width and thickness of 20 cm by 20 cm, not a radius of 10 cm. To avoid conversion of rads to centimetres for finding volumes, factors are applied, and the slab measurement section (Chapter 6) describes the application and use of these factors.

5.2.3 The Application of the Scale Stick to Measure Lengths

The scale stick may also be used for measuring length. Starting from the tine of the stick, lengths are graduated in 0.1 m (1 dm) increments. Odd decimetres are marked with a red line at the exact increment and even decimetres are indicated by red numbers which are offset from the exact increment.

5.2.4 The Application of the Scale Stick for Unit Volumes

Reference to unit volumes and average unit volumes are made throughout this manual. A unit volume is the volume of a 1 m length of one end of a log in cubic decimetres per metre, and an average unit volume is the average of the unit volumes of both ends of a log. They are directly proportional to end areas of a log; the end area in square decimetres is always 1/10 of the unit volume. Unit volumes are provided on the scale stick to calculate gross volumes, defect volumes, and net volumes.

5.2.5 The Application of the Scale Stick for Half Volumes

References to half volumes are made throughout this chapter. They are simply the expression of the volume, in cubic decimetres, of a log or slab of any given length for one-half of its length. Half volumes are provided on the scale stick to allow the calculation of a volume by simply adding the half volumes from each end of a log, rather than calculating a full volume for each end and dividing by two.

Figures 5.1 through 5.8 on the following pages illustrate the parts and use of the scale stick.

The approved BC Metric Scale stick specifications are documented  at the end of this chapter.

6.1 Measurements

6.1.1 Units of Measure

The legal units of measurement for scaling in British Columbia have been based upon the International System of Units (SI) since the late 1970s. The SI system is commonly referred to as the Metric System.

The units of measure used fall into two general categories:

1. Base units are those measurements actually taken such as length, radius, diameters, width, thickness, and mass or weight:
 - the metre and the decimetre are used for lengths,
 - the centimetre is used for radius, widths and thicknesses,
 - the radius class unit or "rad" (equal to 2 cm) is used for diameters, widths and thicknesses,
 - the kilogram and tonne are used for mass (see the chapter on *Weight Scaling*), and
 - whole number units are used for piece counts (i.e., 527 Christmas trees - see the *Special Forest Products* chapter).
2. Derived units (those units calculated from the base units such as cubic metres):
 - the cubic metre, cubic decimetre and the stacked cubic metre are used for volumes,
 - the square metre and square decimetre are used for areas, and
 - the weight scale ratio is expressed in cubic metres per tonne.

6.1.2 The British Columbia Metric Scale

In British Columbia the official scale rule for purposes of scaling under the *Forest Act* is the British Columbia Metric Scale. This scale rule uses Smalian's formula to calculate the volumes of individual logs. The net firwood volumes, expressed in cubic metres, are recorded.

6.1.3 Errors in Measurement

No measurement is exact. It instead represents a range within which the true value lies. The graduations used in scaling, such as the "radius class unit" or rad, allow any measurement falling within a range of 2 cm to qualify as a single unit. Similarly, length measurements allow any measurement falling within a range of plus or minus 0.1 m to be recorded as a single unit. These divisions are established to allow rapid measurement and

to reduce errors. Standardized units, methods and conventions, combined with good training and reliable tools also contribute to acceptable error levels.

Errors can be classified into four kinds:

Mistakes	Mistakes can include incorrect use of an instrument, recording errors, and calculation errors. Large mistakes are detected by systematic checking of all work and may be corrected by redoing part or all of a job. Small mistakes can be very difficult to detect, because they merge with other types of errors. Good practice is needed to minimize mistakes.
Compensating (accidental) Errors	These errors are due to the nature of the object being measured, variable environmental conditions, limitations in instruments, and dependence on assumptions. Positive errors will, on average, be balanced by negative error.
Systematic Errors (bias)	These errors are recurring, relatively constant, and are not compensating. Bias may be caused by faulty equipment, technique, subjectivity, and dependence on erroneous assumptions.
Sampling Errors	These errors are due to faulty sample design including poor estimates. The magnitude of error can be estimated from the variance of the population and the sample size, and can be reduced, or rendered largely self-compensating, by adhering to an objective sampling approach.

6.2 Measuring Log Dimensions

Following consistent and recognized procedures for measuring log diameters and lengths is one of the most rigorous tasks of the scaler. It is important to develop identical ways of taking measurements throughout the province so that meaningful data is provided for users on an equitable basis. The scaling procedures are defined in the *Scaling Regulation* and this section explains those procedures.

Where this chapter describes the measurements required for the determination of volume, the chapter on *Timber Grading* contains more information about measuring logs or slabs for the determination of grade, also defined in the *Scaling Regulation*.

6.2.1 Measuring Log Diameters

The objective of measuring log diameters is to record the single rad class that most closely represents the end area of a log, while avoiding excessive measurement. With the use of a BC Metric Scale Stick, radii for the purpose of volume calculations are found by:

- measuring, in rads, across the diameter, along a plane perpendicular to the longitudinal axis, inside the bark of each end,
- if a log has an elliptical or oval (egg shaped) cross section measuring two diameters at right angles to one another, through both the short and long axis of each end, averaging the diameter measurements, and rounding the result to the nearest even number where the averaged measurement falls exactly half-way between two radius classes,
- if a log has an irregular cross section determining the approximate area of the cross section by measuring two or more axes of the cross section and determining the radius of a circle with an equivalent area, and
- recording the rounded, average measurement. This measurement, if expressed as a diameter in rads, is the same as the radius in centimetres.

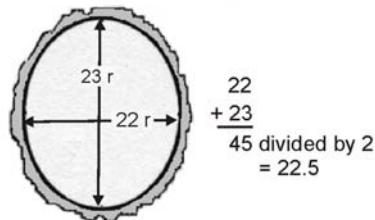
6.2.1.1 Measuring Round and Out of Round Log Ends

Figure 6.1 shows where measurements are taken on elliptical and oval logs and how they are averaged.

Diameter measurements are taken through the **geometric centre** rather than the growth ring centre. The **geometric centre** is found by first measuring at the widest point of the short axis and then measuring the long axis at right angles to the short axis.

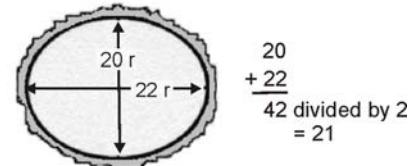
Voids or abnormal protuberances are not considered when measuring diameters. Voids are accounted for in firmwood deductions as holes or missing wood and protuberances are outside of the normal line of taper. Abnormal protuberances occur when logs are bucked through a knot, burl, or goitre.

1. Ellipse



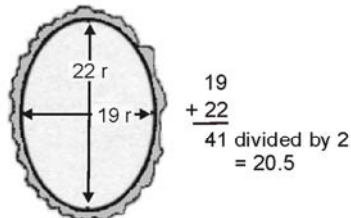
Record as 22 rads

2. Ellipse



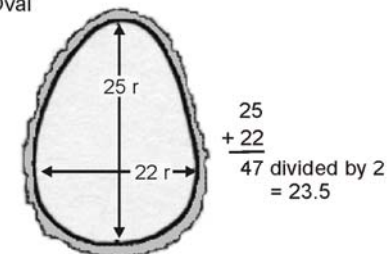
Record as 21 rads

3. Ellipse



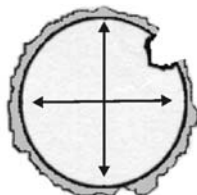
Record as 20 rads

4. Oval



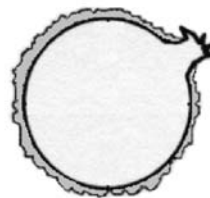
Record as 24 rads

5. Gouge (eg. Splinter)



Do not measure in voids

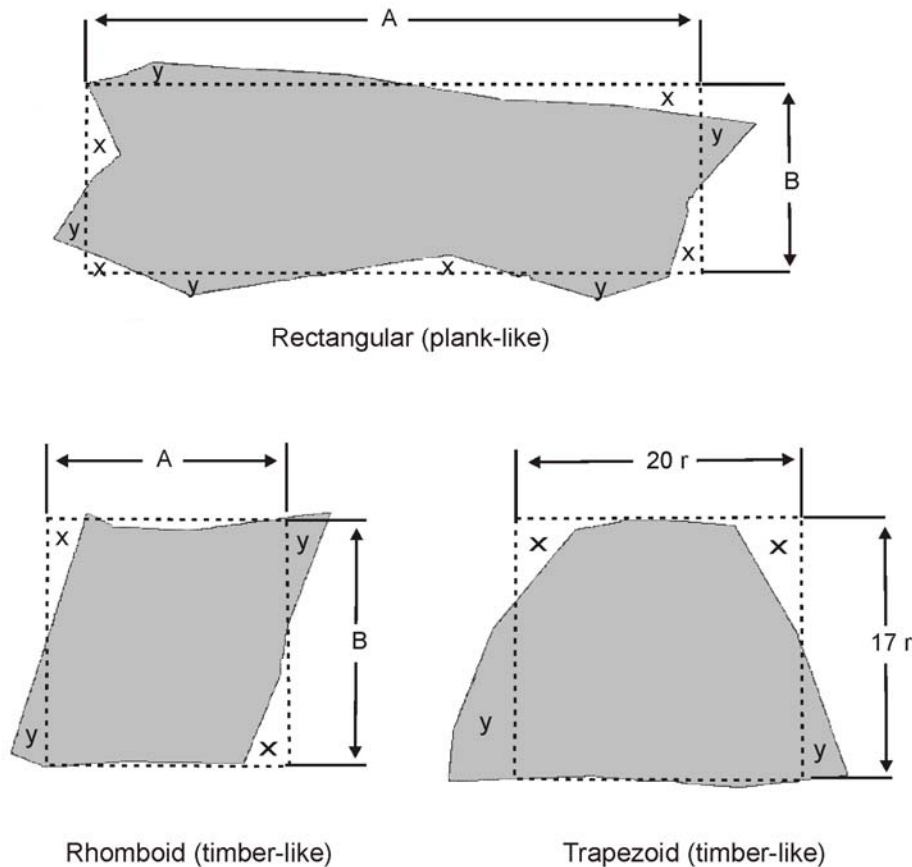
6. Lump (eg. Knot)



Do not measure abnormal protuberances

Figure 6.1 The Method for Measuring and Averaging Diameters.

Figure 6.20 depicts such slab ends. As suggested in the diagram, the width and thickness measurements are taken so that the voids (areas x) balance the protuberances (areas y). Of the quadrilateral shapes, they can be more or less square, rectangular (plank-like), trapezoid, or rhomboid (timber-like). The measurements are taken in the same way for all of them, through the width and thickness, and at 90 degrees to each other. Shapes which are quite irregular may require more than one measurement on an axis to arrive at an average width or average thickness.



$$\text{Slab Unit Volume} = A \times B \times 0.4$$

Figure 6.20 Measurement of Four-sided (quadrilateral) Slab Ends.

To find the volume of a four-sided slab it is necessary to:

- first derive a unit volume of an end of the slab, from the two measurements of its width and thickness,
- record an equivalent radius class unit which is close to the unit volume,
- repeat the above process for the other end of the slab, and
- record the length of the slab so that a volume may be calculated.

The scaling method to find a radius class unit representing the unit volume of the slab end in Figure 6.20 is as follows:

The area of a four-sided slab end is its average width times its average thickness. To arrive at an effective radius class, the calculation is different from circular shapes, because, unlike circular shapes, in which two measurements are averaged, the two are multiplied, which produces a different ratio, or factor, of dimension to unit volume. To obtain the unit volume of a rectangular slab end in order to locate an equivalent effective radius on the scale stick, a factor must be applied to the product of the slab's width and thickness in rads to convert to unit volumes (cubic decimetres per metre). This factor, which is constant, simply provides a shorter way of doing the calculation, similar to the way Smalian's formula is shortened. The full formula for finding the unit volume for one end of a rectangular slab is:

$$\text{Four – sided slab Unit volume} = \frac{(\text{Width in Rads} \times 2) \times (\text{Thickness in Rads} \times 2) \times 100}{1000}$$

Multiplication of the two measurements in rads by 2 converts rads to centimetres. Multiplication by 100 gives the volume in cubic centimetres for one metre of length. Division by 1 000 gives the volume in cubic decimetres for one metre, or the unit volume.

By naming the width and thickness of the slab as A and B the formula shortens to:

$$\text{Four – sided slab Unit volume} = \frac{(2A) \times (2B) \times 100}{1000}$$

By transposing A and B to combine the constants the formula becomes:

$$\text{Four – sided slab Unit volume} = A \times B \times \left(\frac{2 \times 2 \times 100}{1000} \right)$$

And by calculating the combined constants, the formula is simplified to:

$$\text{Four–sided slab Unit volume} = A \times B \times 0.4$$

Where:

$$\begin{aligned} A &= \text{Width in rads} \\ B &= \text{Thickness in rads} \\ 0.4 &= \text{the constant} \end{aligned}$$

By substituting the slab dimensions from the example in Figure 6.20 into the formula,

$$\begin{aligned} \text{Rectangular slab Unit volume} &= 20 \times 17 \times 0.4 \\ \text{Rectangular slab Unit volume} &= 136 \text{ dm}^3 \end{aligned}$$

$$\text{Triangular slab Unit volume} = A \times B \times \left(\frac{2 \times \left(\frac{2}{2} \right) \times 100}{1000} \right)$$

And by calculating the combined constants, the formula is simplified to:

$$\text{Triangular slab Unit volume} = A \times B \times 0.2$$

Where:

$$\begin{aligned} A &= \text{Height in rads} \\ B &= \text{Base in rads} \\ 0.2 &= \text{the constant} \end{aligned}$$

By substituting the slab dimensions from the example in Figure 6.21 into the formula,

$$\text{Triangular slab Unit volume} = 16 \times 14 \times 0.2$$

$$\text{Triangular slab Unit volume} = 44.8 \text{ dm}^3$$

Finally, the unit volume nearest to 44.8 is located on the scale stick, and the corresponding radius class is recorded. In this case, the closest unit volume is 45, which corresponds to 12 rads. The process is repeated at the other end of the slab.

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- divide the rot volume by the average unit volume of the log to find the required length deduction, and
- subtract the length deduction from the gross log length.

The result is the net length of the log to be recorded.

7.4.2.2 Average Unit Volumes

References to unit volumes (UV) and average unit volumes (AUV) are made in this manual. A unit volume is simply the volume in dm³ of a one metre length of a log with the same diameter at each end. It is directly proportional to the end area, which in dm² is always 1/10 of the unit volume (or the area times 1 m). Unit volumes are read directly off the scale stick and because of their relation to end area, form the basis of comparison of defect proportion to firmwood proportion in the observation of a log. An average unit volume is the average, for one metre of log length, of the unit volume of each end of a log.

Different terminology is used from region to region when discussing unit volumes, such as the unit volume per metre (UVM), the factor, the one metre unit volume, the two metre half volume or one tenth of the ten metre volume. These terms are derived from regional differences and the various approaches to finding a unit volume or an average unit volume on a scale stick and should not be misinterpreted as something else; they are all in the same unit.

There are two simple ways to derive an average unit volume from the scale stick. Both are commonly used by scalers according to individual preference:

- in the first method, measure both ends of the log. Add the two corresponding unit volumes for the measured ends and divide by 2,
- in the second method, measure both ends of the log. Add the 10 m half volumes corresponding to the log ends and divide by 10, and
- rounding will often result in a difference of 1 dm³ between the two methods. This difference is of no significance in unit volume calculations.

Please see the Scaling Tools chapter of this manual for information about unit volumes and the scale stick.

The rounding convention relates directly to computing devices and advises that a given number will round up on the exact 0.5. The use of a scale stick for average diameters or average unit volumes, or a tape for length, will round up or down to the nearest even number on the exact 0.5. Scalers must rely on one rounding convention which eliminates the possibility of bias (one up, one down). Although the two conventions appear to be in conflict, computers work in a different domain. For example, a hand held data capture unit is never required to average diameters or lengths. They are first averaged by the scaler, and then entered into the unit.

7.4.2.3 Diameter Deduction or Radius Reduction Method

Diameter deduction or radius reduction as it is often called is the easiest and quickest of the basic deduction procedures for a through running defect or a defect which is estimated to run half way through a log. If a scaler does not consider log length and diameter when making diameter deductions for defects which do not affect the full length or exactly half the length of a log there is a risk of over-deducting. For this reason diameter deductions are limited to defects which travel the full length, or are estimated to travel exactly half the length of the log.

To obtain a net diameter equivalent to the net volume for a log follow these steps:

- measure the diameter of the log at the defect end and obtain the unit volume of that end of the log from the scale stick,
- measure the diameter of the defect and obtain the unit volume of the defect from the scale stick,
- subtract the defect volume from the unit volume of that end of the log to obtain a net unit volume, and
- locate a diameter on the scale stick with a unit volume closest to the net unit volume.

The result is the net diameter in rads or the radius in centimetres to be recorded.

The gross/net deduction method is preferred as its result is the closest reflection of a log's true net volume.

7.5 Conventions for Estimating Rot

When a defect affects the heart of a log, scalers cannot usually see how far it penetrates its length. If indicators are present rot penetration may be accurately estimated, but where there are none conventions may be employed. Basic conventions are outlined in this section to help the scaler in producing uniform and accurate results when unable to determine the actual size and/or length of the defect(s). In making volume deductions for defect, the scaler must pay close attention to any defect indicators, the ratio of the rot to the end, and the stage of the rot development. Conventions may be developed to suit changing conditions and should be tested regularly to ensure that they are still applicable. Scalers working in a new area should discuss local conditions with an experienced District scaling representative.

Ministry and Industry scalers must work together to ensure a complete and accurate scale and where the Regional Executive Director, District Manager or Forest Officer (scaling) determines that a convention does not apply, that person may order that its use be stopped.

7.5.1 Scaling Conventions versus Local Knowledge

The ultimate objective of scaling is to accurately determine the net firmwood volume and grade of each log scaled. To achieve consistent results and facilitate timely scaling most scaling is conducted with some reliance on the use of conventions. Conventions are based on **historic** relationships between external log characteristics and their impacts on firmwood content and product recovery.

While scaling conventions help the pace of scaling and help scalers achieve consistency, strict adherence to them fails to recognize that the trees from which logs are cut are often variable because of their inherent genetic blue print, their physical growing conditions and their history. Because of this diversity logs often do not conform to established conventions, therefore strict adherence to some conventions will not always yield the most accurate scale. Conventions must be tested regularly to ensure their continued applicability.

7.6 Formulas and Their Terms

Formulas are expressed in the next section in standard algebraic form. The example below shows the formula that is used to find the area of a rectangle:

Area (A) is equal to the length (L) times the width (W),

$$\text{Or } A = LW$$

All measurements, excluding length measurements, used in the calculations are in rads. It is important to remember that when measuring the diameter of a circle in rads, the resulting value is equal to the radius in centimetres.

Table 7-1 Chart of Terms Used in Scaling Formulas

Term	Definition
L	Length of log measured in metres.
T	Top or small end diameter of a log measured in rads.
B	Butt or large end diameter of the log measured in rads.
DL	Length of defect measured in metres.
DT	Top or small end diameter of a cylindrical defect measured in rads.
DB	Butt or large end diameter of a cylindrical defect measured in rads.
H	Height of a rectangular or triangular shape measured in rads.
W	Width of a rectangular or triangular shape measured in rads.
DHT	Top height of a rectangular or triangular defect measured in rads.
DWT	Top width of a rectangular or triangular defect measured in rads.
DHB	Butt height of a rectangular or triangular defect measured in rads.
DWB	Butt width of a rectangular or triangular defect measured in rads.
IDT	Inside diameter, top, or small end of a ring defect measured in rads.
IDB	Inside diameter, butt, or large end of a ring defect measured in rads.
ODT	Outside diameter, top, or small end of a ring defect measured in rads.
ODB	Outside diameter, butt, or large end of a ring defect measured in rads.
NDT	Net top or small end diameter of a log measured in rads.
NDB	Net butt or large end diameter of a log measured in rads.
F	Factor of 0.0001570796 (the constant used in shortened Smalian's formula).
UV	One metre unit volume, expressed as dm ³ /m. A ten metre volume may be divided by 10 to obtain the one (1) metre unit volume.
AUV	The average of the unit volumes of both ends of a log or defect.
V	Volume in cubic metres or cubic decimetres.

7.7 Defect Conventions and Examples

7.7.1 Conical Defects

Measurements for Defect Volume:

- the estimated defect length in metres to the nearest tenth of a metre, and
- the defect diameter visible at log end in rads.

7.7.2 Butt Rot Conventions

Butt logs are usually identified by observing the large end for flare, fluting, and/or felling signs such as an undercut or hinge in hand felled trees, or the characteristic face left by a harvesting machine. It is important not to confuse heart rot and butt rot. Although heart rot may show in a butt cut log, and butt rot may show in a second cut log, the rot can usually be identified by its nature. For example, brown cubical butt rot is recognizable by the way the wood fibres are affected. As its name implies, the rot is brown, crumbly, and breaks easily into cubes. The following basic conventions apply to butt rot:

- Where rot appears only in the large end of a butt log with butt qualities, treat it as butt rot unless other indicators are present, such as conk knots or conk rot.
- Butt rot visible at the butt end only will be assumed to be conical in shape, with the same basal diameter as the visible end section of the rot.
- Conical butt rot that extends the full length of a log may be treated as though it is through running heart rot. However, if the rot diameter at the butt is greater than 1.5 times the rot diameter at the top, the cylinder (Smalian's) formula will tend to over deduct the volume of rot, and averaging the diameters will understate the volume of rot. If bucking is impossible, adjustments are required. There are two ways to do this; if using the cylinder formula, the rot diameter at the butt may be reduced to the difference between the callipered butt diameter and twice the average collar thickness. If averaging the diameters, the result will be closer to true defect volume of the neiloid or "golf tee" shape typical of logs with a high degree of flare. By adding 1 rad to the average, the result will be closer when the defect is a frustum of a cone. The cylinder formula is suitable for rot shapes which are parabolic (bullet shape). Section 7.6.3.1 provides example calculations to demonstrate the two concepts.
- The diameter of butt rot used for deduction calculations must not exceed that of the recorded butt measurement where the actual measurement of butt rot exceeds the line of normal taper. This is a common occurrence in decadent logs with a great deal of butt flare.

There are many factors which affect the distance butt rot runs up from the stump: species, flare, taper, size, and age all contribute. Without indicators to establish rot penetration, it

becomes necessary to estimate the length of the rot. Through decay studies, mill studies, and experience, the following conventions have been found to be reliable in most cases:

- In the British Columbia interior, the average distance which butt rot travels in most logs is approximately 15 times the radius of the rot in centimetres, if there are no indicators to the contrary. For example, if the radius is 25 cm (same as the diameter in rads), $25 \times 15 = 375$ centimetres, or 3.75 m. The penetration is therefore 3.8 m (rounded).
- In coastal areas of British Columbia, butt rot, butt shake and related butt defects have the length of defect estimate based on the relation between the defect diameter and the recorded butt diameter of the log.

Where rot measures	It often penetrates
1/4 of the recorded butt dia.	1.8 - 2.4 m
1/2 of the recorded butt dia.	3.6 - 4.2 m
3/4 of the recorded butt dia.	5.4 - 6.0 m
4/4 of the recorded butt dia.	7.2 - 7.8 m

These figures may be adjusted slightly up or down depending on the species and visible butt flare. Douglas fir and spruce, having pronounced butt flare may use the lower figure mentioned as butt rot in these species usually does not run far past the flare. In hemlock, balsam, and sometimes red cedar, where butt flare is minimal, rot may run further into the log and a larger estimate is required. These are general guidelines only.

The Forest Service may endorse other conventions which are applicable to regional conditions. All conventions should be reviewed regularly to ensure continued applicability.

7.7.3 Butt Defect - Butt Rot (Conical) Partial Length of Log

This method of calculation is usually used for defects found in and confined to the butt end of a first cut or butt (flared) log. This method may also be used for all defects that have a geometrical shape of a cone or portion of a cone, **such as** catface.

7.7.3.1 Example and Illustration - Butt Rot Visible at Butt End of Log

Figure 7.2 depicts a typical log harvested from an interior region of British Columbia with conical butt rot measuring 25 rads in diameter and estimated to penetrate 15 times the radius, or 3.8 m.

($30/6 = 5$ times), an overstatement of the defect volume will result from summing the half volumes or from finding the average unit volume, and an understatement of the defect volume will result from averaging the diameters. It is possible to arrive at the volume of rot using a formula for the frustum of a cone in these cases.

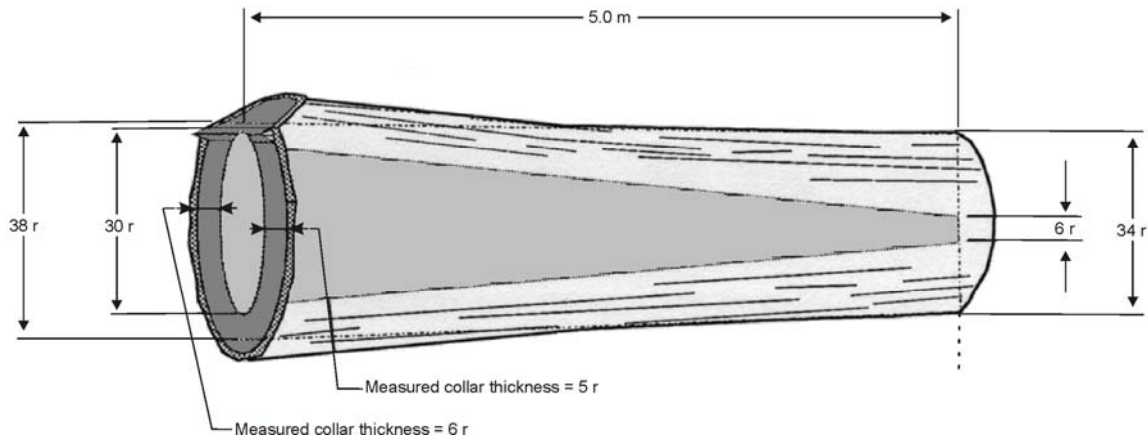


Figure 7.3 A Log with Butt Rot – Through Running.

7.7.3.3.1 Calculations - Butt Rot Visible at Both Ends of Log

It is the general convention to treat butt defect as conical, and in many geographical areas, no other treatment is used. However, experience with certain species and growth conditions may indicate that a neiloid (golf tee) shape or a parabolic (bullet) shape is valid. See Section 4.2 for an explanation of log and rot shapes. In these cases, different field approaches may be used for through running defects with extreme taper. The ability to use the following methods is governed by local conditions:

1. If the shape is assumed to be neiloid, average the diameters.
2. If the shape is assumed to be parabolic, use the average of the end areas.

When conical butt rot projects through to the top end of a log it becomes a frustum of a cone.

Method 1 shows the gross/net calculation that is used with a scaling computer using the formula for the shape of a frustum of a cone.

For net scale, if the shape is assumed to be the frustum of a cone, use Method 2 or Method 3 of the following.

Method 1 Gross/Net Deduction - Through Running Butt Rot

This is the method that a scaling computer would use for finding the net volume of a log with a defect in the shape of a frustum of a cone:

$$V = \left[\left[T^2 + B^2 \right] \times L \times F \right] - \left[\frac{\left[\left[DT^2 + DB^2 + (DT \times DB) \right] \times DL \times F \right] \times 2}{3} \right]$$

Where the following values are substituted for the variables:

$$T = 34 \text{ rads,}$$

$$B = 38 \text{ rads,}$$

$$L = 5.0 \text{ m,}$$

$$F = 0.0001570796,$$

$$DT = 06 \text{ rads,}$$

$$DB = 30 \text{ rads,}$$

$$DL = 5.0 \text{ m,}$$

$$V = \left[\left(34^2 + 38^2 \right) \times 5.0 \times 0.0001570796 \right] - \left[\frac{\left[\left(06^2 + 30^2 \right) + (06 \times 30) \right] \times 5.0 \times 0.0001570796 \times 2}{3} \right]$$

$$V = \left[2600 \times 5.0 \times 0.0001570796 \right] - \left[\frac{1116 \times 5.0 \times 0.0001570796 \times 2}{3} \right]$$

$$V = 2.042 - 0.584,$$

$$V = 1.458 \text{ m}^3.$$

Method 2 Net Dimensions Calculation – Through Running Butt Rot

Determine the difference between the callipered butt diameter and twice the average collar thickness to obtain a reduced rot diameter at the butt (collar measurements are required at the butt to determine average collar thickness).

$$\begin{aligned}
 \text{AUV of 34/38} &= 408 \text{ dm}^3 \\
 \text{Callipered butt diameter} &= 38 \text{ rads} \\
 \text{(Measured rot diameter)} &= 30 \text{ rads) } \\
 \text{Average collar thicknesses} &= \frac{5+6}{2} = 5.5 \text{ rads} \\
 \text{Twice av. collar thickness} &= 5.5 \times 2 = 11 \text{ rads} \\
 \text{Reduced butt rot diameter} &= 38 - 11 = 27 \text{ rads}
 \end{aligned}$$

Defect volume:

$$\begin{aligned}
 \text{Half volume of 5.0/06} &= 28 \text{ dm}^3 \\
 \text{Half volume of 5.0/27} &= + \underline{573 \text{ dm}^3} \\
 \text{Full volume of 5.0/06/27} &= 601 \text{ dm}^3
 \end{aligned}$$

Defect volume:

$$\begin{aligned}
 \text{Defect Volume: } \frac{601}{\text{AUV: } 408} &= 1.47 \text{ m Length deduction} \\
 5.0 - 1.5 &= 3.5 \text{ m Net length} \\
 \text{Net dimensions} &= 3.5 \text{ 34/38}
 \end{aligned}$$

$$\text{Net Volume} - 1.430 \text{ m}^3$$

Method 3 Net Calculation – Through Running Butt Rot

In this example average the top and butt defect diameters. But because the rot is conic and taper is extreme, add 2 rads to the average of the defect diameters. For example, where the defect diameter at the butt exceeds the defect diameter at the top by:

≤ 1.5 times, use the average

> 1.5 times and ≤ 2 times, use the average plus 1 rad

≥ 2 times, use the average plus 2 rads.

$$\text{Average defect diameter} = \frac{6+30}{2} = 18 \text{ rads}$$

$$\text{Adjusted defect diameter} = 18 + 2 = 20 \text{ rads}$$

Defect volume:

$$\text{Half volume of } 5.0/20 = 314 \text{ dm}^3$$

$$\text{Half volume of } 5.0/20 = + 314 \text{ dm}^3$$

$$\text{Full volume of } 5.0/20/20 = 628 \text{ dm}^3$$

$$\text{Average Unit Volume of } 34/38 = 408 \text{ dm}^3$$

$$\text{Defect volume: } \frac{628}{408} = 1.53 \text{ m Length deduction}$$

$$\text{Net dimensions} = 3.5 \text{ } 34/38$$

$$\text{Net volume} - 1.430 \text{ m}^3$$

7.7.4 The Catface (Conical)

Measurements for Defect Volume:

- the defect length in metres to the nearest tenth of a metre, and
- the width and height (big end) of the defect in rads.

7.7.4.1 Example and Illustration - Single Catface

In the example illustrated **below**, a portion of the tree's circumference has been scarred. As a result, it does not form a cylinder for part of its length. Where the catface tapers out as illustrated, the defect approximates the shape of a segment of a cone.

This log is 7 m long with a 20 rad top and a 24 rad butt. The conical catface is 4.8 m long and is 18 rads wide by 10 rads deep at the butt face.

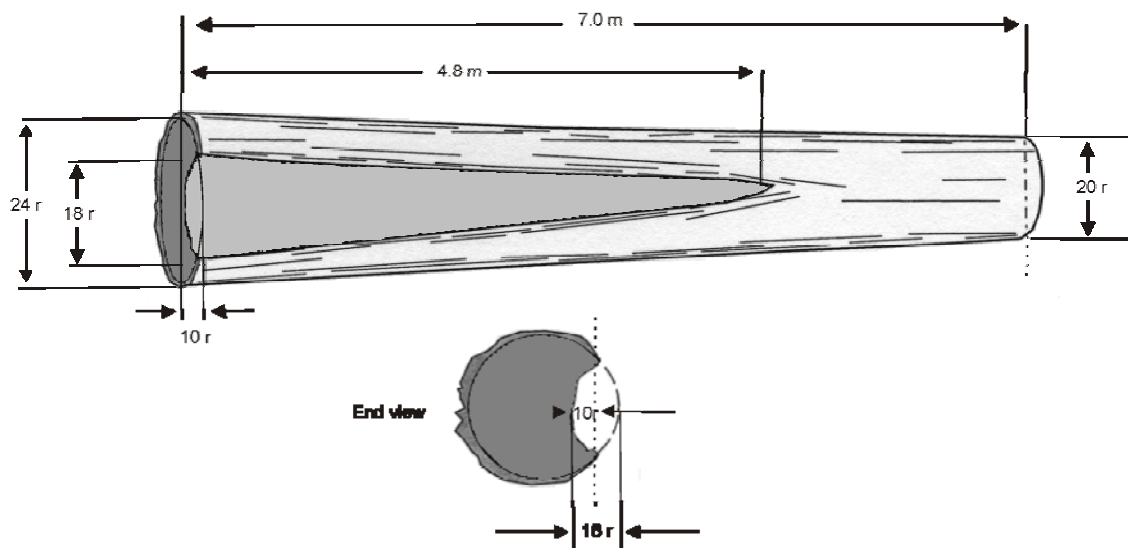


Figure 7.4 A Log with Conical Catface.

7.7.4.2 The Gross/Net Calculation – Single Catface

Using the formula for finding the net volume of a log with a conical defect:

$$V = \left[(T^2 + B^2) \times L \times F \right] - \left[\frac{(DB^2 + DB^2) \times DL \times F}{3} \right]$$

Where the following values are substituted for the variables:

$$T = 20 \text{ rads,}$$

$$B = 24 \text{ rads,}$$

$$L = 7 \text{ m,}$$

$$F = 0.0001570796,$$

$$DB = 14 \text{ rads,}$$

$$DL = 4.8 \text{ m,}$$

$$V = [(20^2 + 24^2) \times 7.0 \times 0.0001570796] - \left[\frac{(14^2 + 14^2) \times 4.8 \times 0.0001570796}{3} \right]$$

$$V = [976 \times 7.0 \times 0.0001570796] - \left[\frac{392 \times 4.8 \times 0.0001570796}{3} \right],$$

$$V = 1.073 - \frac{0.295561}{3},$$

$$V = 1.073 - 0.099,$$

$$V = 0.974 \text{ m}^3 \text{ net volume}$$

7.7.4.3 Net Dimensions Calculation - Single Catface

Using the cone deduction formula the net volume of the log is calculated as follows:

Calculate an end defect measurement in rads by dividing the sum of the width and height by 2.

$$\frac{10 + 18}{2} = 14 \text{ rads}$$

$$\begin{aligned}
 DL &= 4.8 \text{ m}, \\
 V &= \left[(20^2 + 24^2) \times 7.0 \times 0.0001570796 \right] \frac{(9^2 + 9^2) \times 4.8 \times 0.0001570796}{3}, \\
 V &= \left[976 \times 7.0 \times 0.0001570796 \right] \frac{162 \times 4.8 \times 0.0001570796}{3}, \\
 V &= 1.07317 \frac{0.122}{3}, \\
 V &= 1.07317 - 0.041, \\
 V &= 1.032 \text{ m}^3 \text{ net volume}
 \end{aligned}$$

7.7.5.3 Net Dimensions Calculation - Double Catface

Using the cone deduction formula the net volume of the log is calculated as follows:

Calculate a centre defect measurement in rads by dividing the sum of the width and height by two.

$$\frac{8 + 10}{2} = 9 \text{ rads}$$

Calculate the defect volume by looking up the half volume for the length of the defect, or 4.8 m and 9 rads.

$$\begin{aligned}
 \text{Half volume of } 4.8/09 &= 61 \text{ dm}^3 \\
 \text{Full volume of } 4.8/09/09 &= 122 \text{ dm}^3 \text{ (2 x half volume)} \\
 \text{Volume of cone } 4.8/09 &= \frac{122}{3} = 41 \text{ dm}^3
 \end{aligned}$$

$$\begin{aligned}
 \text{Defect volume: } \frac{41}{153.5} &= 0.267 \text{ m Length deduction} \\
 \text{AUV:} &
 \end{aligned}$$

$$7.0 - 0.3 = 6.7 \text{ m Net length}$$

$$\text{Net dimensions} - 6.7 \text{ 20/24}$$

$$\text{Net Volume} - 1.027 \text{ m}^3$$

7.7.6 Standard Heart Rot Conventions

Whereas the *Species Identification and Defects* chapter of this manual provides a general view of rot fungi, the following sections describe the treatment of rots in making firmwood deductions. The *Timber Grading* chapter gives instruction on the treatment of heart rots for grading purposes.

- Decayed heart wood may be visible at one or both ends of a log and will usually be circular or semicircular in shape. Its presence may only be indicated by rotten knots, or “conk.”
- If heart rot appearing at the end of a log is scattered or sporadic in nature, the cylinder of rot must be reduced in diameter to accommodate the firmwood scattered within the rot.

7.7.6.1 Cylindrical Defects

This method of calculation can be used for defects that have the geometrical shape of a cylinder.

This formula or combinations of this formula can be used for calculating volumes of the following defects: through running heart defect, heart defect running partial length of a log, conk defect, sapwood defect, dead side, missing wood, ring defect, ring shake, outside checks and portions of collars.

7.7.6.1.1 Heart Rot Visible at Both Ends

1. If rot is visible at both ends of the log, scale out the cylinder of rot as if it were a log inside the first log. The volume of the inner cylinder is the volume of the rot.
2. If rot is visible at both ends of a short log, they may be presumed to be connected unless there are indications to the contrary. For example, if a different species of rot shows at each end of the log they may not be connected.

7.7.6.1.2 Example and Illustration - Heart Rot, Full Length

Measurements for Defect Volume:

- the defect length in metres to the nearest tenth of a metre, (the same as the measured log length), and
- both defect end diameters in rads.

Heart rot extends completely through the log in Figure 7.6 and is measurable at both ends. The gross volume of this log is 0.763 m³

Calculate the unit volume for the butt end measurement and subtract the unit volume of the butt end defect.

$$\begin{array}{rcl}
 \text{Unit volume Butt (20 r)} & = & 126 \text{ dm}^3 \\
 \text{Less unit volume Butt defect (10 r)} & = & \underline{- 31 \text{ dm}^3} \\
 \text{Net unit volume} & & 95 \text{ dm}^3
 \end{array}$$

Find the rad class corresponding closest to the unit volume of 95 dm³, which is 17 rads.

Net Dimensions – 7.4 14/17

Net Volume – 0.564 m³

Use the diameter or radius deduction method only if heart defect or hole runs the full length or exactly half the length of the log.

7.7.6.2 Heart Defect – Conventions - Partial Length

1. Heart rot, pocket rot, ring rot, and similar defects when showing in only one end of the log are presumed to run half the length of the log to a maximum of 6 metres (coast), and 4 metres (interior) unless there is evidence to the contrary. In all cases, good judgement must be used and local experience is gained by observation of the bucking and manufacturing process. If it can be demonstrated to the local Forest Service staff through proper studies that the defect effectively runs halfway to a maximum of 4 metres (interior) or 6 metres (coast), then it will be assured that the scale data provided will be more accurate.
2. In heart defects with only one end visible, the diameter of the defect at the unseen end is assumed to be the same as at the measured end where the defect penetrates 1/2 way or less. However, in logs where the rot penetrates more than 1/2 **the length of the log**, this assumption is less reasonable, and the Forest Service may order that logs be bucked prior to scaling to improve accuracy. The ratio of the area of the rot to the area of the end which the rot occurs must be maintained at the unseen end or an over-deduction will result.

A convention should be reviewed at regular intervals to ensure that it is  applicable and not outdated. If it can be demonstrated through a study that the rot does in effect, run halfway to a maximum of 4 metres (interior) or 6 metres (coast), then this convention may be used. This study must be conducted in a way that is acceptable to the Regional Executive Director, District Manager, or Forest Officer (scaling). This will ensure that the scale data provided will be more accurate and complete.

7.7.6.2.1 Example and Illustration - Heart Rot, Partial Length

Measurements for Defect Volume:

- the estimated defect length in metres to the nearest tenth of a metre, and
- the defect diameter visible at the log end in rads.

The heart rot visible at the butt end of the log shown in Figure 7.7 is estimated to travel 2.7 m and the diameter of the rot is assumed to be the same at both ends (10 rads).

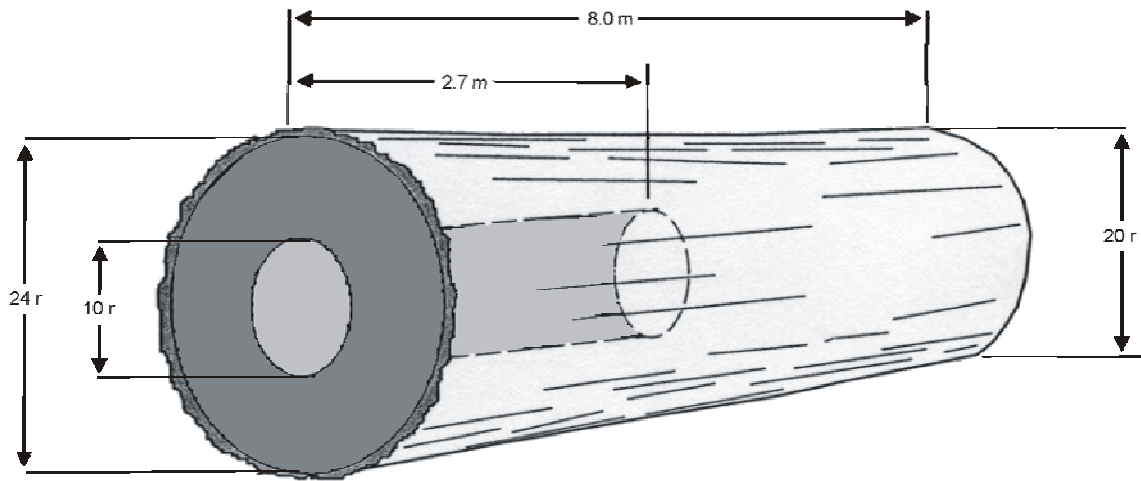


Figure 7.7 A Log with Partial Length Heart Rot.

7.7.6.2.2 The Gross/Net Calculation – Heart Rot, Partial Length

Using the cylinder formula for finding the net volume of this example which has a defect which does not project completely through the log:

$$V = [(T^2 + B^2) \times L \times F] - [(DT^2 + DT^2) \times DL \times F]$$

Where the following values are substituted for the variables:

$$\begin{aligned} T &= 20 \text{ rads,} \\ B &= 24 \text{ rads,} \\ L &= 8.0 \text{ m,} \\ F &= 0.0001570796, \end{aligned}$$

$$\begin{aligned}
 DT &= 10 \text{ rads,} \\
 DL &= 2.7 \text{ m,} \\
 V &= [(20^2 + 24^2) \times 8.0 \times 0.0001570796] - [(10^2 + 10^2) \times 2.70 \times 0.0001570796] \\
 V &= [976 \times 8.0 \times 0.0001570796] - [200 \times 2.7 \times 0.0001570796], \\
 V &= 1.227 - 0.085, \\
 V &= 1.142 \text{ m}^3.
 \end{aligned}$$

7.7.6.2.3 Net Dimensions Calculation - Heart Rot, Partial Length

Using the cylinder deduction formula the net volume of the log is calculated as follows:

$$\text{Average Unit Volume of 20/24} = 153.5 \text{ dm}^3$$

Defect volume

$$\begin{aligned}
 \text{Half volume 2.7/10} &= 42 \text{ dm}^3 \\
 \text{Full volume of 2.7/10/10} &= 84 \text{ dm}^3 \text{ (2 x the half volume)} \\
 \text{Defect volume: } \frac{84}{153.5} &= 0.547 \text{ m Length deduction} \\
 \text{AUV:} &
 \end{aligned}$$

$$8.0 - 0.6 = 7.4 \text{ m} - \text{Net length}$$

$$\text{Net Dimensions} - 7.4 \text{ 20/24}$$

$$\text{Net Volume} - 1.135 \text{ m}^3$$

7.7.7 Assessing Conk, Indian Paint Fungus and Pin Rot

While "conk" is the name used for the mushroom-like fruiting body often seen on standing timber which indicates a fungal invasion of a tree, for scaling purposes conk refers to the types of rot which attack lignin (the glue) and leaves cellulose fibre more or

less intact. In the early stages the wood is only stained purple or light red and requires no firmwood deduction. In later stages, the wood breaks down to form a honeycomb appearance, identifiable at the end of a log by the white, yellow, orange or brown "fleck"(sometimes called "peck" and "white pocket") that distinguishes all conk rots.

During logging operations the external conk indicators are usually knocked off, leaving brown, yellowish brown, and/or orange powdery residues at the entry points. These residues are what a scaler looks for in assessing a log, because their presence indicates a very high probability of extensive conk rot. Conk knots should not be confused with rotten branch stubs, which may not indicate the presence of heart rot. Observation of the ends of logs, where they have been bucked through rotten knots, will indicate the differences in appearance.

If rot does not show at either end of the log but its presence is indicated by conk knots, the challenge is to make a reasonable determination of its range, based only on its indicators. The indicators and the assessment of them are described in the following section on conk rots. For more information on these types of rot please refer to the [Book of Common Tree Diseases in British Columbia](#).

7.7.7.1 Basic Conk Assessments

Because of the variability of the affects of conk, not only by conk species, but by the tree species and location around the province, it is very difficult to establish with conviction any conventions which will have universal application. Mill visits and experience are essential for a scaler to learn to interpret the meaning of conk indicators. In general:

1. Conk can appear in several ways on logs and the estimates for making firmwood deductions and grading are affected by the indicators present. The location of conk knots and the diameter of rot on log ends may be used to estimate the distance that rot travels. That is, the observation of these relationships will help indicate whether the rot is getting worse down the log or "running out".
2. When conk stain or conk rot shows in log end(s) carefully look for conks on the log. Use the tine of the scale stick or a spud to dig into swollen spots, punk knots, and black knots. Size of conks is sometimes helpful in determining the extent of rot in some species.
3. Where there are two or more indications of conk, they are normally presumed to be connected. It is recommended that the scaler have the log bucked to ascertain whether the conk rot has entered the heart of the log or is restricted to  the knot.
4. If, among the enclosed rot, there is a substantial amount of firm wood that can be recovered in chips, then the defect diameter should be reduced proportionately for the firmwood volume determination.
5. In logs where conk shows in one or more knots and only a small amount of rot is present in the log end, that rot may not be representative of the severity of the defect.

$$\begin{aligned}
 DL &= 12 \text{ m}, \\
 V &= \left[(27^2 + 35^2) \times 12.0 \times F \right] - \left[(20^2 + 24^2) \times 12.0 \times F \right] - \left[(16^2 + 20^2) \times 12.0 \times F \right] \\
 V &= [1954 \times 12.0 \times 0.0001570796] - [976 \times 12.0 \times 0.0001570796] - [656 \times 12.0 \times 0.0001570796] \\
 V &= 3.683 - [1.840 - 1.237] \\
 V &= 3.683 - 0.603, \\
 V &= 3.080 \text{ m}^3.
 \end{aligned}$$

7.7.8.2.3 Net Dimensions Calculation - Ring Rot, Full Length

Using the cylinder deduction formulas the net volume of the log is calculated to be 3.080 m^3 .

Three steps are required for a ring defect deduction. Using the same methods as for heart rot:

1. Find a volume using the outside diameters and length of the ring.
2. Find the volume of the sound core using the inside diameters of the ring.
3. Subtract the volume of the sound core to get the volume of the outside ring (Step 2 minus Step 1).

Calculate the volume of the defect using the outside and inside diameters of the defect.

Outside diameter cylinder volume:

$$\begin{aligned}
 \text{Half volume of } 12.0/24 &= 1086 \text{ dm}^3 \\
 \text{Half volume of } 12.0/20 &= \underline{+ 754 \text{ dm}^3} \\
 \text{Full volume of } 12.0/20/24 &= 1840 \text{ dm}^3
 \end{aligned}$$

Inside diameter cylinder volume:

$$\begin{aligned}
 \text{Half volume of } 12.0/20 &= 754 \text{ dm}^3 \\
 \text{Half volume of } 12.0/16 &= \underline{+ 483 \text{ dm}^3} \\
 \text{Full volume of } 12.0/16/20 &= 1237 \text{ dm}^3
 \end{aligned}$$

Volume of defect equals outside cylinder volume minus inside cylinder volume.

$$\text{Defect volume} = 1840 - 1237 = 603 \text{ dm}^3$$

A percentage factor may be applied at this point for a partial ring defect (i.e., if the ring arc forms only one third of the circumference, multiply the above volume by 0.33 or 33 percent).

$$\begin{array}{lcl} \text{Defect volume:} & \frac{603}{304.5} & = 1.980 \text{ m Length deduction} \\ \text{AUV:} & & \end{array}$$

$$12.0 - 2.0 = 10.0 \text{ m Net length}$$

Net Dimensions – 10.0 27/35

7.7.8.3 Ring Defect - Partial Length of Log

Measurements for Defect Volume:

- the estimated defect length in metres to the nearest tenth of a metre,
- the outside diameter of the ring defect visible at the log end in rads, and
- the inside diameter of the ring defect visible at the log end in rads

7.7.8.3.1 Example and Illustration - Ring Rot, Partial Length

Ring rot is visible at only one end of the log in Figure 7.9. Because there are no other indicators, the rot is estimated to travel one half the length of the log and the ring's inner and outer diameters are **presumed** to be the same at both ends.

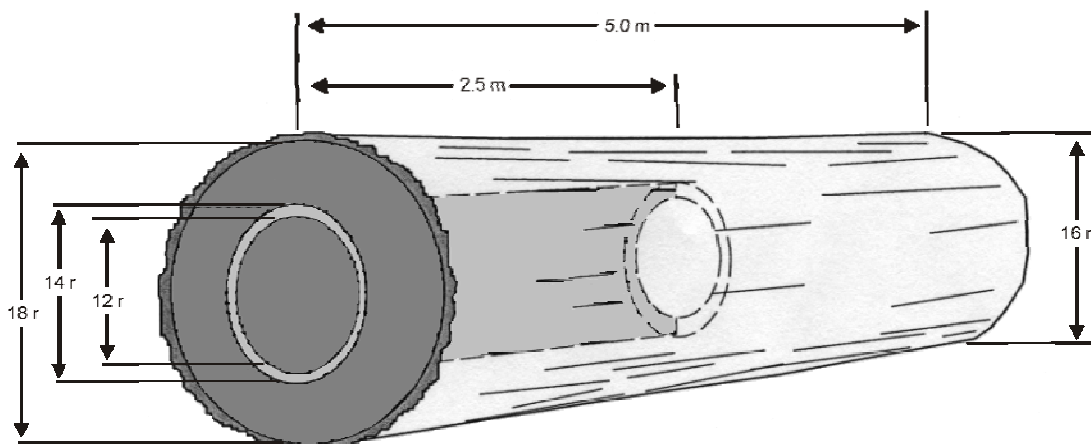


Figure 7.9 A Log with Partial Length Ring Rot.

Timber Grading

8

8.1 Timber Grading

Scaling under the *Forest Act* means to determine the volume and to classify the quality of timber. Classifying the quality of timber is known as grading. Timber is graded in accordance with the schedules of timber grades, set out in the *Scaling Regulation*.

Grading is used to make volume information from the scale more meaningful and useful to traders in timber and managers of forest resources. The quality and potential end use of logs has significant influence on their value. In addition to monetary values, log grade can also determine whether or not logs are accounted for cut control purposes. Grading is a key component in marketing finished products such as lumber, plywood and shingles. The scalers' challenge is to assess the visible characteristics of each log, and, with strict reference to schedules of log grades, determine what can be recovered from it. This chapter describes the principles of grading and details how timber is graded for purposes of the *Forest Act*.

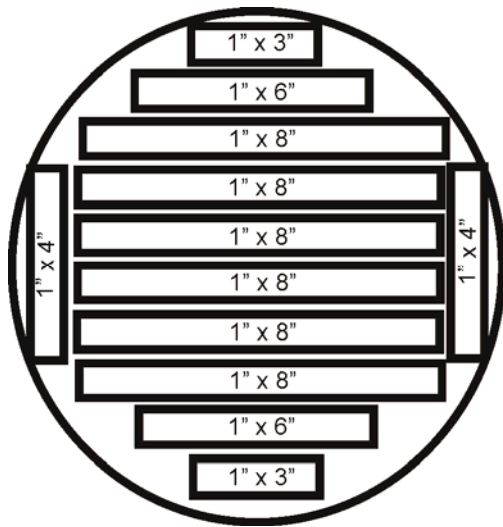
As grading is in place to make scale data more meaningful it must serve many users including buyers, sellers and forest administrators. Grading must also be responsive to changes in  utilization  forest practices and administration. While log grades have evolved and expanded in response to changing needs, the basic principles of grading have changed very little.

In addition to grade reduction, application of the grading rules requires the scaler to assess the quality of the products which could be produced from the log. This requires an assessment of the size, frequency and distribution of knots, and an assessment of any visible spiral grain or twist of the log.

The following sections describe log characteristics which:

- impact potential product recovery (quantity), and
- impact product quality.

8.3.1 Characteristics Which Reduce Product Recovery (Quantity)



Lumber is a manufactured product derived from a log in a sawmill, or in a sawmill and planing mill, which when rough, shall have been sawed, edged and trimmed at least to the extent of showing saw marks or other marks made in the conversion of logs to lumber on the four longitudinal surfaces of each piece for its overall length, and which has not been further manufactured other than by cross-cutting, ripping, resawing, joining crosswise and/or endwise in a flat plane surfacing with or without end matching and working. (Source - the National Lumber Grades Authority)

Figure 8.1 Minimum Dimensions for Recovery.

A board foot is the unit of measurement of lumber 1 inch (2.54 cm) thick, 1 foot (30.5 cm) wide, and 1 foot (30.5 cm) long, or its equivalent in thicker, narrower, or longer lumber.

The log characteristics discussed in this section reduce the proportion of the gross log suitable for the production of lumber, veneer, or shingles. Rot, hole, and char will also reduce the quantity of chips that are recoverable. The scaler must determine what portion of the log is not suitable for manufacture because of these defects. This is known as grade reduction or consideration. Although the defects affecting timber quality are described separately, the scaler must evaluate the whole log in terms of the cumulative effect of the separate quality defects observed.

8.3.1.1 Fractures and Fibre Separation

Wood fibres may separate or split across the annual rings (surface checks, star shake) or between the annual rings (ring shake, water shake). Once this separation has occurred, any lumber manufactured across the separation will likely fall apart. Grading must account for the volumes of firmwood that cannot be cut into lumber, veneer, or shingles because of these fractures.

For the purpose of this manual, fibre separation perpendicular to the growth rings is referred to as *check*, and fibre separation between the growth rings is referred to as *shake*. Shakes are classified into two types according to the direction of the plane of fracture; the

heart shakes (often termed heart check) and the ring shakes. Surface checking occurs on the outer surface (sapwood) and often penetrates to the inner part (heartwood) of logs. End (weather) checking occurs on the ends of logs and usually does not penetrate very far. The loss in lumber recovery is considerably increased where surface or heart checks are in conjunction with twist. In addition, where other factors are the same, surface checks have a proportionately greater lumber recovery loss on small logs than larger logs.

The amount of lumber lost due to deep checks is increased if they are combined with spiral grain. Some situations where spiral checks may occur are in logs with frost checks and in snags. Delays in presenting logs for scaling, such as leaving logs in the woods or in cold decks, often result in a type of surface check known as weather checks or sun checks, which are caused by rapid seasoning. These checks are usually about twice in depth at the ends of the log than elsewhere on the log, because the end is where the fastest drying occurs, and observation of the log ends will tend to overestimate the overall penetration of the check.

Surface and end checks due to delays in processing are disregarded for the purposes of grading. The Forest Service may order that surface checks be ignored. Breakage (splits and shatter), as a consequence of normal harvesting and log handling operations must be accounted for in the process of grading. Damage done to timber after delivery is not accounted for as a grade reduction.

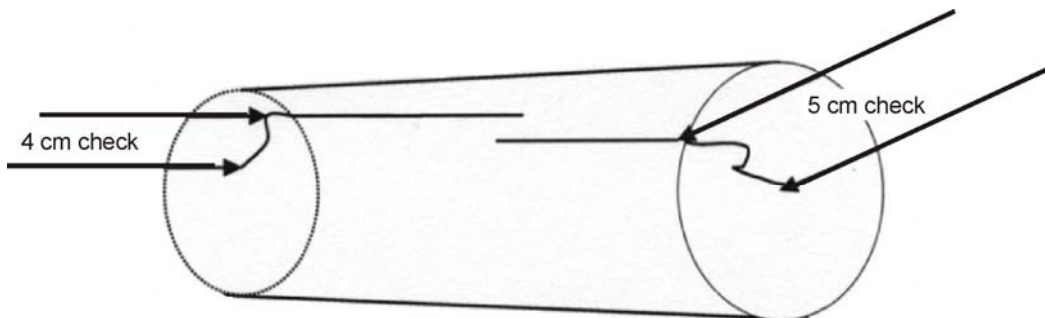


Figure 8.2 An Example of a Irregular Surface Checks (Example 1).

A check is a fibre separation across the growth rings. It can be straight or irregular and sometimes shows as broken or crooked on the ends of a log.

Single checks will sometimes ‘skip’ along the length of a log.

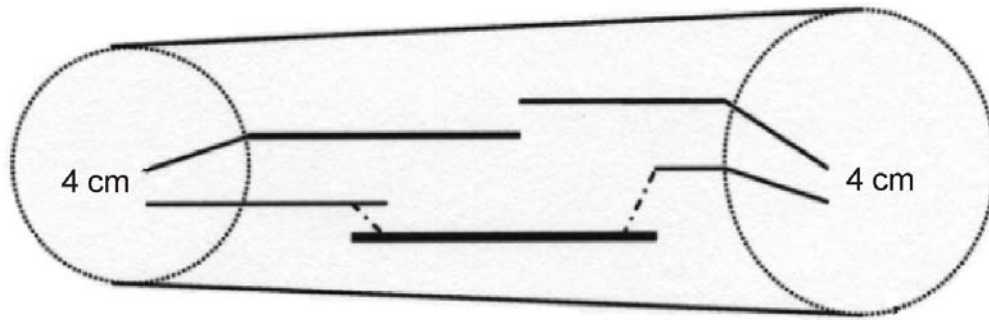


Figure 8.3 An Example of a Irregular Surface Checks (Example 2).

The scaler must first evaluate the check according to what can actually be seen on the log. Then they must follow the requirements for each grade as described in the Timber Grading chapters.

8.3.1.2 Bark Seams

Bark seams are formed as a result of bark enclosing a point on the outside of a tree which has no wood growth, so that over time, a seam of bark is left extending inward from the edge of the tree. Lumber and veneer cannot be recovered from the area of the seam. The volume of firmwood that cannot be manufactured because of bark seams must be determined by blocking out the end area of the wood lost for product recovery and multiplying the cross sectional area by the length of the seam. If there is at least 10 cm between bark seams, it is considered available to manufacture a product

8.3.1.3 Sweep, Crook and Pistol Grip

Sweep is a bow like bend in the trunk of a tree, whereas crook is a definite kink at one point in the stem most often as a result of the tree losing its leader. Pistol grip is a pronounced bend at the butt end of a log resembling the handle of a pistol and is often seen on trees growing on steep side hills. All three reduce the amount of product that can be recovered. The volume of wood that cannot be manufactured because of sweep, crook, or pistol grip must be estimated. Crook also frequently accompanies a firmwood loss since decay fungi may have entered the stem through the broken leader.

8.3.1.4 Rot, Hole, Char, and Missing Wood

Rot is caused by a variety of fungi which break down and feed off the lignin and/or cellulose in the wood. Hole is rot in its final stages. Char is wood that has been reduced or severely weakened by combustion or extreme heat exposure (fire). Rot is the most common firmwood defect for which a grade reduction must be made.

- areas around irregularities are avoided.

The amount of twist permitted for a particular grade is expressed as a percentage of log's diameter according to the grade rules. Specific twist requirements are described by grade in the *Coastal and Interior Schedule of Timber Grades*. Grain deflection is measured as described **below**.

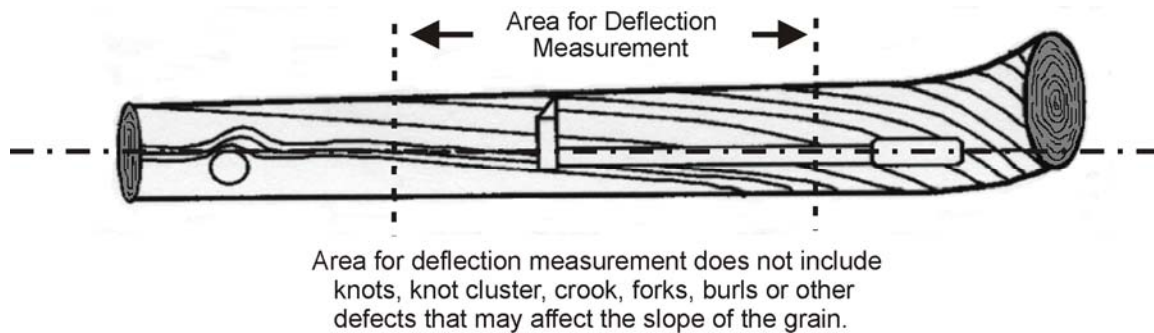


Figure 8.4 Measuring Twist – Placing the Stick.

As shown above, orient the scale stick parallel with log's longitudinal axis on an area where the grain deflection appears excessive.

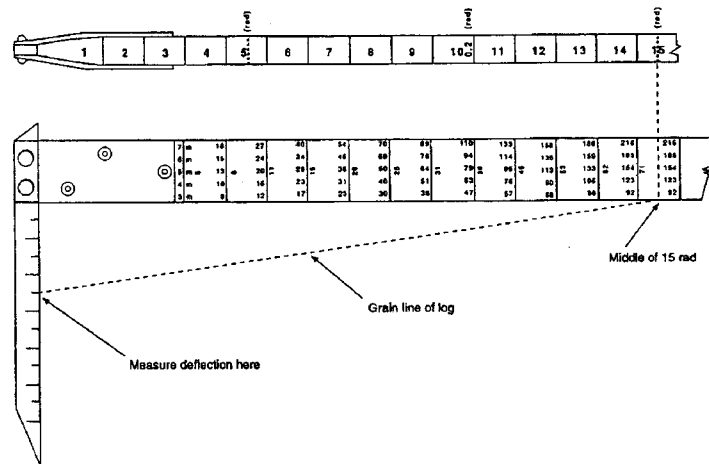


Figure 8.5 Measuring Twist – Reading the Deflection.

With its shaft parallel to the log's central axis, the stick is positioned such that one of the log's grain lines passes right through the middle of the 15 rad class (30 cm). The point where this grain line intersects the tine is the deflection. The deflection is then read where the grain line intersects the tine. Here, it reads as 5 cm.

The tine of this stick is graduated in centimetres. Although not a requirement, scalers often mark them out to improve accuracy.

In the above example this defection measurement is 5 cm or 2.5 rads. If this defection was measured from a log with a 33 rad top, it would constitute a defection of 7.6 percent.

$$\frac{5 \text{ cm}}{66 \text{ cm}} \times 100 = 7.57575 \text{ or } 7.6\%$$

8.3.2.2 Knots

The size, type, and distribution of knots have a significant impact on lumber quality and are a key consideration in applying the grade rules.

8.3.2.2.1 Size of Knots

The presence of knots or knot indications on a log may preclude the production of clear lumber from the affected portion. Knots larger than 2 cm will reduce lumber quality because the grain defection around the knots weaken the recovered lumber, even though the actual knot fibres may be denser and stronger than its supporting tissue. The larger the knot size, the greater the grain defection, causing cross grain in the region of the knot. Extremely large knots will make the cutting of merchantable lumber difficult. Knot size is measured in centimetres or rads of diameter.

Where the Grade Rule requirements stating maximum knot sizes and/or location are met, the merchantable and/or clear lumber percentage requirement for the grade will be satisfied.

Individual grade requirements specify the maximum knot sizes by top diameter class with the exceptions of, for on the Coast logs 12.8 m in length and over, the diameter at 12.8 m measured from the butt end of the log is used for knot assessment.

In the interior, logs over 8 m in length, the top half of the log is assessed using the top diameter and the bottom half is assessed using the midpoint diameter.

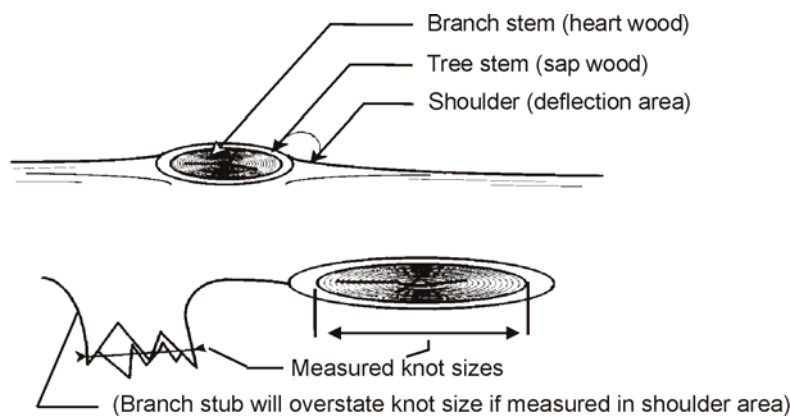


Figure 8.6 Measuring Knot Diameters.

Critical to the assessment of knot diameter is to exclude grain deflection around the knot in the measurement. Under close examination, the knot will have a circular grain pattern, like a log end, and this is the area measured. The tree stem wood grows around the knot (deflection), and forms the shoulder wood. It is easy to measure loose or encased knots, because there is a clear distinction between the knot wood and the tree wood; tight or inter grown knots are harder to learn to assess, because the two are interconnected.

Maximum allowable knot size increases with the diameter of the log and are expressed in centimetres of diameter. When taking this measurement, only the actual knot should be measured and not the shoulder surrounding it.

In addition to their size and characteristics, the location and distribution of knots must be carefully considered. For example, if log segments must be 2.5 m long to produce merchantable lumber, occasional oversized knots are permitted if it is possible to cut merchantable lumber from between them. In general, one oversized knot is permitted every 3 m for the coast and every 2.5 m for the interior, allowing ample room for recovery of merchantable lumber between the knots. Similarly, where the oversized knots are concentrated in one quadrant, along one side, or near one end of the log, the remaining portions will yield merchantable lumber.

As knots are a key determinant in log grading, it is important that scalers become very familiar with their impact. This knowledge is best achieved through on-site training, observation of log breakdown, and practice.

Knot spacing specifications for coast and interior grades are in the Requirements for the Grade.

8.3.2.2.2 Types of Knots

Knots in timber are sound or rotten; and tight or loose. Lumber sawn from logs with sound, tight knots is generally of a higher quality than lumber with loose or rotten knots.

Rotten knots in timber occur when there are broken and dead branches in trees as these represent an entry point for fungus spores, which lead to decay. Rotten knots can also be indicators of internal decay. The appearance of **knots** that have been bucked through or bucking adjacent to such knots serve as good evidence of the general pattern of decay characteristics for a particular timber stand and species.

Tight knots are found where the branches on the tree were still living or green when the tree was harvested. The tissue system of the branch is interconnected or intergrown with the tissue of the log, and the grain orientation in the trunk wood is laterally distorted around the knot and passes in a wide sweep on either side.

When a branch dies, the cambium in the branch ceases to function, and there is a break in the continuity of the woody tissue between the branch and the stem. The portion of the

branch base that is embedded in the tree trunk after the branch dies causes a loose, encased, or black knot in lumber. Since the wood of the tree trunk is not continuous with that of the encased knot, there is less distortion of the grain around it than with tight knots.

Consideration for knots is part of the application of the Grading Rules for both the Coast and the Interior

8.3.2.2.3 Distribution of Knots

The distribution of knots in logs is determined by the growth characteristics of the tree.

After getting established, coniferous trees typically grow 0.2 to 1 m per year depending on the species and suitability of the growing site. When the tree matures upward growth decreases significantly. As Balsam, Fir, Pine, Spruce and Larch grow; they add a whorl of branches at the start of each year. Normal branch distribution in small diameter stems sees whorls spaced between 0.3 and 0.5 m apart. Red Cedar, Yellow Cedar, and Hemlock branches are not produced in regular whorls. Instead, their branches are spaced on the stems of young trees 0.3 to 0.5 m apart.

After a tree reaches mature height, additional branch whorls are still added each year but the branches are much closer together. Sometimes trees produce a number of branches in a bunch, resulting in a cluster of knots in the wood. A close grouping of knots (cluster knots or bunch knots) reduces the strength of the lumber cut from that portion of the log containing the cluster or bunch of knots.

In general, a cluster or bunch knot occurs where the knots are so close together that the grain of the wood is deflected around the knots rather than between them.

Bunches or clusters of knots are to be encircled with the smallest diameter circle or oval that will encompass the grouping. The average diameter of this circle or oval is then taken as the effective bunch knot diameter.

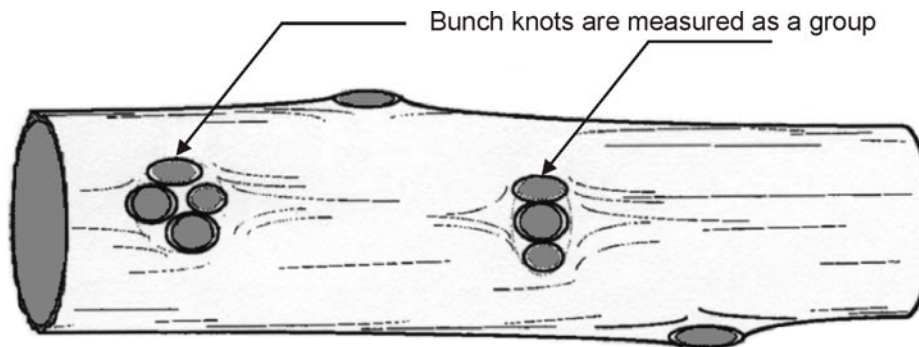


Figure 8.7 Measuring Bunch (cluster) Knots.

The first log shown here has its oversized knots distributed over the entire length of the log. Because there is no portion of the log which allows 2.5 m lumber, the log will not produce merchantable lumber **and is one hundred percent grade reduction**.

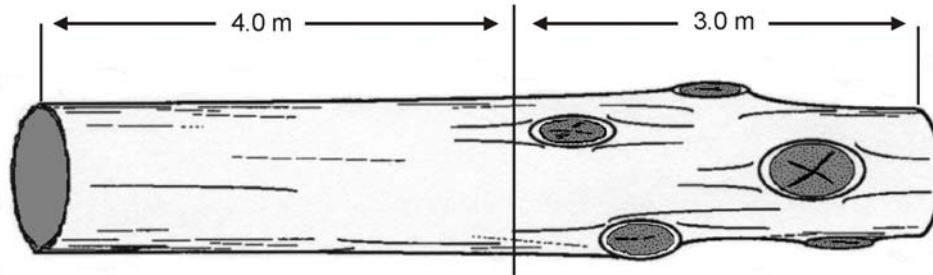


Figure 8.11 Oversized Knots Near the Top of the Log.

This example has oversized knots concentrated near the top of the log. After the scaler notes that 3 m of the log will not produce merchantable lumber, the impact on the quality of the whole log is calculated to be about 43 percent of its total length, but somewhat less than 43 percent of its volume.

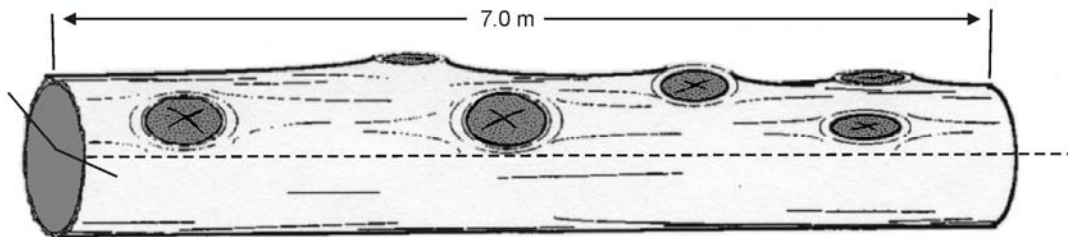


Figure 8.12 Oversized Knots on One Side.

The third log has its oversized knots concentrated along one side. Almost half of the log will not produce merchantable lumber because of this, but more than half is not affected at all by knots. Therefore, the impact on the quality of the whole log is estimated to be about 45 percent of its volume. However, size is also a factor in the assessment; a 30 rad log may be broken down into quarters to maximize merchantability, where a 5 rad log cannot even be halved.

Of course, these examples are somewhat conceptual in that knots do not usually present themselves so obligingly. Although in time, scalers will learn to quickly understand the impact of knot location and distribution, it is best for the beginner to pick out each of the elements in turn. For example, if the knots are distributed along one quadrant and around the top end, do one assessment, then the other. The total assessment is the cumulative effect on the log.

8.3.2.3 Insect or Worm Holes

A number of insects lay eggs under the bark of trees and the larvae will bore through the wood as they develop. When the presence of borings is observed, the quality of potential products may be reduced and the log grade affected.

Several grades do not allow borings, other than those of the ambrosia beetle, to penetrate beyond the sap wood or allow them only in a limited manner.

The ambrosia beetle attacks felled timber, and the small holes made by this insect are common. This is not a serious defect for sawlog and utility grades which require merchantable quality lumber. Where the borings penetrate beyond the sap wood, the affected portion of the heart wood may not produce any clear lumber.

Cedar is affected by the borings of larvae of the western cedar borer. It is known as powder worm and it is a serious defect, not allowed in six of the cedar coastal grades.

Damage caused by marine creatures, including teredos, is not considered in the official scale for volume or grading purposes, but should be noted as a remark on the scale return.

8.3.2.4 Non-Permissible Defects

There are a number of defects which are not permitted to be present in certain grades of logs. Where such a defect is present, the log will be disqualified from the grade in Coastal grading, and from lower grades where the log is required to have been "otherwise" the higher grade for which it has a prohibited defect. For Interior grading non-permissible defects may disqualify a log from the premium grade based on a number of factors.

Examples of defects which are not permitted in certain grades are conk stain, powder worm and checks over 4 cm deep.

Some grades permit certain defects only to a clearly defined limited extent. Examples of this are ring shake, pocket rot, pitch pockets and the number of insect holes. When the defect is not confined to the stated limit, it is treated as a non-permissible defect for that grade. All of the above defects are defined by log grade under the Log Requirements to Make the Grade.

8.3.2.5 Grain Density (Ring Count) - Coastal Grading Only

The diameter growth rate of a tree is dependent upon the species, its genetic makeup, climate and other site specific conditions. Growth is more rapid early in the growing season, and the 'early wood' produced at this time consists of large, light coloured cells. The 'latewood' cells produced later in the season are smaller with thicker walls, and so appear to be darker. Each pairing of light and dark bands comprises one 'annual ring', which marks one year's growth.

Grain density or the closeness of the annual rings is a consideration in coastal grading. Finer grained logs (more closely spaced annual rings) yield higher quality lumber and veneer, and as such, usually command higher values than logs with more widely spaced annual rings.

8.3.2.6 Compression Wood (Interior only)

The general effects of compression wood on the performance of sawn timber are reduction in the strength, stiffness and dimensional stability, resulting in a decrease in yield of high quality end products.

Compression wood is a type of defect that tends to form in conifers on the underside of leaning stems, on the leeward side of trees exposed to strong winds, in crooked stems and in the lower part of trees growing on a slope. Compression wood can cause problems in processing the wood. It can cause bow and spring.

Compression wood is formed in a leaning tree and it is often characterized by a dense hard brittle grain and reacts to seasonal moisture changes. In hardwood trees, it forms on the upper side of the lean and is called tension wood. In softwood trees it forms on the lower side of the lean and is called compression wood.

8.4 Applying the Principles of Grading

Grade Reduction is the process of determining what portion of a log is not suitable for the manufacture of various products. The previous section outlined the defects found in logs which reduce the amount of finished product which can be recovered from logs. These defects include:

- firmwood defects (including rot, hole, char, and missing wood), and
- non-firmwood defects (including shake, checks, frost cracks, shatter, splits, forks, catface, deadside, lightning scar, bark seams, goitre, pistol grip, sweep, and crook).

As explained in later sections, grade reduction requires that a trim allowance be applied around most defects. In addition, grade reduction must account for other volumes which are not available for manufacture. These include:

- collars of firmwood too thin to cut lumber,
- segments of slabs too thin to cut lumber,
- sound hearts that are too small in diameter, and
- the defect free portion of logs and slabs too short to cut lumber.

Grade reduction is only used in the assessment of log grade. The firmwood contents or the net dimensions that yield the firmwood contents must always be recorded as the official British Columbia Metric Scale volume.

The volume of the log not available for the manufacture of lumber or the other products is the grade reduction volume. In applying the grading rules, the scaler must deduct this volume from the gross log volume and express the remaining volume as a percentage of the gross volume. This percentage represents the percentage of the log which can be manufactured.

$$\frac{\text{Gross Volume} - \text{Defect Volume}}{\text{Gross Volume}} \times 100 = \% \text{ Suitable for Manufacture}$$

Determining the grade reduction volume and calculating the percentage suitable for product recovery while not difficult, can be time consuming. As scalers gain experience and complete numerous grade reduction calculations, they become proficient at estimating grade reductions.

Experienced scalers may find it necessary to perform only periodic full calculations for confirming their estimates and determining grades on borderline logs.

An experienced scaler will also follow a number of approaches to avoid needless calculations:

- they look for obvious tree characteristics which may impact the grade (e.g., excessive knots or twist will considerably narrow a logs grade potential), and
- they understand the relationship between certain defects and log size (e.g., a 2 rad surface check on a small log may have a very significant impact compared to the same check on a large log).

Initially, scalers are strongly advised to calculate all grade reductions. It is only through such a background of disciplined practice that good judgement and "log sense" will develop. While this log sense is never really lost, it can be weakened by periods of inactivity and even highly experienced scalers should periodically reconfirm their skills, especially after periods of layoff.

8.4.1 Determining Grade Reduction

Using field methods which do not account for taper (known as linear methods) will not yield the same results as methods which employ a full metric volume approach using Smalian's formula (known as volumetric method). The volumetric method is deemed to be correct and accurate.

Although characteristics are described individually, scalers must consider the whole log in determining its grade. Generally speaking, the scaler must determine and consider the following factors:

- log size,
- whether it is a round log or a slab,
- what proportion of the log will produce lumber and chips,
- the quality of end products, and
- the presence of non-permissible defects.

8.4.2 Log Size

Potential end use and product recovery is in large part determined by each log's end diameter. Other factors being equal, larger logs will produce more and better quality lumber than smaller diameter logs. As such, grade rules specify minimum log diameter criteria.

While the official coastal grade rules are expressed as centimetres of radius, this unit is the equivalent to “radius class units” (RADS) which are expressed as “RADS of diameter”. The scaling convention is that diameters are measured and recorded in RADS. For example, a recorded measurement of 5 rads is equal to 5 cm of radius for the purpose of grading.

In applying the diameter criteria, note the following:

- Unless otherwise specified, diameters are the gross diameter inside bark at the small end of the log. The gross diameter is the actual measured diameter before making any deduction for any defect and including sap rot.
- For logs which require more than one diameter measurement, the diameter for the purpose of grading is the rounded gross diameter for the small end, or top of the log. A log which rounds up to the minimum diameter for a grade qualifies for that grade.

8.4.2.1 Length

Length measurements specified in the grade rules are the actual unrounded gross measurements. Where a log meets the minimum gross length for a grade but requires a deduction, which reduces the net recorded length below the minimum, it is graded based on its gross length.

Length is a factor in log value, both in terms of efficiency in handling and lumber value potential.

Scalers use various accepted indicators at the local forest service level (local knowledge) to accurately estimate the length of defects. In cases where there are no accepted indicators by the local forest service, the conventions for estimating rot in the *Firmwood Defect and Conventions* chapter may be employed after approval by the Regional Executive Director, District Manager or Forest Officer (scaling).

8.5 Assessing Product Recovery

Grade rules require that a certain specified percentage of the gross log volume must be available for manufacture of a given product based on the grade rule. This requires the grade reduction volume to be calculated. The net log volume, available for manufacture of a given product based on the grade rule, must then be calculated and expressed as a percentage of the logs gross volume.

The official methods for calculating grade reduction are similar to those used for determining firmwood deduction. Scalers should carefully study the *Firmwood Measurement Procedures* chapter and practice these procedures on logs until they are thoroughly understood.

Except for logs with sap rot or char, which are otherwise sound, the grade reduction volume is always larger than the firmwood deduction volume. There are three reasons for this:

- there are a number of defects such as fractures, bark seams, goitre, sweep, and crook that reduce product recovery but do not cause firmwood loss,
- additional defect free volume around the allowable defects (the trim) is lost in the manufacturing process, and
- while the firmwood loss is related only to the size of the defect, the grade reduction loss is also dependent upon the orientation of the defects in the log. That is, a defect may be so positioned as to render additional log segments too short or may cause the residual collar (log shell) to be too thin for manufacture.

Log radius in the grade rules is expressed as centimetres of radius, which is equal to and interchangeable with, rads of diameter.

An exception should be noted in the grade rule for firmwood reject where the measurement is expressed in centimetres of diameter.

Potential end use and product recovery are in large part determined by each log's end diameter. Other factors being equal, larger logs will produce more and better quality lumber than smaller diameter logs.

While the official grade rules are expressed as centimetres of radius, this unit is the equivalent to "radius class units" (RADS) that are expressed as "RADS of diameter". The scaling convention is that diameters are measured and recorded in RADS. For example, a recorded measurement of 5 rads is equal to 5 cm of radius for the purpose of grading.

8.5.1 Lengths of Defects

Scalers may use a variety of accepted indicators at the local level (local knowledge) to accurately determine the lengths of defects. Scalers must be cautioned however, that conventions are only ‘rules-of-thumb’. When logs are bucked shorter than 4.9 metres scalers must not, and should not automatically downgrade based on “the heart rot in one end” convention. Bucking practises must be conducted for the purpose of ensuring an accurate scale. It is the responsibility of the scaler to demonstrate how the defect length determination was made.

Experience is gained through the observation of bucking and manufacturing process. Conventions should be tested regularly to ensure they are applicable. This is demonstrated through study, training, observation and support from the scaling community in both industry and government.

Although scalers should work together to ensure a complete and accurate scale, when the Regional Executive Director, District Manager or Forest Officer (scaling) determines that a convention does not apply, they may order that its use be stopped. This will ensure that the scale data provided is accurate and complete.

8.5.2 Determining Grade Reduction for Collars (Shells)

Where logs have heart defects, the collar or shell of sound wood surrounding the defect must meet a minimum thickness requirement in order for lumber to be cut from it, according to the following specifications:

1. The minimum collar thickness specified is the actual unrounded measurement of the collar taken before trim allowance has been added to the defect,
2. For all **logs scaled and graded under the Schedule of Coast Timber Grades**, the minimum collar or shell thickness needed in order to produce lumber is 5 rads (10 cm). This applies to all collars surrounding internal (heart) defects such as heart rot, pocket rot, holes, ring rot, ring shake, water shake, and star shake,
3. For all **logs scaled and graded under the Schedule of Interior Timber Grades**, the minimum outer collar thickness is 7.5 rads (15 cm) for heart rot, holes, and star shakes only. For pocket rot, ring rots, ring shake and water shake the minimum collar thickness is 5 rads (10 cm).
4. Where a collar or a portion of a collar does not meet the minimum thickness requirement, the volume of the collar or portion must be included in the grade reduction. An exception is where the diameter of the defect is 20 percent or less than the diameter of the log end in which it appears. In such cases, the collar is deemed to be thick enough to cut lumber, so trim allowance is added to the defect measurement and the grade reduction is then calculated. This rule is used to prevent unreasonable down grading of smaller diameter logs with a very small core of heart rot. Only logs up to 12 rads in diameter (with 5 rad collar requirement) or logs up to 18 rads in diameter (with 7.5 rad collar requirement) are affected.

Scalers must exercise care when measuring collar thickness. They must evaluate the actual, unrounded measurements of the collar. It is tempting to simply subtract the defect diameter from the recorded log diameter and divide the difference by two, but this method of averaging the collar thickness can lead to mistaken assumptions. For example:

- on logs with excessive butt flare, this method will often considerably underestimate the true collar thickness since the butt diameter has been reduced by callipering to compensate for the flare, but the defect is not. Experience has shown that defects usually follow the growth rings, so it is more reasonable to presume that if there is collar at the end of a log, there will still be collar at the point where the log was callipered, and
- on logs which have an off-centre defect, this method will not reflect the possibility that a portion of the log will or will not meet the grade requirement. For example, in Figure 8.13 the off-centre star shake has a portion with sufficient collar and a portion without. By averaging, a scaler may not take a grade reduction when one is **required**, and may take an excessive reduction when a portion of the collar actually does meet the grade requirement.

The following guidelines are used to help ensure consistency in assessing collars:

- collar thickness is obtained by direct measurement of the collar with the scale stick at the log end in which the defect appears, including flared butt logs,
- if adequate collar is found on the cut face of a flared butt log, there will be adequate collar where the butt diameter was callipered,
- where a defect runs a partial length of a log, the measured collar thickness is presumed to hold true for the entire length affected by the defect, except for cone shaped defects (butt rot),
- where a defect runs the full length of a log, the collar determination made at each end is presumed to hold true for half the length of the log, and
- where a defect is located so that merely a portion of a collar is below the minimum requirement, only that portion is considered grade reduction and added to any other grade reduction.

Collar thickness principles are provided in the figures below, without showing trim allowance. Trim allowance is added after any collar assessments.

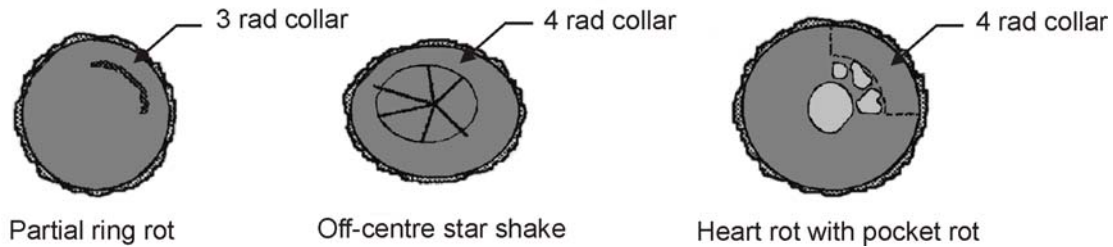


Figure 8.13 *Examples of Logs with a Portion of the Collar Too Thin to Produce Lumber.*

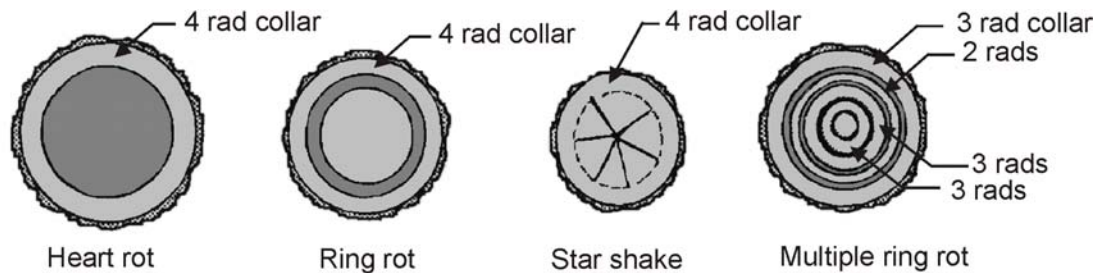


Figure 8.14 *Examples of Logs with Entire Collar Too Thin to Produce Lumber.*

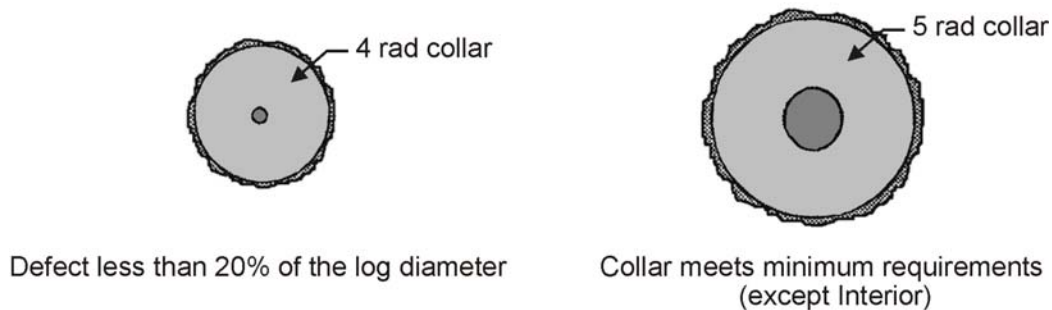


Figure 8.15 *Examples of Logs with Sufficient Collar to Produce Lumber.*

8.5.3 Determining Grade Reduction for Sound Hearts (Residual Cores)

Sound hearts inside defects such as sap rot, charred wood, ring rot and ring shake are considered suitable for lumber production if they are 5 rads (10 cm) or more in diameter. Hearts less than 5 rads are included in the grade reduction. The treatment of sap rot is illustrated [starting on the next page](#).

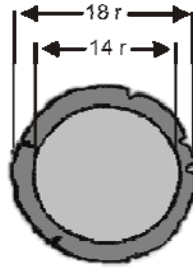


Figure 8.16 Sap Rot.

The first example here shows the end of a log with sap rot with an outer diameter of 18 rads and a residual core diameter of 14 rads. The grade reduction is the outer portion of the log for the distance the rot travels. From the scale stick:

Gross unit volume	=	UV 18 r	=	102 dm ³	
Grade reduction	=	UV 18 r – UV 14 r	=	(102 – 62)	= 40 dm ³
% of log which can be manufactured	=		=	$\frac{102-40}{102} \times 100$	= 60.8 percent

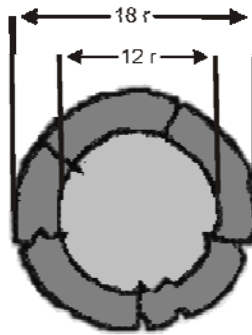


Figure 8.17 Advanced Sap Rot.

The second example shows relatively advanced sap rot with an outer diameter of 18 rads and a residual core diameter of 12 rads. Advanced sap rot like this often requires an additional firmwood adjustment to account for irregular rot penetration, and a further grade adjustment for checks which penetrate into the sound core.

From the scale stick:

Gross unit volume	=	UV 18 r	=	102 dm ³	
Grade reduction	=	UV 18 r – UV 12 r	=	102 – 45)	= 57 dm ³ per metre
% of log which can be manufactured	=		=	$\frac{102-57}{102} \times 100$	= 44.1 percent

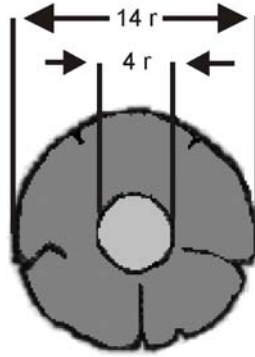


Figure 8.18 Residual Core is a Grade Reduction.

This example shows a log with sap rot which has advanced to the point where the residual core is less than 5 rads (10 cm) in diameter **at the top**. This log is 100 percent grade reduction for the distance the rot travels. **However, if this sap rot presented at the butt end of the log, this log would Grade 'Z' based on Section 9.5.1.1(1)(c).**

8.5.4 Determining Grade Reduction for Multiple Defects

Occasionally, scalers will encounter log ends with two or more defects positioned such that there is less than 5 rads (10 cm) of usable fibre available between the defects. In these situations, simply adding the trim around each defect and calculating the grade reduction would understate the recovery loss. In such cases the available material separating the defects is also unsuitable for manufacture and is added to the grade reduction.

Area Available to Cut Lumber

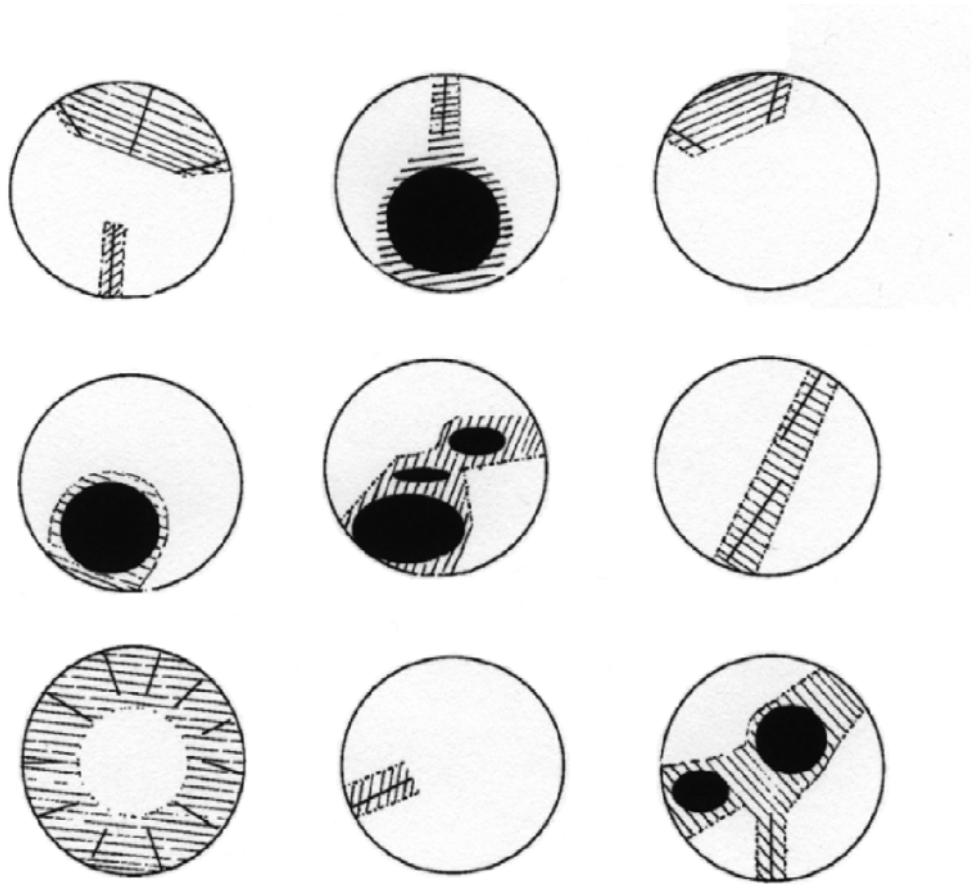


Figure 8.19 Shaded Areas are Unsuitable for the Manufacture of Lumber.

The shaded areas in these examples represent the area that has been lost to defects in each illustration. When checks are in conjunction with other defects consideration must be given to the area between these defects to assess manufacturability. **The challenge is to decide if the log has 10 cm between defects.**

8.5.5 Slab Thickness and Grading

To be considered suitable for various grades, slabs must achieve a certain minimum thickness. For interior grading, slabs or portions must be at least 7.5 rads (15 cm) thick to be considered suitable for manufacture into lumber. For the interior, portions of slabs which do not meet the minimum thickness must be assessed as grade reduction. This includes measured lineal portions since, unlike collars on round logs which can be measured only on the ends, slab thicknesses can be measured at any point along their length.

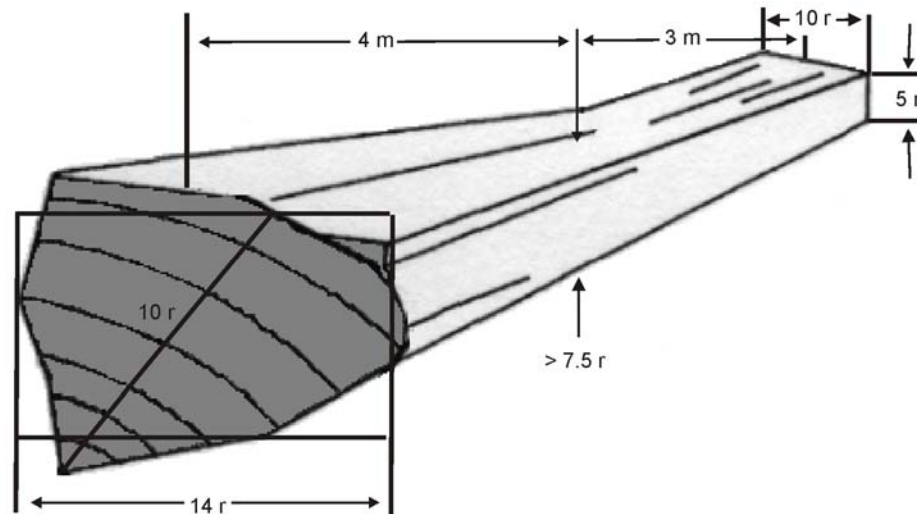


Figure 8.20 *Slabs with Portions Meeting the Grade Rule.*

This slab is measured for firmwood content according to the methods described in the Gross Measurements Procedures chapter, where the cut faces are enclosed in a rectangle which has an area equivalent to the slab end. The dimensions are 7 by 14 rads and 5 by 10 rads by 7 m, and an equivalent radius class unit is found for each end of the slab using the rectangular formula:

Slab Unit volume, big end	=	10 x 14 x 0.4	=	56 dm ³
Slab Unit volume, small end	=	05 x 10 x 0.4	=	20 dm ³
Average unit volume	=	(56 + 20) / 2	=	38 dm ³
Gross volume	=	38 x 7 m	=	266 dm ³

In the Interior a further calculation is necessary to account for portions of slab that are less than 7.5 rads in thickness. The portion of the slab less than 7.5 rads thick is 3 m long. The width at 3 m from the small end is 12 rads. The interior volumetric calculation is:

Unit volume @ <7.5r	=	7 x 12 x 0.4	=	34
Unit volume, small end	=	5 x 10 x 0.4	=	20
Average unit volume	=	(34 + 20)/2	=	27 dm ³
Grade reduction volume	=	27 x 3m	=	81 dm ³
% of slab which can be manufactured	=	$\frac{266 - 81}{266} \times 100$	=	69.5 percent

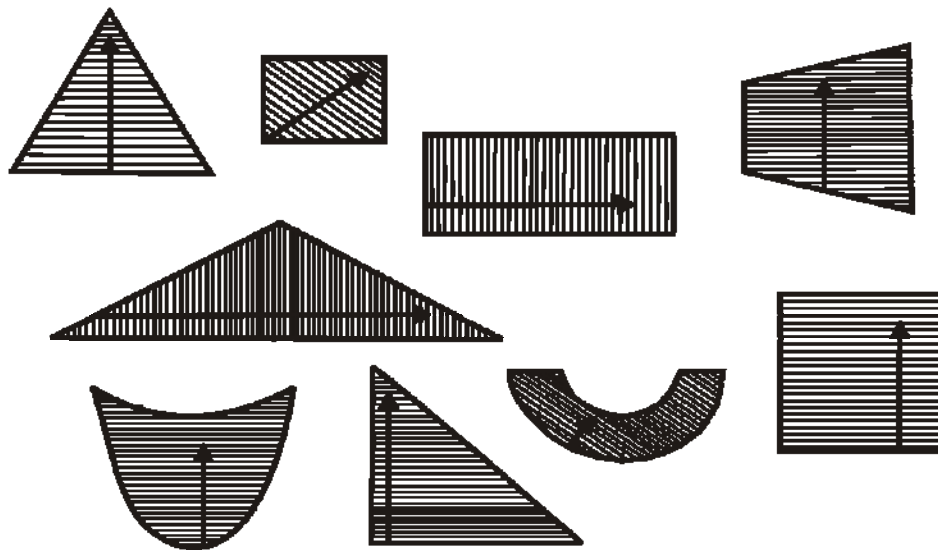


Figure 8.21 Measure Minimum Thicknesses at Right Angles to the Grain.

For grading purposes, the maximum thickness at **right angles** to the growth rings where a 2 rad board can be cut is used to determine whether a slab qualifies for a particular grade.

The specified minimum thicknesses in the *Schedule of Grade Rules* are the actual and unrounded measurements measured at right angle to the growth rings.

8.5.5.1 For Coastal Grades

1. Slabs are not permitted in the peeler B and C grades and the sawlog J grade.
2. Slabs must be at least 38 cm (19 rads) to qualify for classification as D, E, F, G, H, I and K grades, and meet the minimum diameter for the grade.
3. The minimum slab thicknesses for the shingle grades are specified in the grade rule for each grade.

4. To qualify for the utility U grade slabs must be at least 16 cm (8 rads) thick with a mean diameter of 8 rads, and a shape suitable for lumber manufacture.
5. To qualify for the utility X grade slabs must be at least 10 cm (5 rads) thick, meet the grade rule minimum diameter of 5 rads and have a shape suitable for lumber manufacture.
6. Slab thicknesses specified are actual unrounded measurements.

8.5.5.2 For Interior Grades

1. Slabs must be at least 20 cm thick and 20 cm in width to qualify for grade code 1.
2. 15 cm thick and 15 cm wide to qualify for grade code 2.
3. 10 cm thick and 10 cm wide to qualify for grade code 4.

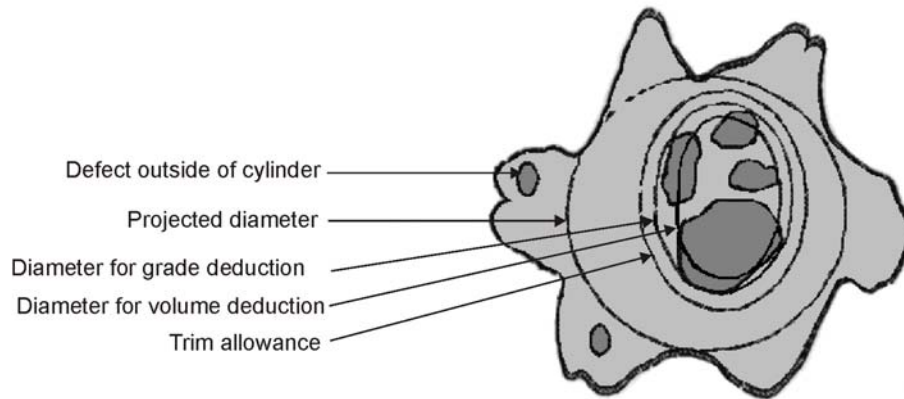


Figure 8.27 Irregular Butt Defects in a Fluted Butt Log.

The third example in Figure 8.27 shows scattered butt rot. Irregular or sporadic rot and water shake and those with defect extending into the collar will require a significantly larger initial measurement (before adding trim) than what would be used for a firmwood deduction. The illustration includes the following relationships:

- any defects outside of the gross butt diameter (projected butt diameter) are not considered for either firmwood deduction or grade reduction, although these defects may serve to indicate the severity of a butt defect. i.e. the distance it penetrates up the log,
- the grade reduction diameter is increased to include all the rot and other defect within the cutting cylinder that affects lumber recovery,
- trim allowance is added to the diameter for grade reduction in through running butt rot, and
- when two or more defects are positioned such that there is less than 5 rads (10 cm) of usable fibre available between the defects, the available material separating the defects is also unsuitable for manufacture and is included in the grade reduction .

8.6.2 Trim Allowance and Ring Shake

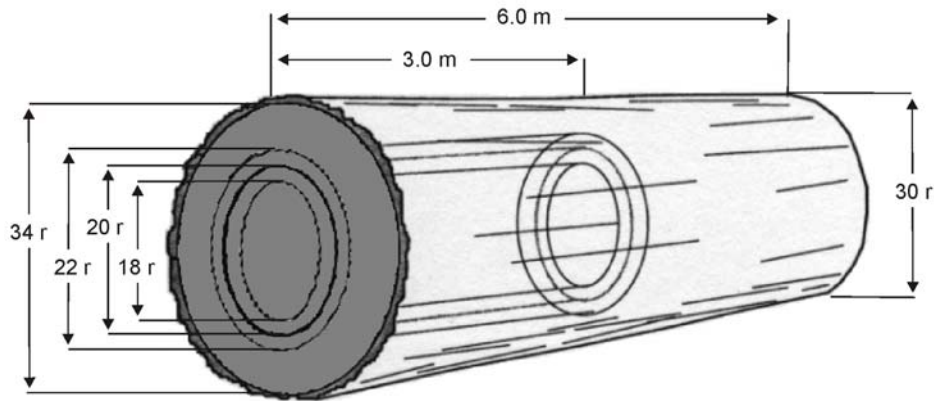


Figure 8.28 Ring Shake and Both Collar and Core are Thick Enough to Produce Lumber.

The example in this figure shows a log with ring shake which is estimated to penetrate one-half of the log length. Because the collar meets the minimum collar requirements, add a 1 rad trim allowance on both sides of the shake and deduct the volume of a 2 rad ring.

From the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 6 \text{ m}/30 \text{ r}/34 \text{ r} = (848 + 1090) = 1938 \text{ dm}^3 \\
 \text{Grade reduction} &= \text{UV } 22 \text{ r} - \text{UV } 18 \text{ r for 3 m} = (152 - 102) \times 3 = 150 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1938 - 150}{1938} \times 100 = 92.3 \text{ percent}
 \end{aligned}$$

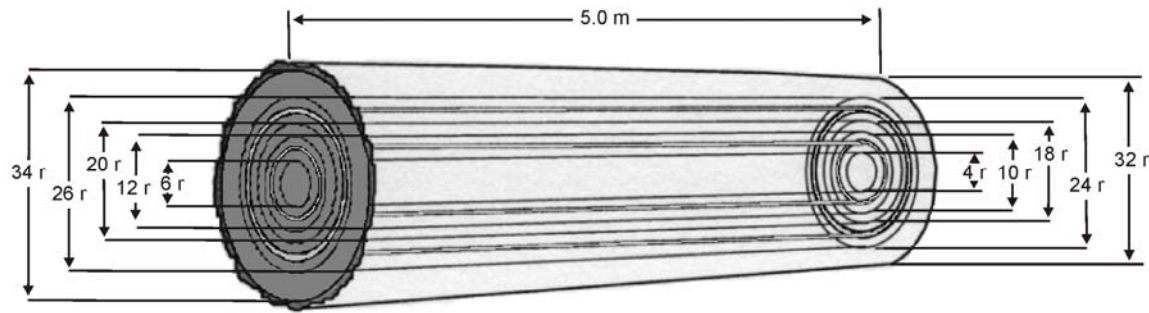


Figure 8.35 Multiple Ring Rot and the Firmwood Between Rings is 5 Rads or More.

The example above shows a log with two 1 rad rings of rot penetrating the full length and circumference of the log. Because both collars and the residual core meet minimum thickness requirements, trim allowance is added to both collars and the core. Although the number of dimensions shown in this example appears to represent a complex situation, there is only one extra step involved, and as with calculating the firmwood deduction, the work is done progressively, from the outside ring to the inside ring.

From the scale stick:

$$\text{Gross volume} = 5 \text{ m}/32 \text{ r}/34 \text{ r} = (804 + 908) = 1712 \text{ dm}^3$$

Outside ring:

$$\begin{aligned} \text{Grade reduction} &= \text{Outer cylinder } 5 \text{ m}/24 \text{ r}/26 \text{ r} = (452 + 531) = 983 \text{ dm}^3 \\ \text{less} &= \text{Inner cylinder } 5 \text{ m}/18 \text{ r}/20 \text{ r} = (254 + 314) = 568 \text{ dm}^3 \\ &= (983 - 568) = 415 \text{ dm}^3 \end{aligned}$$

Inside ring:

$$\begin{aligned} \text{Grade reduction} &= \text{Outer cylinder } 5 \text{ m}/10 \text{ r}/12 \text{ r} = (79 + 113) = 192 \text{ dm}^3 \\ \text{less} &= \text{Inner cylinder } 5 \text{ m}/04 \text{ r}/06 \text{ r} = (13 + 28) = 41 \text{ dm}^3 \\ &= (192 - 41) = 151 \text{ dm}^3 \\ \text{Sum of grade reduction} &= (415 + 151) = 566 \text{ dm}^3 \\ \% \text{ of log which can be manufactured} &= \frac{1712 - 566}{1712} \times 100 = 66.9 \text{ percent} \end{aligned}$$

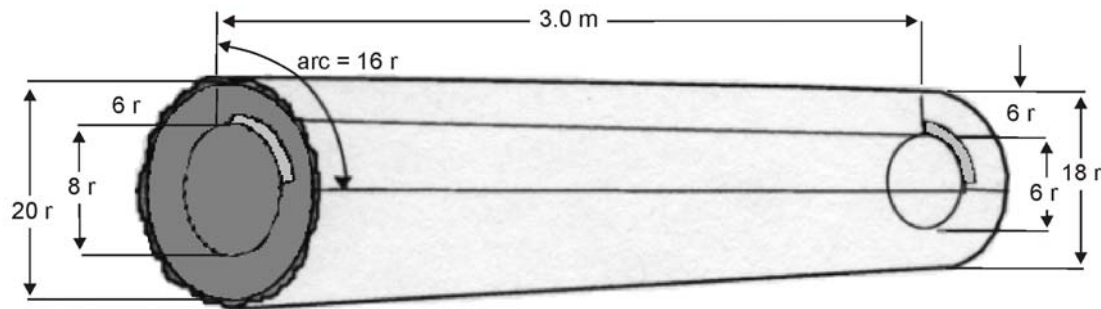


Figure 8.36 Partial Ring Rot 2 Rads Thick.

The example above shows a log with a partial ring of rot penetrating the full length and 1/4 of the circumference of the log. Because the collar does not meet the interior minimum thickness requirement, the entire portion of collar between the ring rot and the bark is grade reduction, and the entire core is available for manufacture. As with firmwood deductions, a factor is applied to obtain the net grade reduction. This factor may be easily visualized, if it is in simple fractions such as 1/4, 1/3, and 1/2. It can be calculated as a ratio of the circumference by multiplying the diameter by **the factor** and dividing the result into the arc of the defective sector, but finding the arc is not practical with conventional scaling tools, so an acceptable alternative may be used. Degree of arc is one option, using a watch or compass dial to learn to visualize sectors which are not obvious divisions of 360 degrees.

Factor from formal calculation:

Radius times π	=	20×3.14159	=	63 r circumference
Defect arc factor	=	$16 \text{ r arc} \div 63$	=	1/4 or 0.25 or 25 percent

Factor from a clock face, major divisions in 12ths (secondary divisions in minutes or 60ths, which are equal to 6 degrees/minute):

Position of hands	=	12:00 to 3:00	=	15 minutes
Defect arc factor	=	15 divided by 60	=	0.25 or 25 percent

Factor from **arc**

Position from North	=	90 degrees
Defect arc factor	=	$90 \text{ divided by } 360 = 0.25 \text{ or } 25 \text{ percent}$

There are several incremental options available to the scaler just from these two common objects, and of course, that which is most comfortable and familiar is preferred, even a piece of paper, which may be easily and accurately folded into 16ths.

From the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 3 \text{ m}/18 \text{ r}/20 \text{ r} = (153 + 188) = 341 \text{ dm}^3 \\
 \text{less} &= \text{Inside cylinder } 3 \text{ m}/06 \text{ r}/08 \text{ r} = (17 + 30) = 47 \text{ dm}^3 \\
 \text{Grade reduction} &= 341 - 47 = 294 \times \text{factor of } 0.25 = 73.5 = 74 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{341 - 32}{341} \times 100 = 78.3 \text{ percent}
 \end{aligned}$$

If a scaler encounters rot which does not penetrate the full length of the log, and indicators do not support the convention that it penetrates exactly 1/2 way, the use of unit volumes rather than half volumes is convenient. For example, with an assumption that the rot penetrates only 1.2 m in from the large end, from the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 3 \text{ m}/18 \text{ r}/20 \text{ r} = 153 + 188) = 341 \text{ dm}^3 \\
 \text{Grade reduction} &= \text{UV log (20 r) - UV core (8 r) } \times \text{factor (.25)} \times \text{length (1.2)} \\
 &= (126 - 20) \times 0.25 \times 1.2 = 106 \times 0.25 \times 1.2 = 32 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{341 - 32}{341} \times 100 = 90.6 \text{ percent}
 \end{aligned}$$

8.6.5 Application of Trim Allowance to Checks and Shake

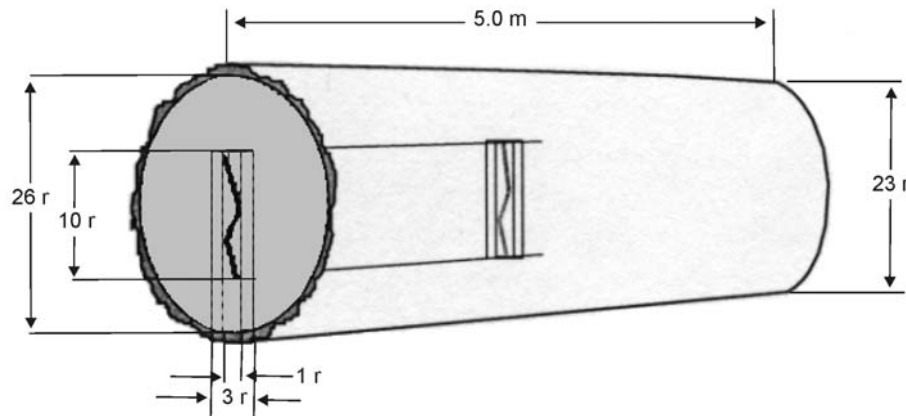


Figure 8.37 Irregular Heart Check.

This log illustrates an irregular heart **check** estimated to penetrate one-half the length of the log. Because the check is not straight, the area affected is enclosed, and in this case a 1 rad "box" will just contain it. Trim allowance is then added to both sides of the area enclosing the check, so that the grade reduction is for a block 3 rads by 10 rads by 2.5 m. Two common ways of finding the result are described below, depending on scaler preference. The first uses a factor of 0.4 to convert "square rads" times metres to cubic decimetres as follows:

From the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 5 \text{ m} / 23 \text{ r} / 26 \text{ r} / &= (415 + 531) &= 946 \text{ dm}^3 \\
 \text{Grade reduction} &= 3 \text{ r} \times 10 \text{ r} \times \text{factor of } 0.4 \times 2.5 \text{ m} \\
 &= 3 \times 10 \times 0.4 \times 2.5 = 12 \times 2.5 = 30 \text{ dm}^3
 \end{aligned}$$

Another popular method to find the grade reduction for rectangular defects is to use centimetres for the width and height of the defect (6 cm by 20 cm by 2.5 m), convert the measurements to decimetres, (cm/10 and m x 10) and calculate the example as follows:

$$\begin{aligned}
 \text{Grade reduction} &= 6/10 \text{ dm by } 20/10 \text{ dm by } 25 \text{ dm} \\
 &= 0.6 \times 2 \times 25 = 30 \text{ dm}^3
 \end{aligned}$$

Either method will produce the same results:

$$\begin{aligned}
 \text{\% of log which can be manufactured} &= \frac{946 - 30}{946} \times 100 = 96.8 \text{ percent}
 \end{aligned}$$

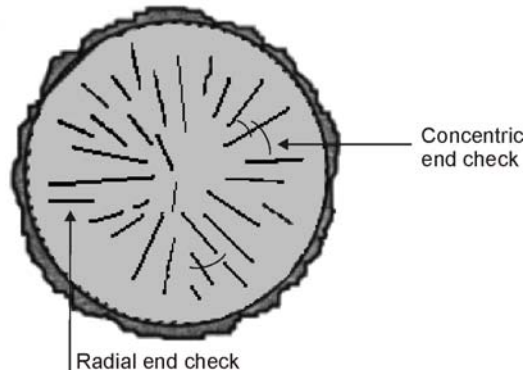


Figure 8.38 End (weather) Checking.

This example shows typical end checking. It is caused by rapid seasoning at the ends of logs after they are bucked green, and normally penetrates only a short distance into the log. It is typified by being numerous, usually following the wood rays (radiating out from the heart, and are not necessarily part of a surface check). They are occasionally concentric with the growth rings. Trim allowances and grade reduction may be applied only to those which have developed into extensive end split and are permissible under current grading rules (the Forest Service may order that end checking be ignored).

End checking is not to be confused with splits, shakes and surface checking visible at the end of a log. End checking is caused by rapid drying at the end of a log after it is bucked green and normally penetrates only a short distance into the log. End checking will be ignored for grading purposes.

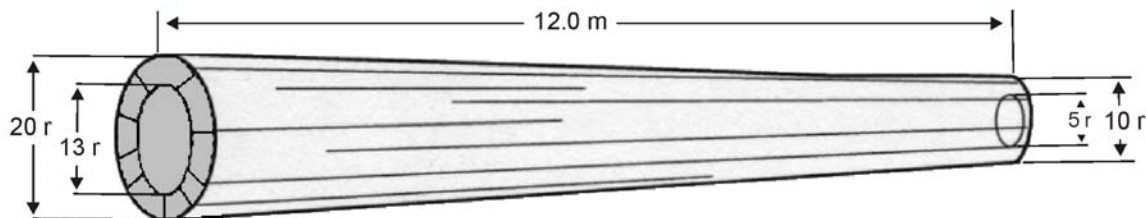


Figure 8.39 Extensive Surface Checking.

This log illustrates multiple deep surface checks which cover the entire log, with the penetration clearly visible on the ends of the log. Here it is estimated that the recoverable core of the log is equal to a 5 rad by 13 rad log 12 m long, after excluding the area affected by the checks.

From the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 12 \text{ m}/10 \text{ r}/20 \text{ r} = (188 + 754) && 942 \text{ dm}^3 \\
 \text{Volume available} &= 12 \text{ m}/5 \text{ r}/13 \text{ r} = (47 + 319) && = 366 \text{ dm}^3 \\
 \text{Grade reduction} &= 942 - 366 && = 576 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{942 - 576}{942} \times 100 && = 38.8 \text{ percent}
 \end{aligned}$$

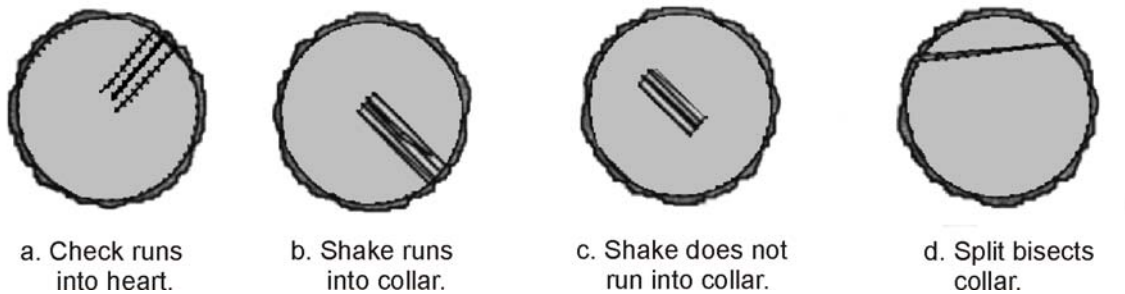


Figure 8.40 Trim Allowance for Check, Shake and Split in Relation to Collars.

This example shows four log ends, each with one straight separation, located at different points on the log. Trim allowance is added according to the following conventions:

1. Log "a." has a straight surface check running to the heart. Trim allowance is added to both sides of the check.
2. In log "b.", a heart shake runs out at a point less than 5 rads from the bark. Trim allowance is added to both sides of the shake and extended to the bark to include the affected portion of collar in the grade reduction.
3. In log "c.", a heart shake runs out at a point 5 rads or more from the bark. Trim allowance is added only to the sides of it.
4. In log "d", a split bisects the collar less than 5 rads from the bark. Trim allowance is not added to the split, and the entire segment outside of it is grade reduction.

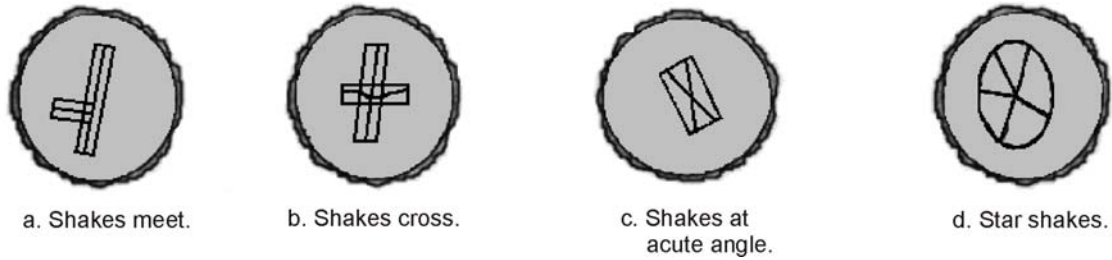


Figure 8.41 Trim Allowance for Multiple Heart Shake.

This example shows four log ends with multiple heart shake. It is necessary to apply trim allowance in a manner which best accommodates the forms which the shake takes. Two conventions allow for the full range of heart shakes.

1. Logs "a." and "b." both have two straight heart shakes that meet or cross each other, and they are at more or less right angles to each other. It is apparent from this form of separation that it is possible to "square up" around them by adding trim allowance individually to each one.
2. Log "c" also has two straight shakes, but they are at too extreme of an angle to each other to consider adding trim allowance to each one. Log "d" has a star shake, which is characterized by having more than four points that are asymmetric to each other. In this form of shake, trim allowance is added by encircling them, (in a circle or ellipse), because it is not practical to cut lumber from around each one. Depending on the size of the log and the arms of the star shake however, it may be possible to cut lumber from between them where any adjoining arms are 5 rads or greater apart. In these cases, the grade reduction should be decreased.



8.6.6 Application of Trim Allowance to Off Centre and Overlapping Defect

Although the two examples below are completely different types of defect, they are treated in a very similar manner to each other, when a heart defect extends into a portion of a collar. The only difference between the two is in the application of trim allowance, as described in the example calculations.

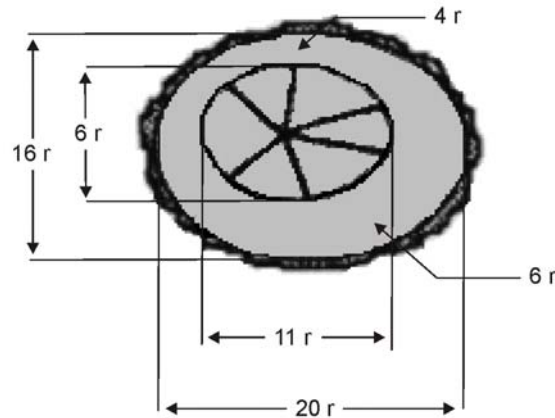


Figure 8.42 The Application of Trim Allowance to Off Centre Defects.

The example above shows the end of a fir log which has grown with an off-centre heart. Typical of this type of log, the defect radiating from the pith is also off centre, and one-half of the collar is too thin to produce lumber (**coast**). Since there are too many arms to add an allowance to each one, the affected area is completely enclosed in a circle or ellipse. The first grade reduction is for the star shake for the distance it is estimated to travel.

From the scale stick:

Gross unit volume	=	UV 18 r	=	102 dm ³
Grade reduction	=	(6 + 11)/2	=	UV 08 r = 20 dm ³
Net unit volume	=	102 – 20	=	82 dm ³

The second grade reduction is for the collar which is less than 5 rads thick for 1/2 the circumference (based on the net unit volume from the first calculation to avoid duplication of the overlapping grade reductions):

Grade reduction	=	82 x 0.5	=	41 dm ³
Total reduction	=	41 + 20	=	61 dm ³
% of log which can be manufactured	=	$\frac{102 - 61}{102} \times 100$	=	40.2 percent

This example also demonstrates the need to go through the calculations to achieve and maintain proficiency. At first glance, a scaler may decide that this log was 100 percent grade reduction, but because the defect is offset, it is not.

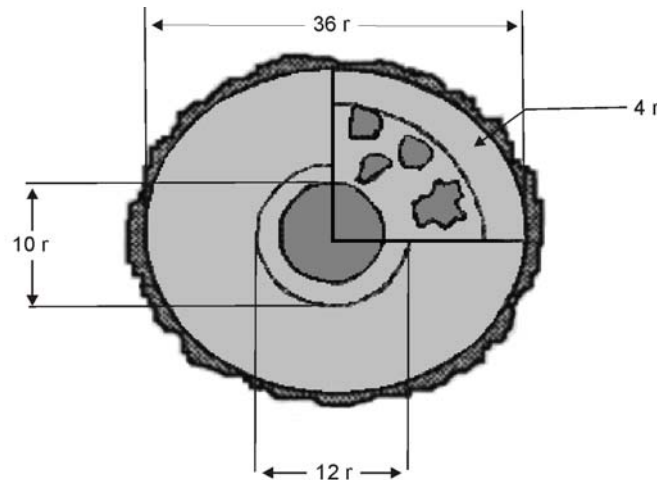


Figure 8.43 The Application of Trim Allowance to Overlapping Defects.

This example shows a log which has a rotten core and scattered pocket rot with less than 5 rads separation between the pockets. The entire area enclosing the pockets is grade reduction, and because the pockets are closer than 5 rads of the bark, the collar is 100 percent grade reduction. Trim allowance is added to the core of rot and to the area enclosed by the pockets. From the scale stick:

The first grade reduction is for the rotten core:

Gross unit volume	=	UV 36 r	=	407 dm ³
Grade reduction	=	UV 12 r	=	45 dm ³
Net unit volume	=	407 – 45	=	362 dm ³

The second grade reduction is for the collar which is less than 5 rads thick for 1/4 the circumference (based on the net unit volume from the first calculation to avoid duplication of the overlapping grade reductions):

Grade reduction	=	362 x 0.25	=	90 dm ³
Total reduction	=	45 + 90	=	135 dm ³
% of log which can be manufactured	=	$\frac{407-135}{407} \times 100$	=	66.8 percent

8.6.7 Determining Grade Reduction for Spiral Checks

Where spiral checks occur, the scaler must "block out" the portion of the log affected by a check  to calculate the grade reduction. No trim allowance is added to spiralled check .

In field application, this is normally a visual estimate. The scaler can easily assess the lumber loss due to a spiral crack by observing the deviation from a straight line over the length of the log. For example, if a surface check penetrating to the heart follows the spiral grain from "12 o'clock" at one end to "3 o'clock" at the other, the deviation is 3/12, or 25 percent of the log's circumference for the length of the check. The length of a log is important in calculating grade reduction: Logs less than 5 m long are assessed over their entire length. Logs 5 m and longer are assessed on 2.5 m segments.

If a spiral surface check does not penetrate all the way into the heart, the grade reduction is of course less than for a full check, and it is important to understand the relationship between the depth of penetration and the effect on volume. For example, a check penetrating half-way to the heart would have 75 percent of the effect of a full check, because 75 percent of the volume of any round log is contained in the outer half of its radius.

The following examples show the effect of spiral check and heart **check** on grade reduction for short and long logs, and ways of calculating grade reduction.

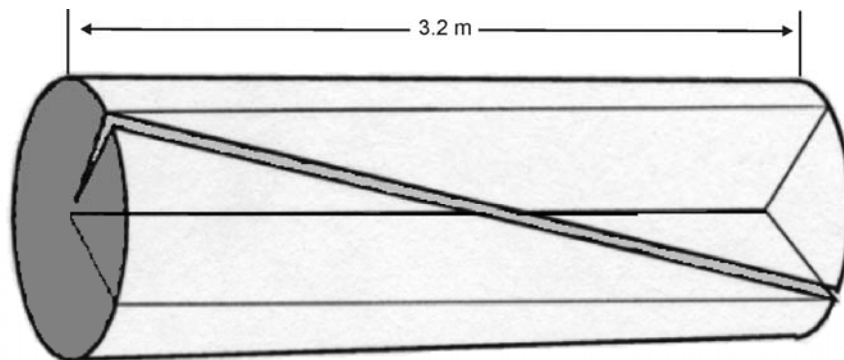


Figure 8.44 Logs Shorter Than 5 Metres are Assessed on Their Length.

The first log shows a uniform spiral check running its full length. Because the log is less than 5 m long, assess the twist on the log length. In field practice, it is only necessary to observe the degree of spiral from one end to the other and estimating the percentage of the log affected, in this case 25 percent of its circumference. Therefore the grade reduction on the log is also 25 percent.

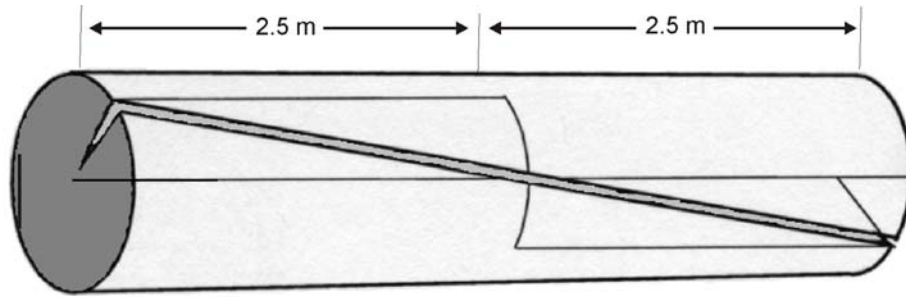


Figure 8.45 Logs 5 Metres and Longer are Assessed in 2.5 Metre Segments.

The second figure shown here also has a uniform spiral check running its full length and affecting 25 percent of its circumference. If a 25 percent grade reduction was taken, however, it is too severe for logs of this length or longer, because lumber recovery is gauged on 2.5 m minimum lengths. Therefore, the log is visually segregated into two segments, each with a 12.5 percent grade reduction.

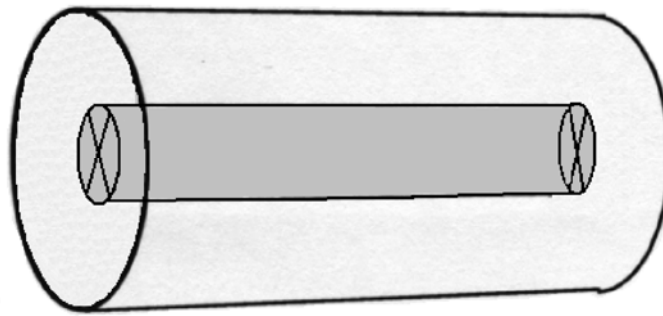


Figure 8.46 Log with Spiral Heart Check.

This log shows a spiral heart **check**. It may be treated similarly to acute or irregular heart shake, as shown in the examples except that trim allowance is not added. That is, the grain deflection is projected to the opposite end of the log, the area affected is enclosed in a circle, and the grade reduction calculated from that.

8.6.8 Determining Lengths for Grading Purposes – Logs and Log Segments

Logs and slabs must be at least 2.5 m long to produce lumber. Logs, slabs, and chunks shorter than 2.5 m are considered to be 100 percent grade reduction. In most instances, the portion of the log's length that is 5 rads (10 cm) or more in diameter is the basis for its grade.

Some situations, however, require the scaler to deem the log to be another length for the purpose of establishing its grade. Where timber has been cut into lengths less than 2.5 m (interior) or 5.2 m (coast); for the purpose of grading they may be deemed to be 2.5 m (interior) or 5.2 m (coast) long if:

- the portion of a log cut from the top of a tree exceeds 5 rads (10 cm) in diameter and the log displays a cut face on the butt end, or
- the log is scaled after it has been bucked at the scale site, or
- if a scaler is instructed under the Scaling Regulation to use deemed lengths for the purpose of grading.

In all instances, breakage is always graded on the basis of its actual length (breakage is defined as any piece, meeting the minimum diameter of the cutting authority, which is shorter than 2.5 m in length and broken at the large end or at both ends).

For reporting purposes, the actual net length of a log is always recorded on the tally sheet, not the deemed length.

In general, deemed lengths are used in scaling short pieces for two purposes:

- they help to ensure that scaling is consistent with the merchantability specifications, and
- they facilitate more consistent grading decisions.

The following figures demonstrate examples of the principles of length determination for calculating grade reduction in scaling, including situations where short logs are deemed to be another length for purposes of grading.

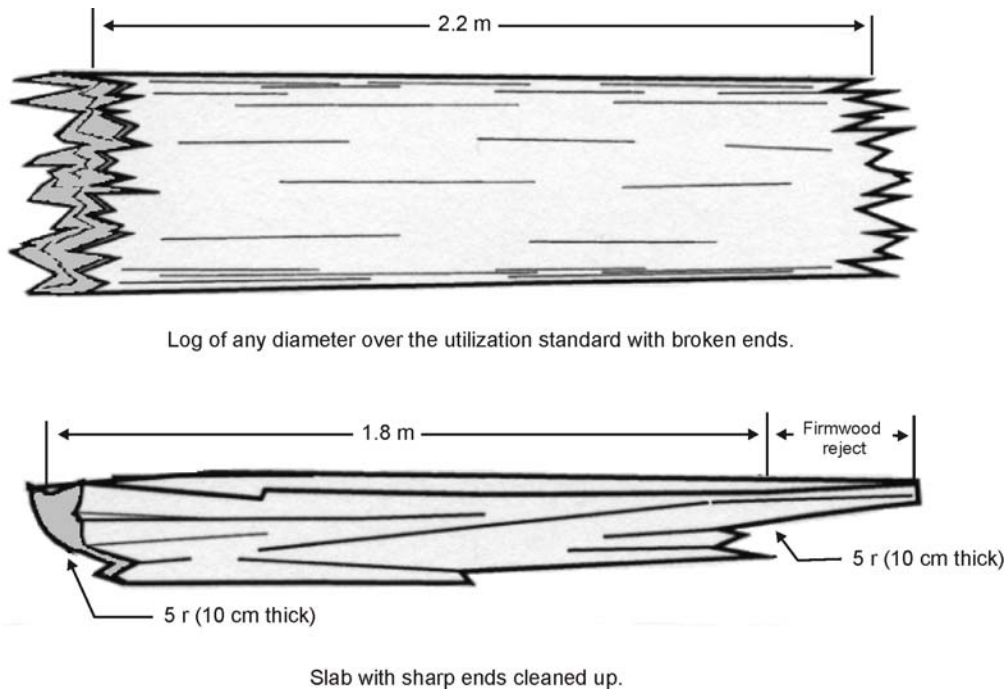
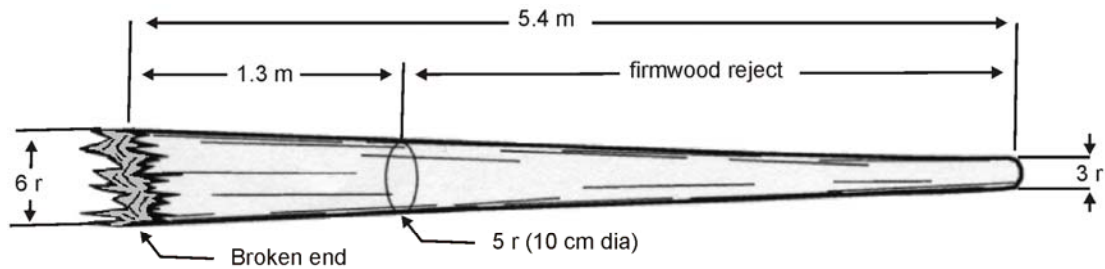


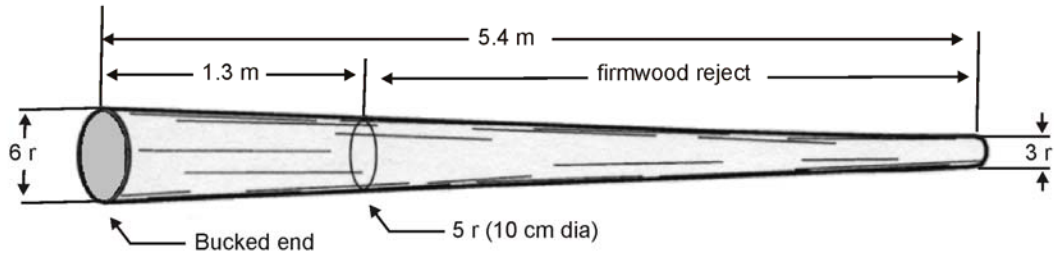
Figure 8.47 Short Breakage Pieces Contained in a Conventional Load.

These logs show two examples of breakage which are graded on the basis that the log length available to cut lumber is less than 2.5 m. These pieces are considered to be normal breakage. If they were broken subsequent to delivery, however, they would be deemed to be 2.5 m (interior), and 5.2 m (coast) for the purpose of grading, excluding the firmwood reject portions.

In breakage, log ends may or may not be "cleaned up" when they arrive at a scale site. It is shown in the second example that the sharp ends have been bucked off for obvious safety reasons, and is most often apparent to the scaler because some signs of breakage are usually showing, such as splits, pulled bark and remaining shatter. Therefore, when assessing these logs, if evidence of breakage is apparent, they are graded on the basis of actual length.



The 1.3 m portion of this log is graded on the basis of its actual length.



The 1.3 m portion of this log is deemed to be 2.5 m long (Interior) or 5.2 m (Coast).

Figure 8.48 Rat Tail Tops Delivered with a Short Segment Over 10 cm 



The example above shows two similar "rat tail" logs which were delivered to a scale site. For both logs, the portion of the log less than 5 rads (10 cm) in diameter is graded as firmwood reject. The portions of the logs 5 rads (10 cm) and larger, however, are treated differently for grading purposes because one log is normal breakage, and the other is "bucking waste"; it should have been bucked at the point where the log became 5 rads (10 cm) in diameter.

The examples on the previous page illustrate a number of instances of short logs left after handling and bucking at the scale site prior to scaling. For grading purposes, these logs are all deemed to be 2.5 m long in the interior and 5.2 m long on the coast, even though the recorded measurements are as shown in the examples. That is, they may not be down-graded because they are shorter than the minimum requirements.

Where unscaled timber is bucked and delivered to a scale site or bucked at the scale site for the purpose of manufacturing special forest products prior to scaling, the timber is to be scaled and graded as logs unless it has been classified as a special forest product. The classification and scaling of special forest products are described in the chapter of the same name in this manual. Figure 8.50 below provides examples of different logs which were bucked to specific lengths to suit the specifications of the product, but do not have special forest product status. Therefore, just as with other logs and chunks shorter than 2.5 m long for grading purposes, they are deemed to be 2.5 m long in the interior and 5.2 m long on the coast.

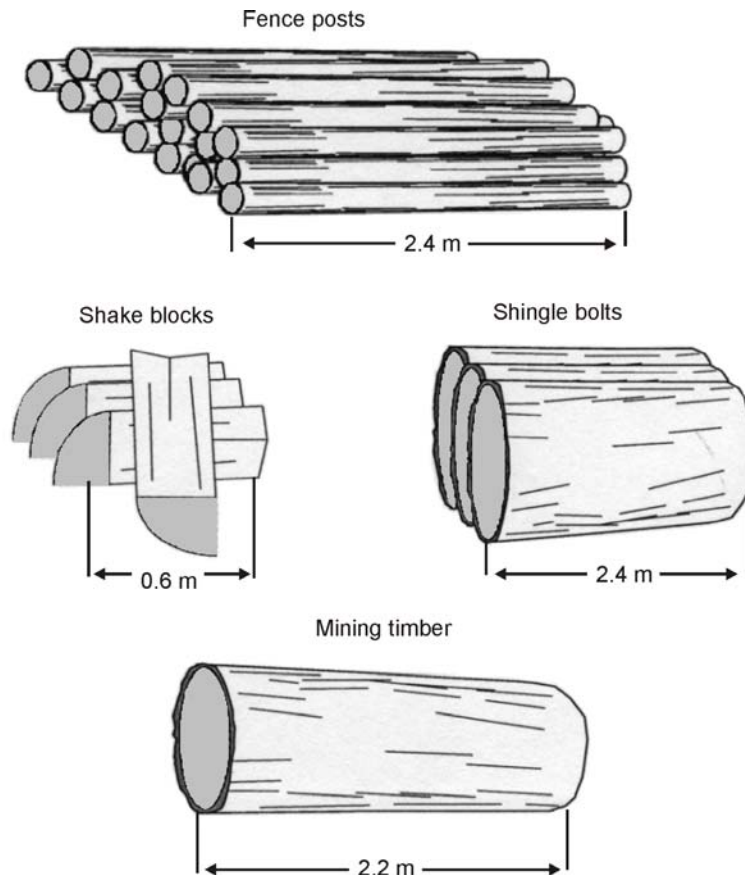


Figure 8.51 Example of Logs Cut to Special Forest Product Lengths but Not Classified as Such and Deemed to be 2.5 m Long (Interior) and 5.2 m Long (Coast).

8.6.9 Assessing Grade in Logs with Crook, Pistol Grip and Sweep

8.6.9.1 Crook

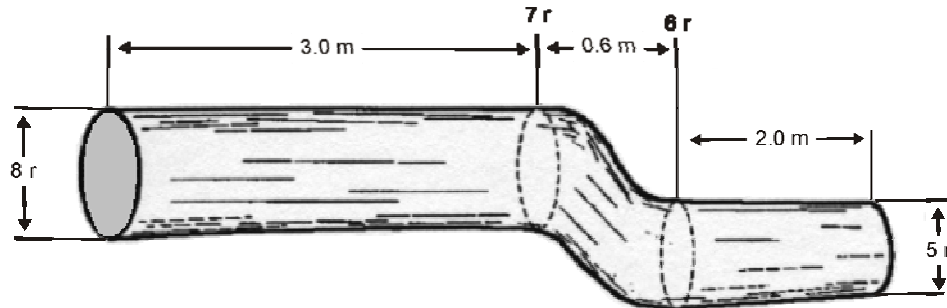


Figure 8.52 *Visually Bucking a Log with Crook to Assess Lumber Recovery.*

The first log in this section is a log with severe crook near the top end of the log. The crook is grade reduction because that portion is not straight enough to recover lumber. The portion above the crook is also grade reduction because it is too short to cut lumber, so the log is 100 percent grade reduction for 2.6 m.

8.6.9.2 Pistol Grip

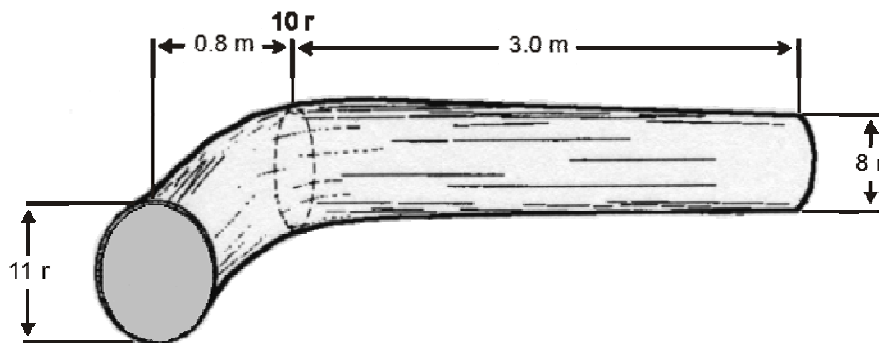


Figure 8.53 *Visually Bucking a Log with Pistol Grip to Assess Lumber Recovery.*

The pistol grip in this example affects 0.8 m of the butt end of the log and because this section is too short to manufacture lumber, it is a 100 percent grade reduction for 0.8 m.

8.6.9.3 Sweep

For logs affected by sweep, the scaler should assess the percentage that is available to cut 2.5 m of lumber that is straight enough. An example of straight enough lumber is based on the NLGA (National Lumber Grading Authority) requirements that would allow a minimum warp.

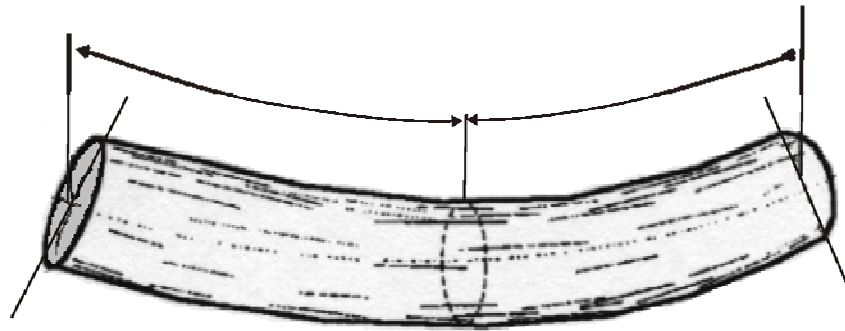


Figure 8.54 Visually Bucking a Log with Sweep to Assess Lumber Recovery.

The log shown here has severe sweep which is uniform throughout the length of the log. If this log was bucked at its mid-point, the sweep would be reduced and it would produce two logs of adequate length. The log would be suitable to produce a portion straight enough to cut lumber and milling losses would be minimized.

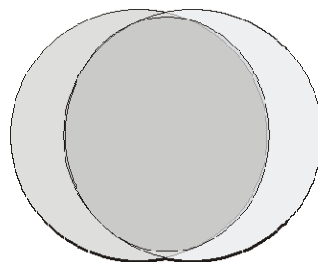


Figure 8.55 An Ellipse Shape is Created When Sweep Misaligns the Two Ends of a Log.

When considered from the end, the area available to cut lumber from a log shows as an elliptical shape. The darker shade shows what portion is available to cut lumber.

This ellipse can be calculated using the following formula:

$$\text{Width (cm)} \times \text{Height (cm)} \times (\pi/4)$$

8.6.9.3.1 Measuring the Sweep

The following is the procedure to measure the offset:

Lay a tape straight on the log from the top centre to the butt centre of the log.

Find the geometric centre of the affected section.

Measure the distance between the tape and the geometric centre of the affected segment.

This procedure can be repeated vertically or horizontally for logs affected by more than one sweep. The example below shows a loggers tape being positioned at the geometric centre point of each log end. The geometric centre of the log at midpoint is then determined. Measure from that geometric centre to the tape edge with a scale stick to establish the offset in rads.

8.6.9.3.2 Simplified Method

The following calculation methods will provide you with accurate percentages, however they may be somewhat onerous in a field situation. In recognition of the difficulty with multiple calculations, simplified methods have been provided.

A comparable method is:

Midpoint – Offset/Midpoint (or top measurement if $\leq 2.5\text{m}$) x 100 = % available to cut.

Midpoint diameter (or **top** on logs or segments 2.5 m in length) – offset = width and height.

Using the example shown in Figure 8.5.7 this becomes:

$$20 - 5 = 15 \text{ width and height}$$

Using these numbers the simplified formula becomes:

$$\frac{15}{20} \times 100 = 75 \%$$

This example shows a 2.5 metre log with an 18 rad top and 19 rad butt. The measured offset is 4 rads.

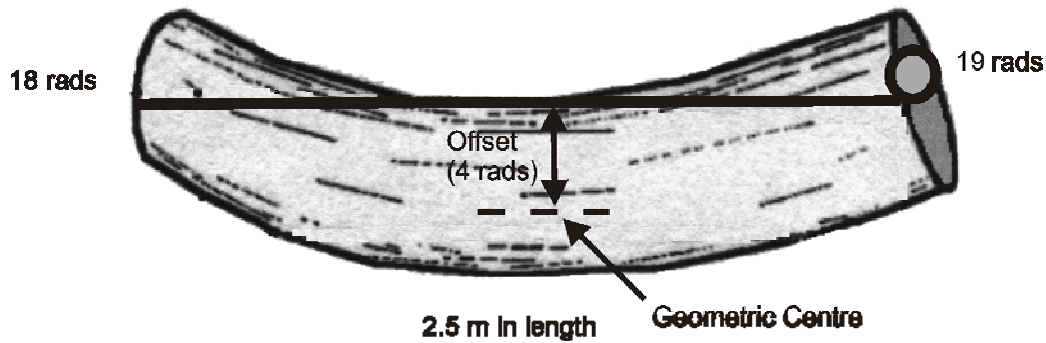


Figure 8.56 Measuring the Offset for 2.5 m Log.

8.6.9.3.3 Section/Segment Less Than 2.5 Metres

For this calculation the width is equal to the height minus the offset. The height is equal to the small end in rads. This formula is then divided by the area of the small end times the length of the log in decimetres. Multiply that product by 100 to convert to the percentage available to cut lumber.

* All value have been converted to decimetres or square decimetres.

$$\frac{\text{Width (dm)} \times \text{Height (dm)} \times (\pi/4) \times \text{length (dm)}}{\text{Small End Area (dm}^2\text{)} \times \text{length (dm)}} \times 100 = \% \text{ available}$$

Small End (rads) - Offset (rads) = Width (rads)

For example in Figure 8.5.6:

18 rads - 4 rads offset = 14 rads (28 **cm**) = 2.8 **dm** Width

18 rads (36 **cm**) = 3.6 **dm** Height

Area of small end = $18 \times 18 \times 3.141592 (\pi) = 1018 \text{ cm}^2 = 10.2 \text{ dm}^2$

2.5 **m** = 25 **dm**

Using these values the formula becomes:

$$\frac{2.8 \times 3.6 \times (.7854) \times 25}{10.2 \times 25} \times 100 = 77.6 \%$$

8.6.9.3.4 Logs 2.5 Metres to 4.9 Metres

There is a difference in the formula for sweep on logs between 2.5 m. and 4.9 m. The midpoint area is used for this length rather than the small end. The formula becomes:

$$\frac{\text{Width (dm)} \times \text{Height (dm)} \times (\pi/4) \times \text{length (dm)}}{\text{Midpoint Area (dm}^2\text{)} \times \text{length (dm)}} \times 100 = \% \text{ available}$$

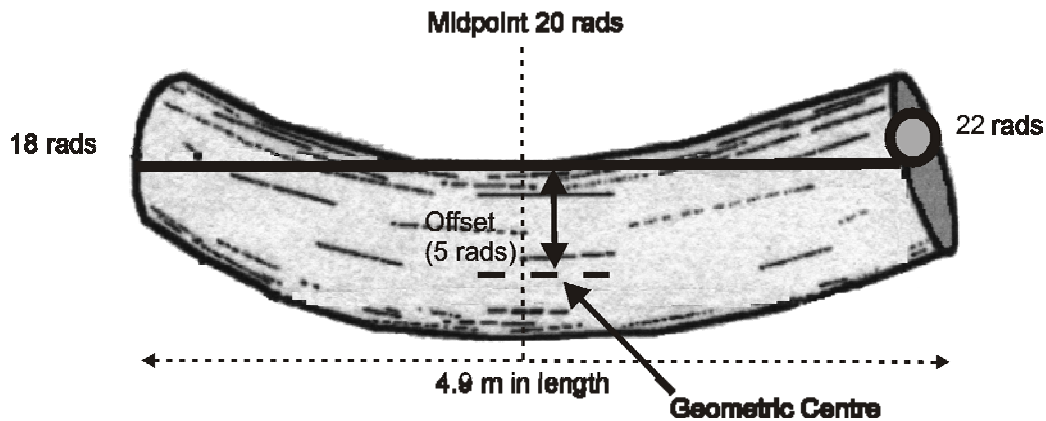


Figure 8.57 Measuring the Offset of Logs 2.5 m to 4.9 m.

20 rads - 5 rads offset = 15 rads (30 cm) = 3.0 dm **Width**

20 rads (40 cm) = 4.0 dm **Height**

Area of midpoint = $20 \times 20 \times 3.141592 (\pi) = 1256 \text{ cm}^2 = 12.5 \text{ dm}^2$

4.9 m = 49 dm **length**

Using the values in this example the formula becomes:

$$\frac{3.0 \times 4.0 \times .7854 \times 49}{12.5 \times 49} \times 100 = 75.4 \%$$

8.6.9.3.5 Sweep Calculation Summary:

- For 2.5 m section, small end – offset = width
- For 2.5 m to 4.9 m log, mid point - offset = width
- Volume of ellipse/ gross volume x 100

9.1.3 Identifying Undersized Logs in the Interior

When scaling interior timber, scalers must assign an undersized grade to logs which are cut from trees which are smaller than the diameter measured outside the bark at a point 15 cm (7.5 rads) from the butt end on candidate logs.

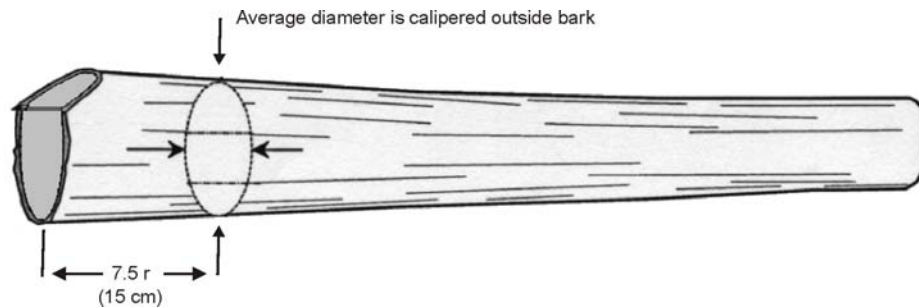


Figure 9.1 Measuring Diameter for Interior Undersize Grade.

To be considered for the undersized grade:

- A log must show sufficient evidence such as an undercut, butt flare, **feller buncher cut**, thick bark or other butt characteristics to indicate it comprises a tree and not a top cut or long butted log, and
- the outside bark measurement (averaged) at a point 15 cm from the butt face must be less than the minimum diameter specified.
- If the undercut portion **or feller buncher cut** of a log has been removed, it cannot be classified as an undersized **log**.
- Scalers are to use minimum of 15 cm (7.5 rads) for lodgepole pine and 20 cm (10 rads) for all other species.

If there is no evidence a log was cut from an undersized tree, it must not be graded as Grade 6.

9.2 Physical Characteristics Affecting Log Grades

Some aspects of the factors affecting log grades have been explained in the Timber Grading chapter, while others require further explanation specific to interior grading.

9.2.1 Compression Wood

Where the heart (pith) is displaced by more than 20%, from the centre of the log it affects the quality of the lumber which is cut from the “compressed” side, or portion of the log. Compression wood is identified in off centre hearts by the “compressed” or tight grain that appears on the smaller log side (shaded area), while the other (larger segment) of the log has normal ring separation and is free of “compression” effects.

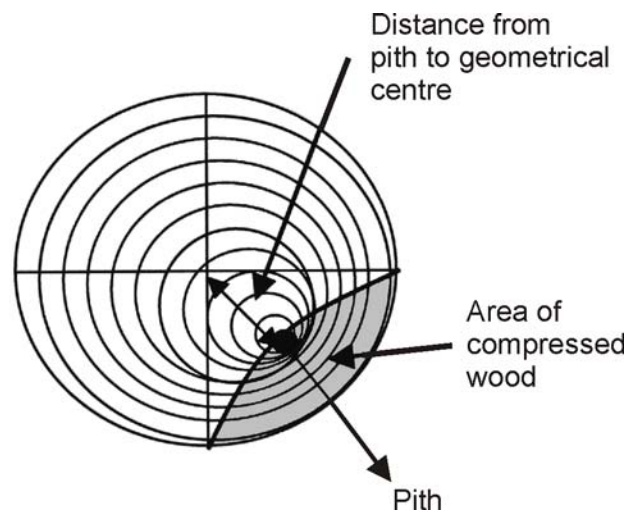


Figure 9.2 Measuring Compression Wood (the shaded area is the area of grade consideration).

A grade reduction can be made in the assessment of grade code 1 only. Normally off centre heart affects less than 2.0 metres of the log length however, other external indicators may be present which indicate the displacement of the heart extends further in the log.

To calculate the determination of the 20% offset measure the gross diameter of the log where the defect is seen, determine the geometrical centre of that end, and measure in centimetre from the pith to that centre. That measurement divided by the gross diameter multiplied by 100 will be the percentage of the offset. Example: gross diameter is 20 rads; the measurement is 4 rads, $4 \text{ rads} / 20 \text{ rads} \times 100 = 20\%$.

The measurements must be taken from the section of the log that is affected or compressed. If the percentage is greater than 20% a grade consideration must be calculated.

1. Measure the area affected by the compressed area from the pith to the outside edge.
2. Decide on the length of the defect to a maximum of 2.0 metres, unless there is an indication that another length would be more suitable.
3. Calculate the volume of grade reduction for grade 1 candidate logs only.

9.2.2 Checks

Types of Checks:

- End
- Surface (Straight)
- Spiral
- Weather

End checks are checks that show only on the ends of the log, and extend from the outside surface towards the heart. These may or may not run up the bole of the log. End checks must be counted to assess the grade according to the Grade Code 2 Log Requirements to Make the Grade

Surface (straight) checks are on the bole of the tree with no degree of spirality. Surface checks must be assessed in conjunction with end checks to determine grade and in some instances may assist with determining the depth of checks on the bole of the log..

Spiral checks may follow the deflection of the grain and can cause a much greater grade reduction than a straight check because of the loss due to the inclusion of the fibre as it spirals.

Weather checks differ from end or straight checks in that they appear to be wider in the centre of the log end than at the edges. Often weather checks will radiate towards, but not as far as, the surface of the log.

If there are not sufficient numbers of checks to downgrade using the Grade Code 2 Log Requirements, then all checks 4 cm or greater must be assessed by adding trim allowance to the grade reduction and using an appropriate deduction method.

Scalers must use good judgement in deciding how far a check runs along the bole. If the surface check is visible at the log end, but not visible on the surface of the log, the convention is to run the check half the length of the log, or 2.5 m (metres), whichever is less. This convention must only be used if it cannot be determined how far the check runs due to ice, snow, or mud. This convention is not to be used if the bole is bark covered, or if the actual length of the check can be determined.

Checks are assessed in 2.5 metre sections as per the Timber Grading chapter of the manual. Any check or other defect that hampers lumber recovery is a possible grade consideration. Where defects such as checks, shake, heart and ring shake, bark seam, cat-facing, sweep, crook, pistol grip, rot, hole, charred and missing wood affect the recovery of lumber, a grade reduction consideration must be made.

9.2.2.1 Procedures for Assessing Checks under the Grade Code 2 Log Requirements to Make the Grade:

Measure the end and count the number of end or surface checks over 4 cm in depth.

Determine if there is more or less than 50% bark covering the bole.

Determine whether the number of checks available for grade reduction meet the requirements of Section 9.5.4.2.

If YES, the section is 100% grade reduction.

If NO, the section can not be 100% grade reduction for surface checks alone. Each check is boxed with trim allowance and the grade reduction is calculated using the appropriate method. This is also the method for determining grade reduction for checks on ends greater than 10 rads.

9.2.2.2 Weather Checks

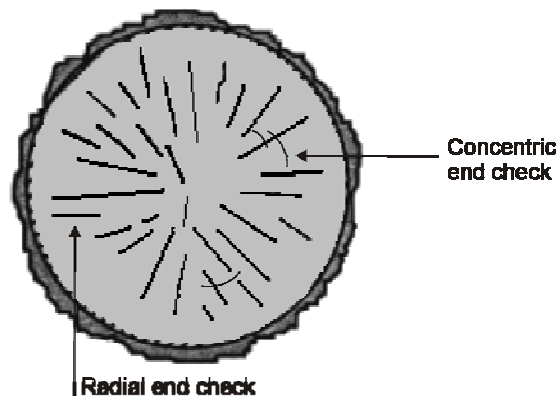


Figure 9.3 Weather Checking.

This example shows typical weather checking. It is caused by rapid seasoning at the ends of logs, and normally penetrates only a short distance into the log. It is typified by being numerous, usually following the wood rays (radiating out from the heart) and are not part of a surface check. They are occasionally concentric with the growth rings.

Weather checks differ from end or straight checks in that they appear to be wider in the middle of the log than at the edges. Often weather checks will radiate outward but not as far as the surface of log.

Weather (end) checking is not be confused with splits, shakes and surface checking visible at the end of a log. Weather checking is caused by rapid drying at the end of a log and normally penetrates only a short distance into the log.

9.2.3 Delay in Scaling

A delay in scaling is determined as follows:

- logs have been decked for a period of time such that the ends of the logs are dark and weathered,
- a field scale was previously conducted on the timber, or
- a determination has been made by the District Manager that a delay has occurred.

In circumstances where surface and end checks are due to delays in scaling the Forest Service **will** order **these** checks to be disregarded.

9.3 Potential for Manufacture of Product - Quantity

Sawlog grades specify percentages of the gross scale that must be suitable to cut out lumber.

In order to ensure standard application of grade reduction procedures some additional information on assessment of defect on interior timber is provided

9.3.1 Log Size

In applying the diameter criteria, note the following:

- Diameter for purposes of applying interior grade rules is the gross diameter inside bark at the small end of the log for logs up to and including 8.0 m in length and the mid-point diameter for logs longer than 8.0 m. The gross diameter is the actual measured diameter before making any deduction for any defect, including sap rot, for all species.

9.3.2 Insect or Worm Holes

A number of insects lay eggs under the bark of trees and the larvae will bore through the wood as they develop. When the presence of borings is observed the quality of potential products may be reduced and the log grade affected.

Grade code 1 does not permit 5 or more insect holes to penetrate beyond the sapwood and/or heartwood of the tree per running metre, except for those of the ambrosia beetle which are disregarded altogether.

The Ambrosia beetle attacks felled timber and the small holes made by this insect are common. This is not a serious defect for sawlog grades which require merchantable quality lumber.

9.4 Potential for Manufacture of Products - Quality

As well as prescribing a percentage of the gross scale that must be suitable to produce manufactured products, each grade rule above Grade code 4 includes a specification regarding the quality of the potential product. Specifically, percentages of the lumber are required to be "merchantable".

Each grade rule has guidelines appended which state requirements regarding quality factors.

9.4.1 Occasional Oversized Knots

All sawlog grades can have occasional oversized knots. Knots which exceed the maximum for the log diameter are considered as oversized. Interior grading allows one oversized knot for every 2.5 m of log length. An exception to this rule is for Grade code 2 where the section of a log between 5 rads (10 cm) to 7 rads (15 cm) in diameter does not allow any oversized knots.

The location and frequency of oversized knots is a key determinant in assessing the merchantability of potential lumber recovery.

9.4.2 Knot Spacing

Knot spacing is only a consideration for Grade 1 logs. Knots ≥ 3 cm must be spaced at least 30 cm apart when measured lengthwise, and they must be 10 cm apart when considering knots measured side-to-side. As well, a single knot spacing consideration is permitted for every 2.5 m much the same as oversized knots. Adventitious knots are not considered for knot spacing.

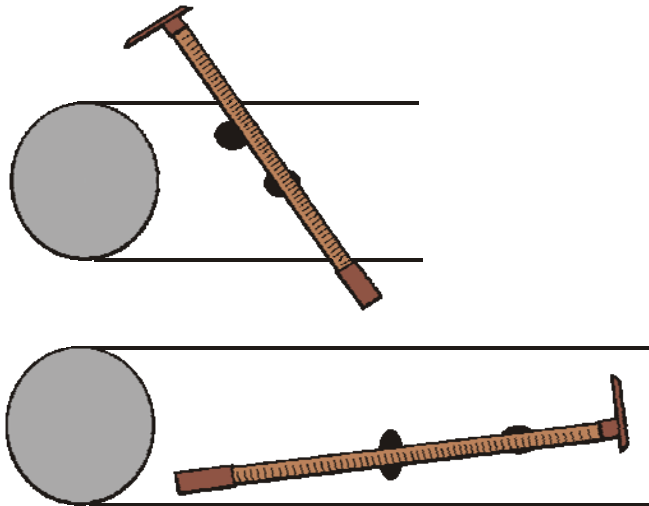


Figure 9.4 All Knots Must be Physically Measured in Any Direction.

9.4.3 Twist (Spiral Grain)

Measure twist over a 15 rads (30 cm) log section. To manufacture merchantable lumber the grain deflection over the 15 rad (30 cm) section cannot exceed 7 percent for grade code 1 and 15 percent for grade code 2, of the reference diameter. See the Timber Grading chapter for a more detailed explanation on measuring grain deflection.

9.4.4 Non-Permissible Defects

There are a number of defects which are not permitted to be present in certain grades of logs. Where such a defect is present the log is disqualified from the grade. An example of defect which is not permitted in certain grades is checks deeper than 4 cm in a Grade 1 code log.

Some grades permit certain defects only to a clearly defined limited extent. An example of this is checks 4 cm or deeper in Grade code 1 logs. When the defect is not confined to the stated limit it is treated as a non-permissible defect for that grade.

9.5 Interior Grade Rules and Application

The following sections state each of the five interior grade rules as they appear in the Scaling Regulation. The sections entitled "Application of the Grade Rule" which follows each grade rule includes information on how to apply the grade rule and enter the grade on the scale tally sheet or into a scaling computer.

9.5.1 Firmwood Reject - Grade Code Z (weight scale, species code or species code R)

The Firmwood Reject grade rule is identical for all species. When scaled in a weight scale sample, the grade code Z logs can be identified by species or by the letter R. For piece scale loads, the species code is always used.

9.5.1.1 Grade Rule

1. A log where:
 - a. heart rot or hole runs the entire length of the log and the residual collar of the firmwood constitutes less than 50 percent of the gross scale of the log,
 - b. rot is in the log and the scaler estimates the net length of the log to be less than 1.2 m, or
 - c. sap rot or charred wood exists and the residual firmwood is less than 10 cm in diameter at the butt end of the log.
2. That portion of a log that is less than 10 cm in diameter or that portion of a slab that is less than 10 cm in thickness.

9.5.1.2 Application of the Grade Rule

1. Portions of logs and slabs less than 10 cm (5 rads) must be recorded as separate logs and graded as firmwood reject.
2. The correct species is always entered against all grades for piece scale and can be entered for weight scale. For weight scaling the letter R can also be used for samples.

9.5.2 Undersized Log Grade- Grade Code 6

9.5.2.1 Grade Rule

A log higher in grade than firmwood reject and cut from a tree that was below the minimum diameter, including the bark, at stump height.

9.5.2.2 Log Requirements to Make the Grade

The criteria outlined under Section 9.2.2 of this manual must be closely followed.

To conclude that a log was cut from an undersized tree:

- the logs must show sufficient evidence that they are cut from undersized trees such as an undercut, butt flare, feller-buncher cut, or other butt characteristics to indicate that it comprises a tree and not a top cut or second cut log from a larger tree,
- if the log is trimmed or long butted and the undercut is removed, it can no longer be graded as undersized
- the outside bark measurement must be taken at a point 15 cm from the butt face, and
- it must be less than the minimum diameter of 15 cm for Lodgepole Pine and 20 cm for all other species.

9.5.3 Premium Sawlog- Grade Code 1

9.5.3.1 Grade Rule

A log 2.5 m or more in length and a log 10 cm or more in radius, or a slab 2.5 m or more in length and 20 cm or more in width and 20 cm or more in thickness measured at right angle to the growth rings, where:

1. For a hemlock, balsam log or slab, at least 90 percent of the gross scale can be manufactured into lumber,
2. For a cedar log or slab up to and including 25 cm in radius at the midpoint at least 90 percent of the gross scale can be manufactured into lumber, or with a midpoint radius greater than 25 cm in radius at least 75 percent of the gross scale can be manufactured into lumber,
3. For all other species at least 75 percent of the gross scale can be manufactured into lumber, and
4. For all species at least 75 percent of the lumber will be merchantable.

9.5.3.2 Log Requirements to Make the Grade

1. Internal rot/hole defect is not allowed in cedar slabs.
2. Sap rot or burnt/charred wood (excluding bark), where the total is at least 25% of the circumference of the log and at least 10% of the log length is affected by the defect is not allowed.
3. Section of the log where five or more insect holes per running metre, penetrating the sapwood and/or heartwood of the tree is not allowed.
4. Ambrosia beetle holes and surface beetle galleries are allowed.

5. 
6. Outside surface checking 4 cm or more in depth is not allowed.
7. 
8. Section of the log with catface with minimum dimensions of 2 cm in depth, by 2 cm in width, by 2 cm in length is added to the grade reduction.
9. Heart pith displacement of more than 20% from the geometrical centre of the log is a grade consideration. The affected shape of the compression wood defect for up to a 2.0 m length section is added to the grade consideration.
10. Section of the log that exceeds, the maximum twist permitted over 30 cm of length is 7 percent of the diameter from a minimum deviation of 2 cm up to a maximum deviation of 6 cm is added to the grade consideration.
11. By log radii, maximum knot size diameters that should not prevent the manufacture of the merchantable lumber requirements of the grade are:

Log Radius	Knot size diameter
5-7 cm	2 cm
8-13 cm	3 cm
14-18 cm	4 cm
19-24 cm	5 cm
25-37 cm	6 cm
38 + cm	7 cm

12. Section of the log where there is less than 30 cm spacing measured lengthwise and section of log where there is less than 10 cm spacing **physically** measured from side to side between knot centres are grade considerations. One spacing of less than 30 cm for length or 10 cm for side to side is allowed per 2.5 m of running length. This applies to all knots 3 cm or larger. The section of log affected is added to the grade consideration. Adventitious knots are not considered for knot spacing.
13. Other defects as per the scaling manual are allowed providing that the portion of the log free from these defects is sufficient to meet the grade rule.
14. 

9.5.4 Sawlog - Grade Code 2

9.5.4.1 Grade Rule

A log 2.5 m or more in length and 5 cm or more in radius, or a slab 2.5 m or more in length and 15 cm or more in width and 15 cm or more in thickness measured at right angle to the growth rings, where:

1. For a hemlock log, at least 75 percent of the gross scale can be manufactured into lumber.
2. for a cedar log:
 - a. up to and including 25 cm in radius at the midpoint, at least 75 percent of the gross scale can be manufactured into lumber, or
 - b. greater than 25 cm in radius at the midpoint, at least 50 percent of the gross scale can be manufactured into lumber.
3. For a balsam log, at least 67 percent of the gross scale can be manufactured into lumber.
4. For a log of species other than hemlock, cedar or balsam, at least 50 percent of the gross scale can be manufactured into lumber.
5. At least 50 percent of the lumber will be merchantable.

9.5.4.2 Log Requirements to Make the Grade

1. For logs with **less than 50 % bark** covering (visual estimate $\pm 10\%$) and also displaying blue stain or beetle galleries, the following applies:
 - Section of the log, 5 cm to 7 cm in radius, where there is **1 or more surface check** (4 cm or more in depth) is added to the grade reduction.
 - Section of log 8 cm in radius, where there are **2 or more surface checks** (4 cm or more in depth), or **1 spiral check** (4 cm or more in depth) affecting more than one quadrant of the log, is added to the grade reduction.
 - Section of log 9 cm in radius where there are **3 or more surface checks** (4 cm or more in depth), or **1 spiral check** (4 cm or more in depth) affecting more than one quadrant, is added to the grade reduction.
 - Logs equal to or greater than 10 cm of radius, **subtract 2 cm of radius** from the diameter as a grade reduction. Logs ≥ 10 cm of radius cannot be downgraded for surface checks alone. They must display other defects as per Chapter 8 of the *Scaling Manual*.

2. 

3. For logs with **more than 50 %** bark covering (visual estimate ± 10 %) and also displaying blue stain or beetle galleries, the following applies:
- Section of logs, 5 cm to 7 cm in radius, where there is **1 or more surface check** (4 cm or more in depth) is added to the grade reduction.
 - Section of logs 8 cm or more in radius, where there are **3 or more surface checks** (4 cm or more in depth) or **2 spiral checks** (4 cm or more in depth) affecting more than two quadrants, is added to the grade reduction.
 - Section of logs 9 cm in radius with **4 or more surface checks** (4 cm or more in depth) or **2 spiral checks** (4 cm or more in depth) and affecting more than two quadrants, is added to the grade reduction.
 - Logs equal to or greater than 10 cm of radius cannot be downgraded for surface checks alone. They must display other defects as per Chapter 8 of the *Scaling Manual*.

4. 

5. Section of a log that exceeds, the maximum twist permitted over 30 cm of length is 15 percent of the diameter, from a minimum deviation of 4 cm up to a maximum deviation of 9 cm, is added to the grade consideration.
6. By log radii, maximum knot size diameters that should not prevent the merchantable manufacture of the lumber requirements of the grade are:

Log Radius	Knot size diameter
5-7 cm	4 cm
8-13 cm	6 cm
14-18 cm	8 cm
19-24 cm	10 cm
25-37 cm	12 cm
38 + cm	14 cm

7.  The section of logs between 5 rads (10 cm) to 7 rads (15 cm) does not allow any oversized knots.

8. Other defects as per the scaling manual are allowed providing that the portion of the log free from these defects is sufficient to meet the grade rule.

9. 

10. 

9.5.5 Lumber Reject Grade Code 4**9.5.5.1 Grade Rule**

A log or slab lower in grade than sawlog and higher in grade than firmwood reject.

9.5.5.2 Log Requirements to Make the Grade

1. Logs and slabs which do not meet the requirements of the sawlog code 2 grade fall into this grade unless:
 - they meet the firmwood reject definition, or
 - they are cut from trees that are undersized.

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10.4.9 No. 5 Utility All Coniferous, Grade Code U**10.4.9.1 Grade Rule**

A log:

- 5 m or more in length, and
 - 5 to 7 cm in radius where at least 75 percent of the gross scale can be manufactured into lumber, or
 - 8 to 18 cm in radius where at least 66 2/3 percent of the gross scale can be manufactured into lumber, or
- 3.8 m or more in length and 19 cm or more in radius where at least 50 percent of the gross scale can be manufactured into lumber and at least 35 percent of that lumber will be merchantable.

10.4.9.2 Log Requirements to Make the Grade

1. By log radii, maximum knot size diameters that should not prevent the manufacture of the lumber requirements of the grade are:

Log radius	Knot size diameter
5 - 7 cm	4 cm
8 - 13 cm	6 cm
14 - 18 cm	8 cm
19 - 24 cm	10 cm
25 - 37 cm	12 cm
SP only 38 - 49 cm	14 cm
SP only 50 + cm	16 cm

2. Maximum twist permitted over 30 cm of length is 13 percent of the diameter up to a maximum deviation of 13 cm.
3. Butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

10.4.10 No. 6 Utility All Coniferous, Grade Code X**10.4.10.1 Grade Rule**

A log 3 m or more in length and 5 cm or more in radius where at least 33 1/3 percent of the gross scale can be manufactured into lumber and at least 35 percent of that lumber will be merchantable.

10.4.10.2 Log Requirements to Make the Grade

1. By log radii, maximum knot size diameters that should not prevent the manufacture of the lumber requirements of the grade are:

Log radius	Knot size diameter
5 - 7 cm	4 cm
8 - 13 cm	6 cm
14 - 18 cm	8 cm
19 - 24 cm	10 cm
25 - 37 cm	12 cm
38 - 49 cm	14 cm
SP only 50 + cm	16 cm

Logs 25 cm and over in radius will allow oversize knots up to a maximum of two per 3 m of log length.

2. Maximum twist permitted over 30 cm of length is 13 percent of the diameter up to a maximum deviation of 13 cm.
3. Butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

10.4.11 No. 7 Chipper All Coniferous, Grade Code Y

10.4.11.1 Grade Rule

Logs lower in grade than utility and higher in grade than firmwood reject.

11.1 Scale Documentation

11.1.1 Introduction

The purpose of this section is to familiarize all users with the submission of the forms used to document the scale and related scaling activities.

Two types of documents are in place:

- the scale return and the documents used to prepare the scale return, and
- other documents which support the scale data control and scaling administration.

Scale Returns, for the purposes of this chapter, include the the original scale tally (or detailed log listing), the weight scale load slips and include any other documentation that is used as the basis for a billing, including summaries. All scaling forms are available along with detailed instructions on their reverse side at:

[Public Forms Index](#)

11.1.2 Documentation Conventions

Before detailing each document you should understand the conventions common to completing every document. These conventions include:

- | | | |
|--------------------|---|---|
| Formats | - | Standard formats, set by the ministry help ensure satisfactory control of scale data. All computer generated facsimiles of the scale returns must be approved prior to their use. |
| Originals | - | In all cases the original signed copy of the scale return must be submitted to the ministry whether using electronic or paper versions. |
| Legibility | - | All hand-written documents must be legible. Always use a sharp pencil, a pen or fresh printer cartridge when preparing originals for submission. |
| Scaler's Signature | - | As detailed further in this section the primary or secondary scaler performing the scale is responsible for signing various scale documents, either on the paper return or electronically. For information on how to receive an electronic authentication signature key please refer to HBS at: |

[HBS Public Training Manual](#)

- | | | |
|--------------------------|---|---|
| Supporting Documentation | - | Any supporting documentation such as tally sheets, should always be retained at the scale site or attached to the paper scale return. |
|--------------------------|---|---|

All documentation must be filed in an orderly manner and submitted to the ministry, or retained in a safe place as per the applicable authorization. This will facilitate retrieval if required for review by a Forest Officer.

It is the obligation of the scaler, the site operator, and the computing service to ensure they are aware of all documentation requirements including retention and submission as per the scaler authorization, the scale site authorization, and/or computing authorization.

Contact the local Ministry of Forests and Range office if clarification on the completion or submission requirements of any document is required. For information on using commonly misinterpreted characters please refer to Section 2.1.4 of the Timber Marking and Branding chapter of the Scaling Manual.

11.1.3 Electronic Reporting

As per the *Forest Act* (s.97) and the *Scaling Regulation* (s.12), if a licensee is scaling over 500 m³ of timber a year the scale data should be submitted electronically to the HBS either by electronic file transfer or entered online in the designated screen(s) on the HBS web site.

While no paper copies of the scale details are required when they are submitted electronically to the HBS, there are some reports that must be printed out and kept at the scale site or sent to the district MOFR office as a backup.

If a licensee is scaling less than 500 m³ of timber a year they are permitted to manually record the scale information on the designated Forest Service paper forms and submit them to their district MOFR office **or** forwarded to Victoria to be manually entered into HBS.

Required documentation may vary slightly by district.

11.2 Scale Returns

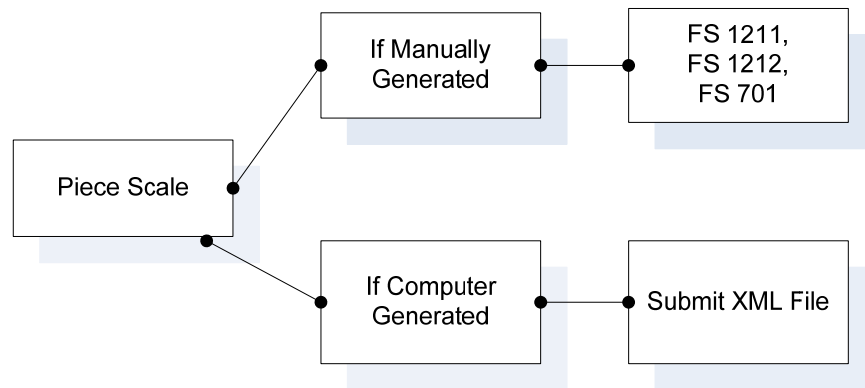
Standard scale return forms and their computer generated equivalents are required to ensure scale data are captured in an orderly manner and the format is compatible with the processing phase of scale billing which ultimately results in invoices being issued.

All scale return tallies produced manually (hand-written) must be legible and signed by the scaler performing the scale. Scale returns are a key component of the documentation trail used for auditing and checking purposes. As such, any changes made by the scaler should always be initialled by the scaler making the return. Any changes made by the ministry must follow the conventions set under Section 11.6.

11.2.1 Type of Scale

- The method of scaling largely predicates documentation requirements. These methods are:

Piece Scale Documentation



11.2.1.1 FS 1211 - Piece Scale Detailed Log Listing (NET)

This form **must be** used to record the piece scale details and red tag scale details for timber that must be reported to HBS. The main use of this form is to submit scale returns under Section 97 of the Forest Act. It may also be used for scaled before rescale and company use. Use scale returns if these types of returns will consume a scaler return number.

BRITISH COLUMBIA		Ministry of Forests and Range		PIECE SCALE DETAILED LOG LISTING (NET)																	
FORM 1211		FORM 1211		FORM 1211																	
FORM 1211		FORM 1211		FORM 1211																	
EVENT TYPE		PRIMARY SCALER LICENCE NUMBER		SECONDARY SCALER LICENCE NUMBER		SCALE DATE		PAGE/OF		LOG COUNT		TIMBER MARK		CUTBLOCK ID		TRANSPORT ID					
198111		1673		1982006053		1		1		1		44		44		40M4 40GS TRUCKS					
INCOMING LOG NUMBER		LOAD ARRIVAL NUMBER		PARCEL ID		PARCEL COUNT		FIELD SCALE FLAG		FIELD SCALE DECK		ORIGINATING SCALE SITE NUMBER (RED TAG ONLY)		WEIGH SLIP NUMBER (RED TAG ONLY)							
1A12380		383																			
LOG #	SP	LENGTH	TOP	BUTT	GRADE	COMPANY USE	LOG #	SP	LENGTH	TOP	BUTT	GRADE	COMPANY USE	LOG #	SP	LENGTH	TOP	BUTT	GRADE	COMPANY USE	
01	FI	1513	08	14	1		34	LA	0812	06	11	2		67							
02	FI	1511	08	16	1		35	LA	0433	05	07	6		68							
03	FI	1510	09	16	1		36	LA	1211	06	11	2		69							
04	FI	142	12	18	1		37	LA	1110	05	08	2		70							
05	FI	1512	10	20	1		38	FI	056	07	12	2		71							
06	FI	151	12	16	1		39	FI	063	06	10	2		72							
07	LA	1418	09	13	1		40	FI	076	06	12	2		73							
08	LA	160	15	24	4		41	SP	0816	09	13	1		74							
09	LA	132	11	20	1		42	LA	020	03	05	2		75							
10	FI	1511	14	23	2		43	FI	008	04	05	2		76							
11	FI	1510	12	20	1		44	FI	042	05	09	2		77							
12	LA	125	10	15	1		45							78							
13	LA	125	11	17	1		46							79							
14	LA	132	10	14	2		47							80							
15	FI	1510	08	18	1		48							81							
16	FI	1516	10	19	1		49							82							
17	LA	136	05	11	2		50							83							
18	LA	140	08	12	2		51							84							
19	LA	140	07	11	2		52							85							
20	FI	151	10	16	1		53							86							
21	LA	136	05	12	2		54							87							
22	SP	162	13	19	1		55							88							
23	FI	1516	14	21	1		56							89							
24	FI	1510	12	20	1		57							90							
25	FI	160	14	26	1		58							91							
26	FI	162	15	24	1		59							92							
27	FI	150	12	22	1		60							93							
28	FI	1314	12	18	1		61							94							
29	LA	150	09	21	2		62							95							
30	LA	150	11	24	1		63							96							
31	FI	122	07	12	2		64							97							
32	FI	136	09	14	4		65							98							
33	FI	096	05	09	6		66							99							
COMMENTS (MAX 256 CHARACTERS)							COMPANY USE							SCALER'S SIGNATURE				SIGNING SCALER LICENCE NUMBER			
														Dan Scaler				9811			
														HBS DOCUMENT NUMBER				980326P18198F			
														TO BE COMPLETED IF DOCUMENT HAS BEEN ENTERED INTO HBS ONLINE							

FS 1211 HBS IAVA 05/10 Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act.

Figure 11.1 FS 1211 – Piece Scale Detailed Log Listing (NET).

11.2.1.4 FS 1210 - Sample Scale Detailed Log Listing (NET)

This form is used to record the scale details of a sample scale load. Instructions are on the reverse side of the form.

EVENT TYPE		PRIMARY SCALER LICENCE NUMBER	PRIMARY SCALER RETURN NUMBER	SECONDARY SCALER LICENCE NUMBER	SCALE SITE NUMBER	SCALE DATE			PAGE/OF	LOG COUNT	TIMBER MARK	WEIGH SLIP NUMBER									
						YEAR	MO.	DAY													
		559811	1674			9	27	20	06	04	03	11									
POPULATION STRATUM		YEAR	SAMPLE WEIGHT (kg)		TRANSPORT ID (REMOTE ONLY)		INCOMING LOG NUMBER (REMOTE ONLY)		LOAD ARRIVAL NUMBER (REMOTE ONLY)		ORIGINATING SCALE SITE NUMBER (REMOTE ONLY)										
7403132007			50780						44671243		11473										
LOG #	SP	LENGTH	TOP	BUTT	GRADE	COMPANY USE	LOG #	SP	LENGTH	TOP	BUTT	GRADE	COMPANY USE	LOG #	SP	LENGTH	TOP	BUTT	GRADE	COMPANY USE	
01	LØ	168	14	18	1		34	SP	056	05	10	2		67							
02	LØ	164	12	18	1		35	SP	062	06	08	2		68							
03	LØ	159	10	14	1		36	SP	042	05	08	2		69							
04	LØ	161	10	15	1		37	SP	054	07	10	2		70							
05	SP	158	10	18	1		38	LØ	032	05	07	4		71							
06	SP	163	12	16	1		39	LØ	054	05	08	4		72							
07	SP	164	10	20	2		40	LØ	066	05	09	2		73							
08	SP	166	12	22	1		41	LØ	052	05	08	2		74							
09	SP	159	13	17	1		42	LØ	020	03	05	2		75							
10	SP	154	15	20	1		43	LØ	003	03	05	2		76							
11	SP	151	12	18	1		44	LØ	002	04	05	2		77							
12	SP	152	14	22	1		45							78							
13	SP	165	16	24	1		46							79							
14	SP	163	16	23	1		47							80							
15	SP	157	14	19	1		48							81							
16	SP	153	15	22	2		49							82							
17	SP	169	16	20	1		50							83							
18	SP	172	18	28	1		51							84							
19	SP	168	18	24	1		52							85							
20	SP	168	17	25	1		53							86							
21	SP	167	16	26	1		54							87							
22	SP	168	14	24	1		55							88							
23	SP	169	15	21	1		56							89							
24	SP	168	15	20	1		57							90							
25	SP	165	14	21	1		58							91							
26	SP	166	18	26	1		59							92							
27	SP	168	19	28	1		60							93							
28	SP	159	15	20	1		61							94							
29	SP	068	08	12	2		62							95							
30	SP	121	05	08	6		63							96							
31	SP	098	05	07	6		64							97							
32	SP	102	08	14	1		65							98							
33	SP	064	10	13	1		66							99							
COMMENTS (MAX 256 CHARACTERS)						COMPANY USE						SCALER'S SIGNATURE <i>Dan Scaler</i> HBS DOCUMENT NUMBER 98/11									

FS 1210 HBS HVA 05/10

Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act.

Figure 11.4 FS 1210 – Sample Scale Detailed Log Listing (NET).

11.2.2 Electronic Weight Scale Documentation/Reports

If a scale site is scaling over 500 m³ of timber a year the Regional Executive Director may direct that scale data be submitted electronically to the HBS either by electronic file transfer or entered online in the designated screen(s) on the HBS web site.

If sample loads are being recorded in a handheld computer it must indicate the event type: SS – Sample Scale. When complete the load is to be digitally signed, then transmitted to the HBS.

There are three required reports for weight scale sites using electronic data submission. They are:

Report Name	Report Purpose	Disposition
Safety Sheet	Recreate the scale information in the event of computer breakdown	Retained for a period at scale site
 Weight Slip	Recreate the scale information in the event of a computer breakdown	Retained for a period at scale site
 Daily Audit Log	Record of change to scale data Printed daily and matched to paper LDS documents	Submitted to the Ministry

The first two are interchangeable. The Ministry prefers that the Safety Sheet is used. However, if this report is not supported by the scale site software, weight slips must be printed after every load is weighed in.

Scale Site	Site Name	Scale Date
15WX	Desolation Weigh Scale	2002-04-10

----- Weigh Slip -----					----- Weight -----		----- Sample -----				-- Field Scale --						
Number	Event Type	Time	LDS Number	Transport Identifier	Gross	Tare	Taken	Deduct	Timber Mark or Brand	Cut Block	Y/N	Deck	PSY	Destination	Scaler	Hash Total	
145785	WSB/SS	0945	0123456	MEV315	45740		Y	0	ER1234	3	N		30120103	-	7485		
145786	WSB/PS	0958	024555	MRV123	48420		N	0	ER2114	6	N		30120203	-	7485		
145785	WSB/SS	1005	0123456	MEV315	45740	23120	Y	0	ER1234	3	N		30120103		7485	876549	
145787	WSO/DP	1048	084752	TRK123		268420	N	0	DSA322		N			321	7485		
145787	WSO/DP	1148	084752	TRK123	45120		N	0	DSA322		N			321	8502	763456	
145786	WSB/PS	1210	024555	MRV123	48420	22320	N	0	ER2114	6	N		30120203	-	8502	987635	

Software Identifier: Weigher2002 1 . 2	Page m	Date: 2002-04-10
Ministry Report Number: WS002		Time: 1945

Figure 11.5 Weight Scale Safety Sheet Example.

11.2.2.1 Computer Generated Weight Slip

 Province of British Columbia		Ministry of Forests	Computer Generated Weigh Slip
Scale Date	2001/11/15	Population Stratum Year	3987 19 02
Scale Site	15WX – Desolation Weigh Scale	Gross Weight (kg)	60000
Scaler Licence	531X – Mike Smith	Sample Deduction (kg)	50000
Weigh Slip Number	934688	Tare Weight (kg)	10000
Timbermark/Source	44/16C	Field Scale / Deck	N
Cutblock	0897	Outgoing LDS	
Transport Identifier	TR160	Destination	
Load Description Slip Number	AB1239	Comments	
Sample Indicator	N		
Secondary Scaler Licence	5319 – Alice Smyth		
Company Use			
Scaler Signature		Driver's Signature	
Software Product	Weigher2002 1 . 2		
EC – Detail Document Number	SD674EW98TER2		
EC – Document Version	1		
EC – Hash Total	28945455		
EC – Digital Signature	76567788		
Event Type	PS – Primary Scale		
Ministry Report Number	WS001		

*Figure 11.7 Weight Slip Example.***Weight Slip Definition**

It is recognized that there will be company use information included on the documents as well. The purpose of this report for the ministry is to be able to recreate the scale information in the event of computer breakdown. If the Safety Sheet is not being used then the weight slip is suitable if an interim version of the slip is printed after the 'weigh in' event.

Weight Slip Print Expectations

The tare weighing occurs shortly after the weigh in event. A Weight Slip is expected to be printed for each arriving load at the time of the tare weighing if the Safety Sheet is NOT being used.

Tare Weighing and Weigh In are Separated

The tare weighing occurs some time after the weigh in event. Typically in this situation, the timber on the truck is sent to another scale site (sample to be measured elsewhere). The truck must then return to the original scale site for the tare weighing. A Weight Slip is expected to be printed for each arriving load after the tare weighing if the Safety Sheet is NOT being used. An interim version of the slip may be printed after the weigh in event.

Weight Slip Corrections

At any point after the tare weighing, a scaler may correct data.

Weight Slip Digital Signing

Digital Signing will most likely occur as a batch process. Each electronic log tally submitted will be digitally signed by either the weigh-in scaler or the weigh out scaler. There are provisions in the data model for the weigh-in scaler and the weigh out scaler to be different. The Weight Slip is NOT expected to be ‘printed and physically signed’ after the digital signing event.

Weight Slip Submission and Retention Expectations

When used, the paper Weight Slip is NOT expected to be submitted to the ministry **if a safety sheet is being used**. When used, the paper Weight Slip is expected to be retained by the scale site operator for a period of six months. During this time these must be provided to a forest officer upon request.

Scalers Diary or Scaler Site Diaries

Scaler diaries are documents that list all the timber that a scaler has scaled for a specified time period. It includes details such as timber marks, piece counts, load numbers, and is signed by the scaler upon completion. The diaries are used to ensure the ministry receives all the scale returns completed by the scaler. Although very useful, scaler diaries are currently being phased out. Please check with the applicable district office for documentation requirements.

Scale Site Arrival and Departure Ledgers (FS 523 and FS 524)

Site ledgers are documents that record every parcel or load of timber that is received at, or transported from a scale site. It lists the load number, the timber mark, scaling information, and must be signed by the scale site operator. An example of Arrival and Departure ledgers are shown below. Detailed instructions for their use **are** printed on the reverse side of each sheet.

BRITISH COLUMBIA Ministry of Forests and Range		SCALE SITE NUMBER 19816		SCALE SITE ARRIVAL LEDGER										FROM DATE 20060501		TO DATE 20060531							
LOAD ARRIVAL NUMBER		ARRIVAL DATE Y Y Y Y M M D D 20060510		LBS. ACRES		TIMBER TYPE / MARK / BRAND		CUTBLOCK		TRANSPORT (CARRIER) ID		OPERATOR / DRIVER / SCALE SITE / SCALE SITE		WEIGH. S.I.P. NUMBER (RECEIVE ONLY)		COMMENTS		SCALER / SCALE NUMBER		SCALE DATE Y Y Y Y M M D D		PARCEL / PARCELS OF / COUNTS	
376	20060510	4786423	BY	DHW	362																		
378	20060512	4786424	BY	DHW	362																		
379	20060512	4786425	BY	DHW	362																		
380	20060512	4786426	BY	DHW	362																		
381	20060522	A12370	PS	NEACD																			
382	20060524	A12376	PS	NEACD																			
383	20060531	A12380	PS	NEACD																			
SCALE SITE NAME Gloria's Mill		FOREST DISTRICT DHW		SITE OWNER / OPERATOR G. Johnson		DATE SIGNED YEAR MONTH DAY 20060602		DATE OF ONLINE ENTRY INTO HES YEAR MONTH DAY 20060602															

BRITISH COLUMBIA Ministry of Forests and Range		SCALE SITE NUMBER 19816		SCALE SITE DEPARTURE LEDGER										FROM DATE 20060501		TO DATE 20060531							
LOAD DEPARTURE NUMBER		DEPARTURE DATE Y Y Y Y M M D D 20060510		LBS. ACRES		TIMBER TYPE / MARK / BRAND		CUTBLOCK		TRANSPORT (CARRIER) ID		OPERATOR / DRIVER / SCALE SITE / SCALE SITE		WEIGH. S.I.P. NUMBER (RECEIVE ONLY)		COMMENTS		SCALER / SCALE NUMBER		SCALE DATE Y Y Y Y M M D D		PARCEL / PARCELS OF / COUNTS	
14	20060510	4786423	BY	DHW	362																		
15	20060512	4786424	BY	DHW	362																		
16	20060512	4786425	BY	DHW	362																		
17	20060512	4786426	BY	DHW	362																		
SCALE SITE NAME Apple Creek Sawmill		FOREST DISTRICT DHW		SITE OWNER / OPERATOR C. Johnson		DATE SIGNED YEAR MONTH DAY 20060531		DATE OF ONLINE ENTRY INTO HES YEAR MONTH DAY 20060531															

Figure 11.11 Site Arrival and Departure Ledgers.

12.3 General Requirements

12.3.1 Scaling

All special forest products removed from Crown or private land are required to be scaled and recorded in a proper manner by an authorized scaler (see the Scaling Administration chapter for more information on scaling authorizations). Scaling may be performed at the harvest site or at another authorized scale site. If the product is transported off the harvest site prior to being manufactured into a special forest product, that is in log form, it must be scaled in log form and graded accordingly.

The underlying objective of special forest product measurement is to determine the net firmwood volume of the products. A notable exception is Christmas trees, which require a piece count by species and length category. Special forest products are not graded like other forms of timber.

Because of the size, shape, and often the number of pieces conventional piece scaling for special forest products is often not feasible. A number of other methods are in place to determine reliable volumes without the practical problems of scaling each piece. These include:

- the Piece Sampling method (applied mainly to round products),
- the Stacked method (applied mainly to split products), and
- the Piece Count (used only for Christmas trees).

Each method is described in Section 12.6.

The recommended method(s) are given in the section that describes each product. In consultation with the operator and scaler, the Forest Service will authorize the use of a method which is considered accurate and practical for the site. Once a method is determined, it must be applied consistently, and may not be changed without a change to the site and scaler authorizations.

12.3.2 Recording the Scale

Recording the scale is a three step process:

- the scale results are recorded to a scaler's tally sheet,
- the tallies are summarized to a scale summary, and
- the documents are submitted to the ministry (see the Documenting and Reporting Scale chapter for detailed information on forms completion and submission).

12.4 Special Forest Product Descriptions

To scale Special Forest Products, a scaler must be able to identify and code the products, know how to calculate the volume of the product in cubic metres, and be able to document the scale so that charges may be calculated.

The Forest Service will approve the classification and scaling method of a special forest product when issuing a cutting authority, based on the following product descriptions and applications.

12.4.1 Christmas Trees

Product Code: XM

Description: In British Columbia, most Christmas trees are Douglas-fir. Trees are selected for appearance, density, form vigour, taper, balance, foliage condition, cleanliness, freshness and size. The Crown sells Christmas trees by the piece with charges dependent on the height of the tree. **The height is to be measured from end to end.**

Dimensions: Three height categories are recognized and segregated as grades, these are:

Height Category

Over 5 m	1
3 to 5 m	2
Under 3 m	3

Scale Method(s): Christmas tree piece count method is used in all cases.

12.4.2 Firewood

Product Code: FW

Description: Firewood is manufactured from round or split fuel logs to specific sizes for heating purposes. Firewood is a finished product.

Dimensions: Firewood lengths range from 30 to 60 cm. Although 60 cm is the longest common length, some modern heating systems will take a “cordwood” length up to 1.2 m. Firewood is consumer marketed in diameters up to 20 cm.

Scale Method(s): The Stacked Special Forest Product Method is used for scaling both split and round firewood. Unless specified in a cutting authority, firewood is not be classified as such.

6. After scaling, a Volume Estimate – Other (FS 701 – see Figure 12.6) is completed and submitted to the appropriate Forest Service district office on or before the prescribed submission time.

[illegible]

Figure 12.6 A Completed FS 701 – Volume Estimate – Other – Summarizes the Information from the FS 222 in Figure 12.7.

12.6.3 Christmas Tree Piece Count Method

The Christmas Tree Piece Count method is used for Christmas tree scaling.

Method

1. The Christmas trees are sorted by species and height category. The height categories are:

Height Category	
Over 5 m	1
3 to 5 m	2
Under 3 m	3

2. A piece count is taken for each species and grade.
3. The piece count is recorded on the FS 200, Christmas-Tree Return. The height category (i.e., 1, 2, or 3) is recorded under the grade field on the tally sheet.
4. After scaling, an FS701 – Volume Estimate is completed and submitted to the appropriate Forest Service district office on or before the prescribed submission time (Figure 12.7).

[illegible]

Figure 12.7 A Completed FS 701 – Volume Estimate – Other Which Summarizes the Information on the FS 200.

12.6.4 Estimating Volumes of Tree Length Piles

Often, a scaler is required to estimate the volume of decks of tree length logs. It is not enough to simply look at a deck and "guesstimate" the volume without some means of measurement to demonstrate confidence that the estimate is based on valid principles. These estimates are used for inventory control, contractor advances, interim invoicing, and the like, but are not adequate for final scale submissions unless pre-authorized by the Regional Manager or District Manager. Piece scaling, weight scaling, and the two Special Forest Products methods (piece sampling and stacked) are the only approved scales for final billing.

Two approaches may be taken, both being a variation of either the round piece sampling method or the stacked method. The level of detail required will influence the scaler's choice of method.

12.6.4.1 Sampling the Pile and Counting Pieces

This method will provide more information on species and grade, but will require enough sampling to develop confidence in the results. If the scaler is concerned with volumes only, then enough samples are taken to represent with confidence the diameter classes and lengths represented. If species and grade considerations are important, then correspondingly more samples must be taken.

1. Determine the number of samples required based on the level of information needed about the pile. Recognized sampling techniques are described in the Weight Scale Sampling chapter, but are more involved than necessary for this estimation process. For a more practical approach, select a sample area representative of the pile by estimation.
2. Scale every piece in the sample area as in Figure 12.8.

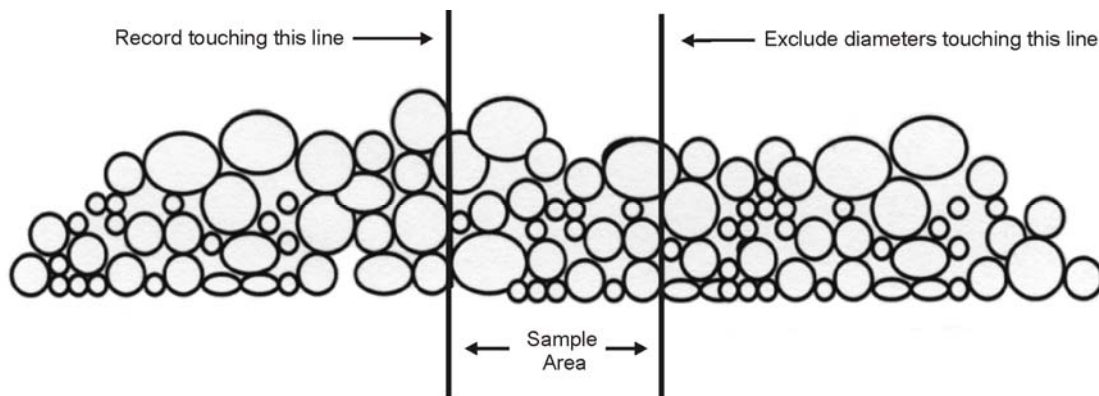


Figure 12.8 Selecting a Sample Section from a Log Deck.

13.1 Weight Scaling - Overview of the System

13.1.1 Background

Weight scaling was introduced in the BC Interior in the early 1960s as a cost effective and reliable alternative to measuring every log to be scaled. The introduction of weight scaling corresponded with the rapid growth of the Interior forest industry. The 1960s also saw the introduction of close utilization harvesting practices, which resulted in greatly increased truck piece counts and reduced average piece sizes. Based on HBS data, in 2006, some 97% of the Interior harvest was scaled with the weight scale system.

On the Coast, because of less consistent forest types, more complex grading, sorting and marketing needs and more complex transportation and log handling opportunities, weight scaling plays a much less prominent role. Based on HBS data in 2006, some 31% of the coastal harvest was scaled with the weight scale system.

While the concepts of precision and accuracy will be explored in detail later in this, and the following chapter, it should be understood that the volume produced through weight scaling is an estimate of the actual volume. The actual volume is not known unless every load going over the weight scale is piece scaled. As such, weight scaling is a sampling method and volumes calculated using it are estimates of the actual volumes.

So, unlike piece scaling where all logs are measured, weight scaling is a sampling method where only a portion of the total production is measured or sampled. Based on the sample results, an estimate is made about the total production.

13.1.2 Estimating Volumes Under Weight Scaling

Under weight scaling, all truckloads are weighed and samples are selected at random and scaled for volume and grade. All logs on each truckload must carry the same timber mark. Conceptually, volumes are estimated by summing the total weight or mass of the total production and multiplying this sum by the volume/weight ratio derived from the samples, as shown in the following formula (Figure 13.2).

	Volume	=	$\text{Weight} \frac{\sum \text{Volume}_{\text{samples}}}{\sum \text{Weight}_{\text{samples}}}$
Where:	Volume	=	total volume estimate
	Weight	=	total net weight of all loads
	$\sum \text{Volume}_{\text{samples}}$	=	total volume of all sample loads
	$\sum \text{Weight}_{\text{samples}}$	=	total net weight of all sample loads
	$\frac{\sum \text{Volume}_{\text{samples}}}{\sum \text{Weight}_{\text{samples}}}$	=	the sample ratio or simply the ratio

Figure 13.2 Conceptual Formula for Estimating Volumes.

In practice, this same principle is followed to determine volumes for each timber mark, for each species and for each timber grade.

13.1.3 Objectives of the Weight Scale System

The reliability of the estimate you wish to achieve is known as the "sampling error objective" and is set under the Scaling Regulation at 1% for the sampling plan. It requires that 95% of the time, the total estimated volume in one year will be within 1% of the actual volume (which is the same as within 1% of the volume you would determine if you scaled every piece). In addition to this objective, data users, including the Forest Service and Industry, may set other objectives to meet their respective data needs.

To reduce the total number of samples required and to better meet other data needs, weight scale populations may be subdivided into groups of truckloads that have similar qualities (e.g., timber mark, stumpage value, and ownership or quality). These groups are known as strata and the process of identifying and subdividing the population into strata is known as stratification. The term "stratum" is singular for strata. The formation of strata will never cause a bias, and should not cause more samples to be needed. The incorrect assignment of a load to a particular stratum cannot cause a bias (but it will probably increase the sampling error), and once a load has been assigned to a stratum it must not be reassigned based on the scale results. The exception to that would be the incorrect recording of a timber mark.

14.4 Operational Procedures to Ensure Sampling Plan Integrity

All timber weighers, sample scalers, and site owners/operators are responsible for conducting operations in accordance with all the conditions of the scale site authorization letter. Timber weighers and scalers must also be fully conversant with, and abide by, all the conditions stated in their scaler/weigher authorization letters. If any matters need clarifying, the District Scaling Supervisor or Check Scaler will be pleased to discuss them with you.

14.4.1 Inspecting Loads Before Weighing

Timber weighers are responsible for inspecting every load of timber arriving at their weigh scale. As each load arrives, the weigher must personally examine it to ensure that:

- all wheels of the truck are fully on the platform,
- the timber marks or brands have been applied in the manner required by the Forest Service, and
- the trucker has presented the necessary load documentation (FS 649 or equivalent) to indicate whether the load is unscaled or previously scaled.

During the inspection, take note of the species and grade make-up of the load so it can be assigned to the correct stratum. Depending on the conditions in the scale site authorization letter, it may also be a requirement to affix identifying tags at this time. If unsure, discuss with the local District Scaling Staff.

Where problems are found with either timber marking or load documentation, immediately contact the District Scaling Supervisor and ask for direction on how to deal with the matter. If the scale operates outside normal working hours or on weekends, ministry staff will not always be available. In those cases, arrangements to deal with such matters should be made ahead of time between the Scaling Supervisor and the timber weigher.

14.4.2 Processing the Load

Depending on the status of the timber to be processed, there are a number of different procedures that will be required. An explanation of each follow.

14.4.2.1 Previously Scaled Timber

When timber has been scaled previously, it must be appropriately entered: either into the weigh scale computer or onto a FS 1217 (weigh slip) if records are being manually kept. Previously scaled timber may be weighed and/or otherwise recorded as directed by the scale site owner/operator.

14.4.2.2 Unscaled Timber

For unscaled timber, load information is entered into the computer (or onto the FS 1217 and FS 523, if keeping manual records). Minimum required data that will be automatically generated by weigh scale computers are date and time of weighing (in and out) and gross, tare, and net weights. The use of rolling tare is not permitted. Measurement Canada demands an accurate net weight:

The use of a `rolling tare is not permitted.

Timber weighers must add the balance of information:

- a. the timber mark (ensure mark is valid and approved for scaling at your site),
- b. the stratum and species,
- c. the contractor/trucker name or code, and
- d. other information as may be required by the scale site owner/operator.

Ensure that a stable reading can be obtained before recording the gross weight of the truck. If the load has been selected as a sample, refer to the next section for more information. If the species/grade profile of the load is such that it is not suitable for inclusion in any stratum in the sample plan, refer to the section on "Loads not Suitable for the Sample Plan." The vehicle may then proceed to the off-load area.

When the truck has unloaded and picked up its trailer, it must return directly to the scale to obtain a tare weight. To ensure an accurate net weight can be calculated, the vehicle must not take on fuel or water or make any other significant changes to its tare (dropping off tire chains, for example) before the weighing out procedure is completed.

Unless formally agreed to in the scale site authorization letter, round trip distances from point of weighing to the off-load area must not exceed ten kilometres.

Once the weighing process is completed and recorded on the weigh slip **or** safety sheet the timber weigher must sign the weigh slip. **If a safety sheet is not used the copies of the weigh slip are distributed according to the company arrangement including a copy to the Forest Service. Districts will give instructions to the scale sites as to the submission requirements.** The daily audit report, safety sheet (if used), weigh slips and other specified documents must be available for auditing by the Forest Service. The data is submitted to the HBS data base according to HBS and Scale Site Authorization requirements.

14.4.3 Managing Sample Loads

If a load has been selected as a sample, the timber weigher must enter it into the sample ledger and it must be noted on the weigh slip and the daily load inventory. Computerized

 BRITISH COLUMBIA The Best Place on Earth	Ministry of Forests and Range		<h2 style="margin: 0;">APPLICATION TO SCALE</h2>
I HEREBY MAKE APPLICATION (PLACE CHECK MARK IN SQUARES APPLICABLE) :			
☐ FOR AUTHORIZATION TO SCALE AT _____ <div style="text-align: right; font-size: small;">(NAME AND ADDRESS OF MILL OR OTHER OPERATION)</div>			
☐ FOR APPOINTMENT AS ACTING SCALER TO SCALE AT _____			
☐ TO TAKE EXAMINATION FOR SCALER'S LICENCE, TO BE HELD AT _____ ON _____, year _____			
☐ FOR APPOINTMENT AS OFFICIAL SCALER IN THE _____ <div style="text-align: right; font-size: small;">(NAME OF REGION OR DISTRICT)</div>			
HAVE YOU EVER HELD A SCALING LICENCE, ACTING SCALER'S APPOINTMENT OR RESIDUE SURVEYOR'S LICENCE?		IF SO, WHERE	
☐ YES ☐ NO		APPOINTMENT OR LICENCE NO.	
FULL LEGAL NAME AND ADDRESS (please print)			
LAST NAME	FIRST NAME	MIDDLE NAMES / INITIALS	ADDRESS
TELEPHONE NO.	FAX NO.		
PROOF OF IDENTITY (please complete at least one of the following)			
DRIVER'S LICENCE NO.		CITIZENSHIP CERTIFICATE NO.	
BIRTH CERTIFICATE NO.		LANDED IMMIGRANT CARD NO.	
CANADIAN MILITARY ID		WORK PERMIT NO.	
PASSPORT		BRITISH COLUMBIA IDENTIFICATION	
PLEASE STATE PLACE OF BIRTH			DATE OF BIRTH YYYY - MM - DD
SIGNATURE OF APPLICANT			DATE SIGNED YYYY - MM - DD
FOR OFFICE USE ONLY			
DATE OF EXAMINATION YYYY - MM - DD	MARK %	LICENCE NO.	DATE ISSUED YYYY - MM - DD
LOCATION		FEE PAID ☐ YES ☐ NO ☐ N/A	
APPROVED ☐ YES ☐ NO	DATE APPROVED YYYY - MM - DD	FS CLIENT NO.	
FS 87 HVA 2008/01 Please be advised that the information may be released under the Freedom of Information and Protection of Privacy Act			

Figure 15.5 Example of an Application to Take a Scaling Exam/Appointment as an Acting Scaler/Authorization to Scale at a Site.

15.4.4.2 Payment of Examination Fees

The Scaling Regulation requires that individuals applying to take an examination for a scalers licence must pay an examination fee and the regulation states the amount of the fee. Ministry of Forests employees and individuals who have paid an acting scaler appointment fee within the past twelve months of the examination date are exempted from payment.

15.4.5 The Administration of Scaling Licences

15.4.5.1 Marking Requirements

Different Regional or District Scaling Examiners will mark all examinations twice in order to minimize errors.

15.4.5.2 Review by Unsuccessful Candidates

Any candidate taking a scaling examination is entitled to review the exam with a scaling examiner. Failing students should have a clear understanding where they went wrong before attempting the examination again.

15.4.6 Other Examination and Endorsements

15.4.6.1 Scaling Endorsements

As scaling serves the needs of various users, it must be responsive to often changing needs. To ensure all scalers are current and able to meet these needs, it is periodically necessary to conduct additional endorsement examinations. Such endorsement examinations have included; metrication in the late 1970s, interior grading in the late 1980s, coastal letter grades in the early 1980s, major coastal grading changes in 1990, and new interior grades in 2006.

Failure to pass an endorsement exam within a specified time will result in termination of the scaling licence. It may also terminate the authorization to scale or make the scaler ineligible for future authorizations until the endorsement has been achieved. Where scalers are inactive and/or miss the scheduled endorsement within the required period they are required to take the full licensing exam again.

15.4.6.2 Re-examinations

In addition, the Forest Act empowers the Chief Forester to require a scaler to be re-examined. This provision is usually exercised where check scales or other inspections have concluded a re-examination is needed to confirm the scaler's ability to meet licensing standards. Failure to pass the examination within the specific time will render the scaling licence cancelled.

- demonstrated scaling competency (an acceptable check scaling history),
- scaling experience (minimum of five years for coastal scalers and three years for interior scalers), and
- at least six months scaling activity in the past year.

15.5.2.2 Licensed Scalers

A licensed scaler may be authorized for up to two years and may be re-authorized upon expiry.

Requirements to be authorized as a licensed scaler include:

- valid licence with all endorsements current.

15.5.2.3 Acting Scalers

An acting scaler appointment is considered only where:

- securing a licensed scaler would impose unreasonable costs or delays, and/or
- volumes and values are minimal and there is little risk that the scaling requirements of the Forest Act will not be met.

Persons working as a timber weigher or assisting a scaler in taking measurements or other capacity must be appointed as an acting scaler.

Requirements to be appointed as an acting scaler are:

- order must be issued by the regional executive director, the district manager, or a forest officer stating that the timber may be scaled by an acting scaler,
- applicant must complete a Timber Weigher's examination if applicable,
- appointments may be conditional upon the applicant attending the next scaling examination held in the region. Each acting scaler appointment may not exceed one year. While these appointments are normally for minor volumes and for a short term they may be renewed upon expiry, and
- applicants who scale more than 300 m³/year must pay a fee of \$100.

15.5.2.4 Forest Service Scalers

An employee of the Ministry of Forests may be appointed as a Forest Service scaler if they:

- hold a valid scaling licence, and

- have been appointed as a forest officer.

Forest Service scalers do not have to be authorized to scale.

15.5.3 How to Obtain an Authorization and/or Appointment

Any person requiring an authorization or appointment should complete an Application to Scale ([FS 87](#)) as shown in **Figure 15.5**, and return it to the local Forest Service office for processing.



15.5.4 Authorization Conditions

In addition to being limited to a time period and an administrative jurisdiction, all scaler authorization documents carry two standard conditional clauses:

- authorization is conditional upon compliance with the *Forest Act*, the *Scaling Regulation*, and approved ministry policies and procedures as detailed in the *Scaling Manual*, and
- failure to comply with conditions of the authorization may result in cancellation or suspension of the authorization.

Other clauses are included in the authorization. These may set conditions to ensure a complete and accurate scale, orderly and timely scaling, conduct on the scale site, documentation and submission of scale data, and other conditions falling under the scalers control.

The issuance of scale authorizations is supported by SCS. Where the standard clauses on the SCS do not satisfy the specific requirements of an authorization, custom clauses may be drafted by the system user. A number of considerations govern the issuance of custom clauses. They must be:

- reasonable (can this scaler comply without undue hardship? Is the requirement under the scalers control?),
- enforceable (can an inspecting officer effectively evaluate compliance?),
- legal (do they conflict with the Forest Act and regulations, the *Canadian Charter of Rights, Freedom of Information and Protection of Privacy Act, Federal Weights and Measures Act*, or others. Is the ministry empowered to set the condition?),
- equitable (do they conform to ministry policy and procedures?),
- compatible (do they conflict with any other clause(s) in the authorization or other authorization?), and
- coherent (are they written clearly and concisely? Are they easily understood?).

 BRITISH COLUMBIA		Ministry of Forests - Province of British Columbia	
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AUTHORIZATION TO SCALE			
		Authorization Num.....	4403
		License Num.....	IB03
		Authorization Date.....	July 08, 2005
		File Number.....	21590-20/Dickson, M

Pursuant to the Forest Act, I hereby authorize

MICHAEL DICKSON, of
BOX 18
BRALORNE BC V0K 1P0

to Scale and Classify Timber
at site IB4C (IAN'S LATEST SITE)

for a period commencing July 08, 2005 and ending July 14, 2006 subject to the following conditions:

1. **FAILURE TO COMPLY WITH CONDITIONS**

This authorization may be suspended or cancelled by the District Manager or Scaling Supervisor for failure to comply with these conditions.
2. **COMPLIANCE WITH FOREST ACT**

All scaling shall be conducted in accordance with Part 6 of the Forest Act, the Scaling Regulation, the Forest Service Scaling Manual and Ministry policies and procedures. test
3. **ORDERLY SCALING**

The scale is to be made in an orderly manner by load or parcel with each parcel or load to be assigned a unique return number and so identified.
4. **test add**

test addition 6 26
5. **1**

cl 1

Page 1

Figure 15.6 An Example of an Authorization to Scale (Page 1).

15.6 Assessing Compliance with Scaling Requirements

Under policy the Ministry is required to maintain an adequate level of monitoring, inspecting, and auditing to ensure the Crown's interests are protected. This requirement is largely met through three activities:

1. check scaling,
2. scale site inspections, and
3. data monitoring.

Some important compliance requirements are answered with these questions:

- is scaling being done in accordance with this manual, the *Forest Act*, the *Scaling Regulation* and the *Scalers Authorization*?
- are all conditions of the scale site authorization being complied with?
- is all required documentation in good order?
- is all material that is harvested both scaled and billed?
- has all data been compiled and submitted in accordance with Ministry standards?
and
- are scaling practices and interpretations consistent?

15.6.1 Check Scaling

15.6.1.1 Purpose of Check Scaling

Check scales are conducted by the Forest Service to maintain scaling standards and uniform scaling practices throughout the province. This is achieved through remeasuring loads of logs scaled by the original scaler and comparing scale results in terms of volume and value in addition to assessing compliance with the scalers authorization to scale.

15.6.1.2 Conducting a Check Scale

Because check scales may result in actions affecting the scalers authorization to scale or scaling licence, it is important that they be representative of the scalers work. To achieve this it is ministry policy that check scales be conducted unannounced and at random whenever feasible. To be valid, the original scaled load must be left untouched after scaling and remain in the same position for check scaling. While the original scaler may be under various production pressures, the check scaler in setting the standard of comparison is required to scale each load with care and not be subject to any time constraints or other operational pressures. The check scale should comprise one full truckload, or parcel of logs.

15.6.1.3 Check Scale Frequency

The objective defined under ministry policy is to set check scale frequency by analyzing the relative revenue risk, the volume scaled, and the scalers past performance. This goal requires an objective evaluation of each scaling situation.

For example, increased check scaling frequency might be warranted where:

- the scalers experience or past performance is weak,
- the scale site conditions may not facilitate accurate scaling, or
- the values and volumes scaled at the scale site are high.

Similarly, a reduced checking frequency might be warranted where:

- values and volumes scaled at the site are low,
- only private timber is scaled and risk assessment is low, or
- scaler past performance or experience is strong.

Scaling policy may also impose specific frequency, volume, or value objectives.

15.6.1.4 Division of Responsibilities – The Scaler

Every scaler must understand the ministry has the responsibility of ensuring that scale results are correct and ensuring scaling duties are being performed correctly. To enable the check scaler to carry out these responsibilities requires the scaler to retain at the scale site and produce a copy of the scale details for the most recently scaled parcel or load of timber and make available any other required documentation for inspection.

At the request of the check scaler, scalers must make themselves available to discuss check scale results.

15.6.1.5 Division of Responsibilities – The Site Operator

The owner and operator of the scale site and the owner of the timber are responsible for ensuring the last scaled load for each scaler is retained for check scaling. To this end the last scaled load must be clearly marked or tagged as scaled as per the scale site authorization and the load should remain in exactly the same position as originally scaled. This is an integral part of ensuring reliable check scale results, and as such, several provisions in the *Forest Act* and *Scaling Regulation* address this topic. In the event of non-compliance with this requirement, the *Scaling Regulation* enables the ministry to assess its costs in attempting to conduct a check scale. In addition, contravention of this section of the *Forest Act* is an offence and subject to ticketing and/or summary conviction. Similarly, contravention may jeopardize the scale site authorization.

15.6.2 Checks to be Made

In addition to the actual scaling, a forest officer will check that authorized scalers are on site to scale the timber, that scaled parcels are being properly identified, that records of scale details are correctly identified and filed and that scale returns are being completed and forwarded on time.

15.6.2.1 Piece Scale

A check scale of a recently scaled parcel is made. The details of the check scale and the original scale each must have the volume and the market value of the timber computed.

To enable meaningful comparisons of the original and check scales, volume and value computations should be made on site. The differences between the volumes are divided by the volume of the check scale to determine the percentage difference. Where the original scale is less, the difference is low or negative. Where the original scale is greater, the difference is high or positive. The difference in value is calculated following the rules for volumes.

The classification of each log to species is to be checked and the number of incorrect classifications identified. Each log where there is no deduction for defect is to have the length and recorded radius measure compared. Any difference in length is considered an error whereas a difference exceeding one radius measure or rad (2 cm of diameter) is considered an error.

15.6.2.2 Weight/Sample Scale

A check of a recently scaled sample is to be made in the same manner as the piece scale parcel is scaled. As with piece scale parcels, computation of values and volumes should take place at the scaling site to enable meaningful comparisons. In addition, the weight recorded should be checked against the load slip . Check that the load has been placed in the correct stratum.

The gross, tare, and net weights of trucks recorded on the daily audit log should be reviewed for abnormalities and it is desirable to re-weigh the most recently weighed truck, gross or tare, to check that this function has been performed correctly. **If this is not possible**, supervise the weighing of another truck and compare the results with those recorded against previous weighing for compatibility. Check that the weigh scaler has checked the weigh scale each day by weighing a vehicle at different ends of the platform, or in the case of a lift weigh scale, by weighing a test load of known weight. Check that the platform is being kept clean and free of debris, snow, and ice that may affect the accuracy of the weighing.

15.6.2.3 Special Forest Products - Stacked

The most recently scaled stack is to be remeasured and the stack volume computed and compared with the stack volume computed from the original scale. Check the face of the stack and estimate the ratio of area of wood to area of wood, air, and bark. Compare the resultant figure with the factor used to convert stacked volume to volume of wood.

15.6.2.4 Special Forest Products - Piece Sampling

Check count the number of pieces by category in the most recently counted parcel and compare with the scale record. Sample measure a number of pieces in each category and compare the average volume per piece of the category sample with the average used by the original scaler.

15.6.3 Actions Upon Completion of the Check Scale

15.6.3.1 Check Scale Advisory

An advisory letter showing the scale details for the original and check scales is issued to the original scaler as soon as possible following the check scale. This report is usually printed at the scale site and presented by hand, or mailed to the original scaler.

While the check scale advisory letter can be in different formats, its basic intent is to provide a meaningful feedback mechanism to assist scalers in assessing their own performance and making them aware of any deficiencies in their scaling methods or interpretations. While check scales confirming the original scale need not provide significant detail other than the scale volumes, check scales outside acceptable tolerances should clearly identify the sources of variance.

Release of Check Scale Data

1. Upon completion of a check scale, the check scale comparison reports and detailed log listing will always be provided to the scaler who performed the scale.
2. Check scale comparison reports and detailed log listings are available to other parties upon request, subject to provisions of the *Freedom of Information and Protection of Privacy Act*.

15.6.3.2 Replacement of the Original Scale by a Check Scale

Where the volume or value of the check scales varies by more than the prescribed three percent set by regulation, the *Forest Act* requires that the check scale replace the original scale. The *Forest Act* also authorizes an exemption to this replacement where it is considered the original scale was conducted in accordance with good scaling practices and the differences in the original and check scale are attributable to the condition of the

timber. The term 'good scaling practices' is subjective and requires an assessment of the nature, magnitude and frequency of scaling errors (both interpretative and quantitative).

For example, where timber is sound and of little butt flare, an exemption to a replacement would likely not follow. On the other hand, where timber is decadent and otherwise good scaling practices were followed, an exemption to a replacement would likely be considered.

Where the scale is to be replaced by the check scale, a copy of the new scale return **is available** to the scaler, the owner of the timber and the mark holder **in the Harvest Billing System**.

The responsibility for ensuring that the check scale replaces the original scale rests with the owner of the scale site, the operator of the scale site, the owner of the timber, and the scaler.

Non-compliance to this responsibility constitutes an offence that is subject to ticketing and/or summary conviction.

15.6.3.3 Update Scaler File and Records

The result of each check scale is posted to the scalers file and the scalers record or the Scale and Administrative Control System (SCS) so that each scalers performance can be tracked and monitored.

In addition to reviewing current check scale comparisons, check scales over the previous twelve months are reviewed to identify any possible bias. This shortcoming, along with any other trend or required corrective action should be noted in the check scale advisory letter.

15.6.3.4 Second Check Scale

Under the *Forest Act* a scaler whose scale is replaced by a check scale may request a second check scale if they disagree with the original check scale. As such, this section provides recourse for scalers to have a second binding opinion about a scale.

Where the scaler requests a second and final check scale the ministry is obligated under the regulation to perform it where it is feasible.

Where a second check scale is conducted, it becomes the basis of comparison with the original scale. If the second check scale varies in volume or value from the original scale by more than the prescribed percent (three percent set under the *Scaling Regulation*), the second check scale must replace the original scale. When the original scale is replaced by the second check scale, the scaler requesting the second check scale must pay the costs and expenses incurred by the ministry in conducting the second check scale. Where the

volume or value of the second check scale is between 0 and 3 percent of the original scale, the original scale is confirmed and the scaler who requested the second check scale is free of any expenses incurred by the ministry in conducting the second check scale. The second check scale is binding and final.

15.6.3.5 Second Scales

Unlike a second check scale, which is available to a scaler who disagrees with a check scale, a second scale is available to anyone with an interest in the scale who disagrees with the original scale, but only if it is feasible to conduct another scale.

A second scale is available to any person whose interest is affected by the scale who

- Objects to a scale return completed for a scale, and
- Serves notice of their objection to a regional or district manager and requests a second scale.

Where notice is served, the Ministry is obligated to have the timber scaled again if another scale is feasible.

In addition, a second scale may be required at the discretion of a regional manager or a district manager. A second scale can not be conducted after a check scale.

When conducted, the results of the second scale are binding. When the second scale varies from the original scale by more than three percent in terms of value or volume, the second scale governs for all purposes of the *Forest Act* and must replace the original scale. When the original scale is replaced by a second scale, the person requesting the second scale is free of any costs and expenses incurred by the ministry in conducting the second scale.

Where, however, the original scale is confirmed by the second scale (the second scale is within three percent in terms of value or volume of the original scale), the person requesting the second scale must pay for the costs and expenses incurred by the ministry in conducting the second scale.

15.6.3.6 Suspension of a Scaling Licence

Under the *Forest Act*, the regional executive director or the district manager is authorized to suspend a scaling licence where its holder fails to properly perform their duties or comply with the requirements of the *Forest Act*, scaler authorization, site authorization, or any other applicable scaling regulations.

Where there is a flagrant contravention of scaling requirements the inspecting forest officer should promptly recommend suspension of the scaling licence to the district manager and suspension should proceed under Section 102 (1) of the *Forest Act*.

Where there is no flagrant contravention of scaling requirements the scaler should receive at least one warning letter signed by the district manager prior to any suspension. When a suspension is made, it must be for a specific term of up to one year and the suspension automatically terminates all authorizations and appointments to scale. All suspensions are recorded on the scalers record in the Scale Control System as well as HBS..

Where suspensions is comferred because the scaler lacks expertise, the scaler may be required to pass the licensed scalers examination again before being authorized or appointed to scale. Any person subject to a suspension may be given an opportunity to be heard before the regional executive director or a district manager.

15.6.3.7 Cancellation of a Scaling Licence

The *Forest Act* also provides for the Chief Forester to cancel a scaling licence where scalers fail to properly perform their duties. This action may be required after several suspensions or may be recommended by the inspecting forest officer after a flagrant contravention of scaling requirements. When this action is contemplated, the scaler must first be given an opportunity for a hearing before the Chief Forester.

15.6.4 Scale Site Inspections

15.6.4.1 Purpose of Scale Site Inspections

Scale site inspections are conducted by the Forest Service to assess compliance with the scale site authorization and ensure scaling conditions support an accurate and reliable scale. Where the inspection reveals contravention of Forest Service requirements, the inspection may result in an instruction letter, a suspension, or penalty as provided under the Forest Act.

15.6.4.2 What to Expect From a Scale Site Inspection

Scale site inspections may be conducted at the same time as a check scale or as a separate inspection. Like check scales, these inspections are unannounced and at random whenever feasible.

Because scaling is conducted under diverse conditions, the format of the inspection varies considerably from site to site. Figure 15.8 provides an example of a Site Inspection Report.

 BRITISH COLUMBIA	Ministry of Forests SCALING SITE INSPECTION FORM	Page 1 of 2
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Site Number : 510 Site Name : P & T HALFWAY Site Type : Weight File Number : 21630-35	Inspection Date : 2007-03-05 Inspected By : BARGERY, JAMES PETER Inspection Number : 166537 Region : SI Southern Interior District : AB Arrow Boundary Forest District
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- 1 Site operating? Y
- 2 Scaler on site? Y
Authorized? Y
- 3 Unauthorized person performing scaling duties? N
- 4 Last scaler parcel retained for check scaling? Y
- 5 All scaled timber marked to signify scaling status as required? Y
- 6 Required scale data on site? Y
Completed correctly? Y
Scale data submitted as required? Y
- 7 Production ledger/site diary current? Y
- 8 Logs spread properly for scaling? Y
- 9 Previously scaled timber being delivered to this site? N
- 10 Scaled timber being removed from this site? Y
SB4 out to: 546 569 512
- 11 Timber marking requirements being met? Y
- 12 Scaling area free of chunks and pieces? Y
- 13 Check scale done? Y
- 14 Unscaled timber on site? N
Scaling of loads being kept current? Y
- 15 Section tests done regularly and documented? Y
- 16 Scale platform free and clear? Y
- 17 Loads being stratified correctly? Y
- 18 Approved scaling procedures being followed? Y
- 21 Unauthorized decking of unscaled timber? N
- 22 Mixing of scaled and unscaled timber? N
- 23 Loads flagged/tagged as required? Y
- 27 Sample Ledger current? Y
- 28 Sample tally balance with random selector? Y
Stratum plan print-out current? Y
- 29 Area designated for scaling being used for other activities? N
- 30 Authorized/approved scaling computer systems? Y
- 31 In compliance with all authorization conditions? Y
- 32 Other documents/instructions issued? N
- 33 List timber marks on site? Y
- 34 Final remarks? Y
Detail: 23/583 62996 W1856A
- 35 Copy given to client? N

Figure 15.7 Scaling Site Inspection Report (Page 1).

A series of checks is required for scaling operations:

- check if the most recent load scaled for each scaler is intact and available for check scaling purposes, and
- trucks waiting to be unloaded should be checked for timber marks and load documentation. Any irregularities should be traced back to the origin of the timber.
- ensure that only authorized persons are scaling and/or assisting with the scaling,
- confirm that any bucking orders, permissions, or restrictions are being complied with,
- check that the scale yard is being cleared of bucking residue, trim ends, and other debris before arriving loads are spread for scaling,
- ensure that the loads are being spread properly,
- cross check a few weight scale slip details with the details on the daily audit log and ensure these agree,
- if feasible, reweigh the most recently weighed truck to ensure weights are the same,
- check that daily scale section tests are performed and corrective action is taken if applicable,
- check stratification calls using sample scale details where feasible or by comparing your stratum assessment with the scaler's at the time of weighing a load,
- check the frequency and documentation of red tag loads,
- seek an immediate explanation where any apparently unscaled timber is mixed with scaled material. If any doubt exists, a seizure may be in order.
- check to ensure that scaled timber brands and marine log brands (if applicable) are being used correctly.
- check compliance with weight scale emergency procedures if applicable, and
- check compliance with other conditions defined under the scale site authorization.
- ensure that copies of all scale returns, scaler diaries, load slips, site ledgers, and other required documentation are current and accurate, complete, and securely and orderly stored,
- check that scalers are maintaining their return or tally numbers, and

- check to ensure that the handheld and software are approved. Ensure that the scalers are downloading to HBS and/or making hard copies regularly and are complying with the requirements in the site authorization and/or computer approval. Periodically enter a set of test data with a known volume and grade profile into the handheld and compare the resultant output to the accepted results.

15.6.4.3 Actions Upon Completion of a Scale Site Inspection

Upon completion of the scale site inspection, a report is prepared and copied to the scale site file. Any contraventions to the scale site authorization or other ministry requirements must be communicated to the site operator in written form. Where violations are serious and compromise the ability to achieve an accurate and reliable scale at that site, a suspension to the scale site authorization may be considered. Suspending a site authorization is serious and disruptive, and is considered a last resort before cancellation of the authorization.

The *Forest Act* provides that only the regional executive director or district manager may suspend or cancel a scale site authorization and may only do so after giving the authorized party an opportunity to be heard.

Where irregularities observed during an inspection become part of an investigation, which may result in ticketing or other consequences, check scalers must ensure that they are mindful of privileges provided under the *Charter of Rights and Freedoms* and proper investigative procedures.

All the findings should be detailed on the Site Inspection Form. Any discrepancies, issues violations, etc. are to be fully discussed with the Site Owner/Operator or designated representative and resolved, if possible. A signed copy of the report should be left at the site.

Glossary of Terms

The following definitions apply to this manual:

Accuracy	How close measurements or estimates are to their actual value or quantity.
Advanced decay	The late stage of decay in which the decomposition is readily recognized as the wood becomes punky, soft, stringy, pitted, or crumbly.
Adventitious	Developing in an unusual position, added from the outside, as adventitious branching.
Annual ring	The annual increment of wood (including early-wood and late-wood) which appears on a transverse section (or cross section) of a piece of wood and denoting one year's growth.
Bark	The tissues of a tree is outside cambium is composed of inner living bark and outer dead bark.
Bark Seams	Seams of bark extending into or embedded in the log.
Bias	A consistent or systematic distortion of sampling results or measurements arising from an incorrect method of sampling or measurement.
Bole	The trunk of a tree (seedlings and saplings have stems, not boles).
Bolt	Any short log specially cut to length, usually for the manufacture of a specific product.
Borer holes	Voids made by wood-boring insects or worms.
Branch whorl	A more or less circular arrangement of branches around a point on the bole of a tree.
Burl	A hard woody bump on a tree, more or less rounded in form, usually resulting from the entwined growth of a cluster of adventitious buds.

Butt end	The larger end of a log.
Butt log (or First Cut Log)	This refers to the first log cut from the bottom of the tree.
Butt rot	Any decay or rot developing in, and sometimes characteristically confined to, the butt log.
Butt swell	That part of a log outside its normal taper and extending from where the normal taper ends and the flare begins to the large end of the log. It is usually manifest only in butt logs due to the self buttressing growth of the tree near its base.
By the piece	By a count or tally of pieces.
Callipering	To take a diameter measurement at a point on a log other than at an end.
Catface	A defect on the surface of a tree or log resulting from a wound where healing has not re-established the normal cross section.
Check	A separation of the wood, perpendicular to the grain (see also end check, surface check and weather check).
Clear	Free of knots and stain, and at least 2.5 m long in the case of lumber. Clear shingles must be free of knots, insect damage and meet the minimum shingle dimensions.
Coast	For the purpose of scaling, coast is defined as that area of the province where a log based stumpage appraisal is used (generally west of the Cascade Mountains).
Coefficient of variation	A measure of variability among units expressed as the ratio of the standard deviation (s) to the mean (x) and is usually expressed by the formula $CV = s/x$.
Collar	The portion of the log between the inside of the bark and a hole or rot in the heart of the log (the same as shell).
Compression wood	Is a type of defect that forms in conifers on the underside of leaning stems on the leeward side of trees exposed to strong winds, in crooked stems and in the lower part of trees growing on a slope.
Crook	An abrupt bend in the length of a log.
Dead side	A misshapen side of a log caused by the lack of growth of wood because of the death or removal of the inner bark, or phloem, along