

File: 195-30/Scal

February 28, 2006

BY EMAIL

To: Regional Executive Directors

From: Bill Howard
Director
Revenue Branch

Re: Amendment No. 7 to the *Scaling Manual*

I hereby approve Amendment No. 7 to the *Scaling Manual*, and attach a copy for your use.

This amendment provides the technical procedures for the new Interior log grades.

This amendment will come into force on April 1, 2006. Further amendments or revisions to this manual require my approval.

A handwritten signature in black ink that reads "Bill Howard".

Bill Howard
Director
Revenue Branch

Attachments

pc: Coast Scaling Advisory Committee

Interior Scaling Advisory Committee



**BRITISH
COLUMBIA**

Ministry of
Forests



MANUAL REVISION TRANSMITTAL

FOR FURTHER INFORMATION OR IF YOU HAVE A CHANGE OF ADDRESS, PLEASE CONTACT: Jim Crover Scaling Policy Forester Revenue Branch Ministry of Forests and Range 6 th Floor - 727 Fisgard Street Victoria, BC V8W 1R8 Phone: 356-1955 PROFS userid: Jim.Crover@gov.bc.ca FAX: 387-5670	MANUAL TITLE Scaling Manual	
	AMENDMENT Amendment No. 7	ISSUE DATE April 1, 2006
	MANUAL CO-ORDINATOR Judy Laton Manuals Co-ordinator	
	AUTHORIZATION (Name, Title) W. Howard Director, Revenue Branch	

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

ACTION (Remove/Insert)	(VOL.) CHAPTER-SECTION-SUBJECT	PAGE(S)	COMMENTS
	TABLE OF CONTENTS		
REMOVE	Table of Contents	i - xxviii	After Table of Contents Tab
INSERT	Table of Contents	i - xxvi	
REMOVE	Chapter 6	1 - 132	After Chapter 6 Tab
INSERT	Chapter 6	1 - 120	
REMOVE	Glossary	G1 - G16	After Glossary Tab
INSERT	Glossary	G1 - G18	
INSERT	Memo and Transmittal		After Amendments Tab

Timber Grading

6

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 timber grading. Timber is graded in accordance with the schedules of timber grades as set out in *Scaling Regulation*.

Grading is used to make the volume information of the scale more meaningful and useful to dealers in timber, and to managers of the forest resource. The quality and potential end use of logs has significant influence on their value.

Grading is a key component in marketing finished products such as lumber, plywood and shingles. The grading of finished products after manufacture is commonly referred to as Lumber Grading and is not a duty performed by a licenced scaler. Instead, the challenge of the scaler is one of assessing the visible characteristics of each log, and, with strict reference to schedules of log grades, determining what can be recovered from it.

In addition to monetary values, log grades can also be used for cut control purposes.

This chapter describes the principles of grading and details how timber is graded for purposes of the *Forest Act*.

6.1 History of Timber Grading in B.C.

Official scale rules (same as log rules) set the standard for estimating the net yield from logs. Since timber was first measured in B.C. in the mid-1800's five official scales have regulated timber measurement:

Official Scale		Yield Estimate: Units of
Prior to 1894	Foley and Doyle Log Rules	Board feet of lumber
1894	British Columbia Board Foot Scale (FBM)	Board feet of lumber
1944	British Columbia Cubic Scale (lumber cubic)	Cubic feet suitable to cut lumber
1965	British Columbia Firmwood Cubic Scale	Cubic feet of firmwood
1979	British Columbia Metric Scale	Cubic metres of firmwood

The significance of these official scales to grading lies in the fact that some of the practices and conventions followed in applying today's grading rules are very similar to those used in applying some of the official scales developed over 100 years ago.

Because 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 marketing, 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.

6.1.1 Coast Grading

Because of its historic settlement patterns, valuable old growth forests, and marine transport opportunities, logging and lumbering first flourished in BC on the coast. Coastal grades have changed over the years in response to varying needs. Timber grading was first introduced to the coast with the 1902 *Timber Measurement Act*. Initial grading excluded hemlock and balsam as these species were not considered to be of commercial quality.

The most recent major revisions were made in 1981 with the implementation of a new schedule of grades. This schedule developed by a joint ministry/industry committee introduced the letter grades (recorded as alphabetical characters), and replaced their numeric predecessors. The 1981 schedule was subsequently revised in 1990.

6.1.2 Interior Grading

Significant growth in the interior forest sector did not really get under way until the mid 1960s. The first interior grading system under the *Scaling Regulation* was introduced in 1988 to enable reduced stumpage rates to be applied to lower quality logs. Prior to this, grading was restricted to firmwood reject logs and 'category 04' logs, recovered from decadent and damaged stands. The interior schedule was subsequently amended in 1990 to meet the needs of a new utilization policy.

The most recent major revision was made in 2006 with the implementation of a change to the Schedule of Interior Timber Grades. This change was developed by a joint ministry/industry committee and redefines two sawlog grades with respect to size, quality and quantity.

6.2 Timber Grading Requirement

In British Columbia, all timber harvested from private or Crown lands or salvaged from the foreshore must be scaled. Grading is an integral component and a legal requirement of the scale.

The legal authority for grading falls under the *Scaling Regulation*. This regulation prescribes two grading schedules; Coast and Interior. The method of stumpage used in the area where the timber is cut determines which schedule must be used:

- timber cut in areas where a log based appraisal is used (predominantly coast) must be graded with the Schedule of Coast Timber Grades, and
- timber cut in areas where a lumber based appraisal is used (predominantly interior) must be graded using the Schedule of Interior Timber Grades.

This chapter further details how timber is graded in accordance with the schedules of timber grades. The scaling and classification of Special Forest Products are described in Chapter 8.

6.3 Principles of Timber Grading

Grades represent the size, quantity and quality available for potential manufacture of specific end products (lumber, veneer, shingles and chips). They are based on the percentage of a log which is available to manufacture merchantable lumber.

Grade rules typically include three components:

- minimum and/or maximum gross log dimensions,
- a requirement that a percentage of the log's gross volume must be available to manufacture a given product, and
- a requirement that a percentage of the product manufactured from the log must meet or exceed a given quality.

Application of the grade rules, as such, requires the scaler to:

- determine the log's gross dimensions,
- estimate what portion of the log is available to produce a given product, and
- consider the quality of the product which could be produced from the log.

To ensure grading is fair, consistent and reliable it is premised on some basic principles:

- done in strict compliance with the grading rules contained in the schedule of grades,
- assumes only common end products,
- assumes only conventional manufacturing processes, and
- is entirely independent of the marketing and/or processing practices of the purchaser.

It is the function of the scaler to assess the visible characteristics of each log, and with strict reference to the schedule of grades, determine what can be recovered from the log given its size and other characteristics.

The potential product recoveries in grading are:

- coastal grading: lumber, veneer and shingles, and chips,
- interior grading: lumber and chips.

The process of determining and quantifying the portions of the log not suitable for the production of lumber (or other product), is known as grade reduction. Unlike firmwood deductions (described in Chapter 5) which reduce the firmwood volume of the log, grade reductions are made solely for the purpose of determining the grade.

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, and
- impact product quality.

6.3.1 Log Characteristics Which Reduce Product Recovery (Quantity)

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 and the application is explained fully under Section 6.4.

Although the defects affecting timber quality are described separately, the scaler must evaluate the entire log in terms of the cumulative effect of the separate defects observed.

6.3.1.1 Fractures and Fibre Separation

Wood fibres may separate or split across the annual rings (e.g., surface checks, star shake) or between the annual rings (e.g., 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 across the growth rings are referred to as check and 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 heart and surface 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. The check wraps around the log, following the grain slope. 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 the depth at the ends of the log than elsewhere on the log, because the apex 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 these 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.

6.3.1.2 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.

6.3.1.3 Sweep, Crook and Pistol Grip

Sweep is a bow like bend in the trunk of a tree.

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 sidehills.

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 and deducted from the log.

6.3.1.4 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.

The rot fungus typically enters the tree through a root, a broken branch, a damaged leader or a scar on the stem. The remains of an old scar, a damaged leader, a crook or fork in a log often means rot is present. Scalers must carefully inspect all visible log surfaces for indicators of firmwood defects. Logs cut from older trees are more likely to contain rot, especially logs cut from tree species such as cedar, hemlock and balsam which are more susceptible to attack by fungi. The area and conditions that a tree grows in may also have an impact on the susceptibility of the tree to rot. No firmwood deductions are made for stain (incipient decay), as long as the wood is still firm, but it may be a consideration in assessing coast grades. (see Chapters 4 and 5).

In grading, the scaler must estimate how much the rot will reduce the percentage of the log that can be manufactured. Some of the sound wood adjacent to the rot is also lost to lumber production since the sawyer must square out around the defect. To account for this additional loss a trim allowance around the defect is usually made.

The scaler must also consider collars and shells of firmwood which surround defects as well as logs and log segments, which are too short to manufacture the products assumed in the grade rules. Section 6.4.2 details the methods of grading for log characteristics which reduce product recovery.

6.3.2 Log Characteristics Which Reduce Product Quality

In addition to the defects that reduce the potential product recovery volume, some log characteristics reduce the quality of the products which may be recovered. These characteristics include twist (or spiral grain) and knots.

6.3.2.1 Twist (Spiral Grain)

As trees grow they sometimes spiral around their central axis. When these twisted trees are manufactured into lumber, slope of grain may affect strength, and therefore the quality of the lumber. When twist is excessive, no merchantable lumber can be milled from a log. Where other quantity reducing defects which follow the grain such as spiral surface checks occur in conjunction with twist, the loss in terms of product recovery caused by those defects is greatly increased.

Twist must be measured where it represents the degree of deflection from straight. Areas around large knots, knot clusters, crooks, forks, burls, goitre, catface and other irregularities are not representative and must be avoided. Twist may also show a general

change over the length of a log, but sometimes only a lineal portion of the log may twist. Where twist is not uniform only lumber from the excessively twisted segment will have its merchantability affected and the scaler needs to determine what percentage of the lumber out-turn will be non-merchantable.

Grain deflection is expressed as a percentage of log diameter using the measurement perpendicular to the longitudinal axis of a log. In coast grading it is the top diameter for logs up to 12.8 m in length and for logs over 12.8 m in length, the diameter inside bark at a point 12.8 m above the large end, or butt of the log.

In interior grading the top diameter is used for logs up to and including 8 m and the measured mid-point diameter is used for logs over 8 m.

For example, a 5 m log with a 24 rad top showing 3 rads (6 cm) of deflection over 15 rads (30 cm) length, has 12.5 percent twist ($3/24 * 100 = 12.5\%$).

The application of these principles is detailed in Section 6.4 and twist allowances for specific log grades are detailed in Sections 6.5 and 6.6.

6.3.2.2 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.

6.3.2.2.1 Size of Knots

The presence of knots or knot indications on a log precludes the production of clear lumber from the affected portion. Knots larger than 1 rad will lower the strength of lumber and hence the amount of merchantable lumber cut. The larger the knot size, the greater the grain deflection, causing cross grain in the region of the knot. Extremely large knots will make the cutting of merchantable lumber impossible. 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, 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, for 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.

6.3.2.2.2 Types of Knots

Knots in timber are sound or rotten, and tight or loose.

Knots may be tight or loose, and lumber sawn from logs with sound, tight knots is generally of a higher quality than lumber with loose knots 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 be indicators of internal decay; the appearance of log ends that have been bucked through, or 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. In lumber grading, these are also known as intergrown or red knots.

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.

Considering knots in the application of the grading rules is covered under Section 6.4.3.1.

6.3.2.2.3 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, apical or 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.

Knot specifications for specific coast and interior grades are found in Sections 6.5 and 6.6.

6.3.2.3 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.

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.

6.3.2.4 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 is disqualified from the grade, and from lower grades where the log is required to have been "otherwise" the higher grade for which it has a prohibited defect.

Examples of defects which are not permitted in certain grades are conk stain, compression wood, powder worm and the required spacing for oversize knots.

Some grades permit certain defects only to a clearly defined limited extent. Examples are ring shake, pocket rot, pitch pockets and a number of peeler defects. 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.

6.3.2.5 Grain Density (Ring Count) - Coastal Grading Only

The diameter growth rate of a tree is dependent upon the species, genotype (i.e., its genetic makeup), climate and other site specific conditions. Growth is more rapid early in the growing season, and the 'earlywood' 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 comprise one 'annual ring', which marks one years growth.

Grain density or the closeness of the annual rings is a consideration in coastal grading. Finer grained logs (i.e., 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.

Considering grain density in applying the grading rules is covered under Section 6.4.3.5.

6.3.2.6 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. The wood on the lower side (inside arc) of the lean is called compression wood and the wood on the upper side (outside arc) is called tension wood. Compression wood is often characterized by a dense, hard, brittle grain and reacts to seasonal moisture changes. It can cause problems in processing timber such as causing bow and spring in manufactured products.

Considering wood compression in applying the grading rules is covered under Section 6.4.3.5.

6.4 Applying the Principles of Grading

6.4.1 Grade Reduction

Grade Reduction is the process of determining what portion of a log is not suitable for the manufacture of various products. Section 6.3 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).

Because logs are round and usually tapering, it is not possible to produce lumber, shingles, or veneer from the entire defect free portion of the log. As detailed 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.

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

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.

Experienced scalers 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).

These types of judgements become second nature to experienced scalers. Initially, scalers are strongly advised to calculate all grade reductions. It is only through such a background of disciplined practice that "log sense" and good judgement 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.

6.4.1.1 Field Methods for Determining Grade Reduction

Instead of using a full metric volume approach with Smalian's formula, shortened field methods may also be used to estimate grade reduction. Field methods such as that outlined in Appendix 6A reduce scaling time and the number of calculations, and at the same time can yield reliable results.

The reliability of field methods is dependent upon the specific characteristics of the logs being scaled.

As such, it is most important for scalers to know the limitations and range of application of field methods if they are contemplating their use.

Coastal timber types and piece scale production scaling support the use of field methods to estimate grade reduction. The field methods contained in Appendix 6A are considered reliable for the purpose of applying the Coastal Schedule of Timber Grades.

Using field methods which do not account for taper (known as linear methods) may not yield the same results as methods which employ a full metric volume approach using Smilians formula (known as volumetric methods). Where linear and volumetric methods yield different grade reductions, the volumetric method is deemed to be correct.

6.4.2 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 and field methods for calculating grade reduction are similar to those used for determining firmwood deduction. Scalers should carefully study Chapter 5 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 (i.e., 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.

The following sub-sections detail grade reductions which affect lumber recovery.

6.4.2.1 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 coast species, 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 interior species, 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 in these species 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.

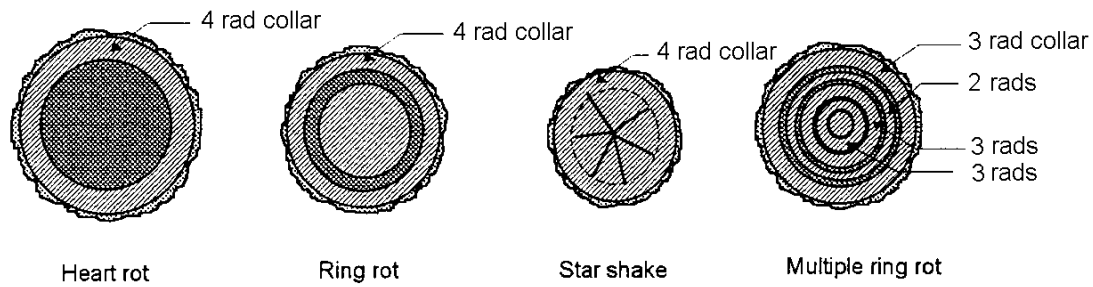
Scalers must exercise care when measuring or estimating collar thickness by taking actual, unrounded measurements of the collar. It is tempting to simply subtract the defect diameter from the recorded log diameter and divide the difference by two, but this method of averaging the collar thickness can 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 calipering 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 calipered, 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 6.10(1) 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 available, and may take an excessive reduction when a portion of the collar actually does meet the grade requirement.

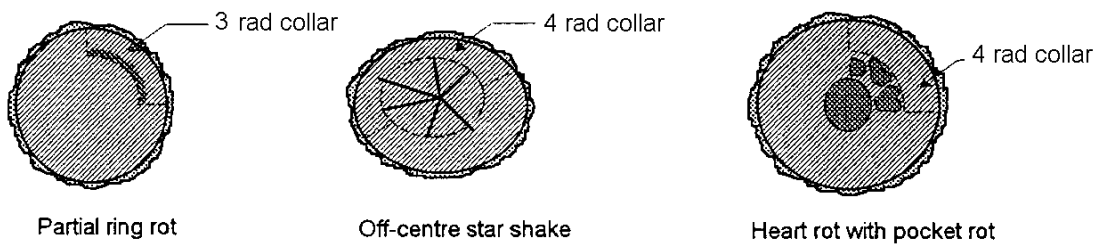
The following conventions are used to help ensure consistency in assessing collars:

- 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 calipered,
- 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.

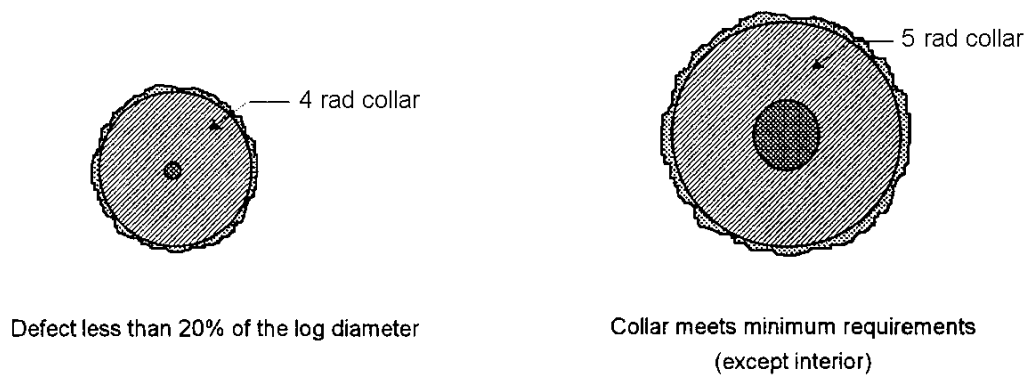
Collar thickness principles are provided in Figure 6.1, without showing trim allowance. Trim allowance is added *after* any collar assessments and is described fully in Section 6.4.2.5.



1. Examples of logs with entire collars too thin to produce lumber



2. Examples of logs with a portion of the collar too thin to produce lumber.



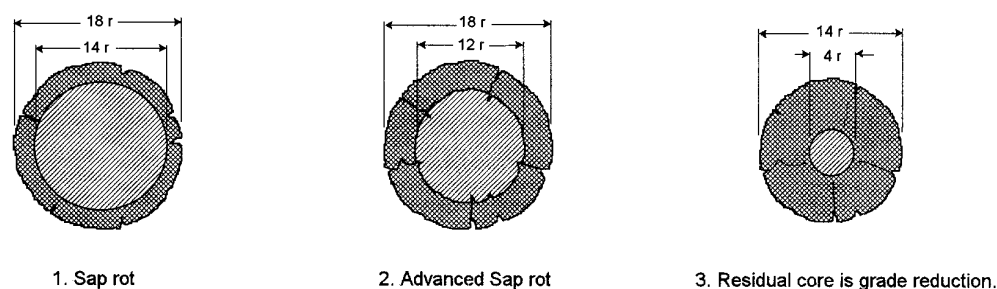
3. Examples of logs with sufficient collar to produce lumber.

(trim allowance is added to the collar surrounding the defect when calculating grade reduction).

Figure 6.1 Examples of collars around internal defects.

6.4.2.2 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 in Figure 6.2. Examples of grading residual cores inside ring shake and ring rot are provided in Section 6.4.2.5 (trim allowance section).



Trim allowance is not added to sap rot but may be added to surface checking of the residual core.

Figure 6.2 Residual Cores in Sap rot.

The first example in Figure 6.2 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:

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

The second example in Figure 6.2 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:

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

The third example in Figure 6.2 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. This log is 100 percent grade reduction for the distance the rot travels, and automatically qualifies as firmwood reject.

Although the following calculations are unnecessary in field practice, they are shown to illustrate the principle of a cumulative grade reduction.

From the scale stick:

Gross unit volume = UV 14 r = 62 dm³ per metre

The first grade reduction is the sap rot for the distance it travels the log:

Grade reduction = UV 14 r - UV 4 r = (62 - 5) = 57 dm³ per metre

The second grade reduction is for the firmwood core which is under 5 rads in diameter:

Grade reduction = UV 4 r = 5 dm³ per metre

Total grade reduction = (57 + 5) = 62 dm³ per metre

% of log which can be manufactured = $\frac{62 - 62}{62} \times 100 = 00.0\%$

6.4.2.3 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 loss in recovery. In such cases the available material separating the defects is also unsuitable for manufacture and is added to the grade reduction. Examples of grading multiple defects with less than 5 rads of separation are provided in the trim allowance Section 6.4.2.5.

6.4.2.4 Slab Thickness and Grading

To be considered suitable for various grades, slabs must achieve a certain minimum thickness.

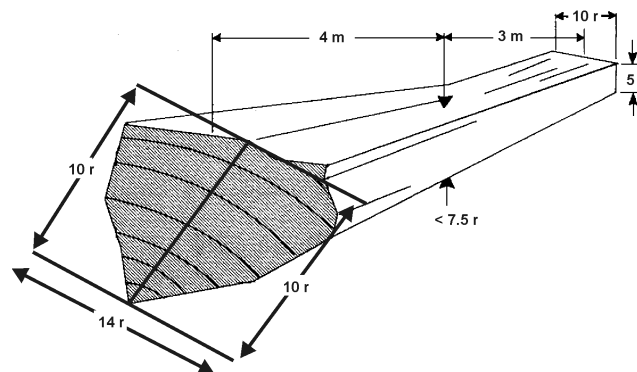
Drawing 2 Figure 6.3 illustrates how slab thickness is determined. For interior grading, slabs or portions must be at least 7.5 rads (15 cm) thick to be considered suitable for manufacture into lumber.

For  grading, the maximum thickness at right angles to the growth rings where a 2 rad board can be sawn is used to determine whether a slab qualifies for a particular grade. Coastal grades D, E, F, G, H, I, and K require 38 cm thickness; L requires 26 cm; M and U require 16 cm; X requires 10 cm, and no slabs are allowed in B, C, and J grades.

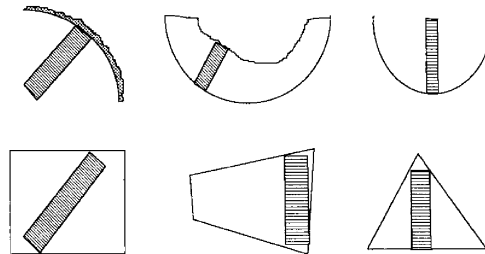
Interior grades code 1 requires 20 cm in width and thickness and code 2 requires 15 cm in width and thickness.

The specified minimum thicknesses in the grade rules are the actual, unrounded measurements measured at right angle to the growth rings.

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.



1. 4 m portion of log which is thick enough to cut lumber (interior only).



2. Maximum thickness is determined at right angles to the grain.

Figure 6.3 Slabs with portions meeting the grade rule.

Drawing 1 in Figure 6.3 is measured for firmwood content according to the methods described in Chapter 5, 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:

$$\text{Slab Unit volume, big end} = 10 \times 14 \times 0.4 = 56 \text{ dm}^3$$

$$\text{Slab Unit volume, small end} = 05 \times 10 \times 0.4 = 20 \text{ dm}^3$$

$$\text{Average unit volume} = (56 + 20) / 2 = 38 \text{ dm}^3$$

$$\text{Gross volume} = 38 \times 7 \text{ m} = 266 \text{ dm}^3$$

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:

$$\text{Unit volume } @ < 7.5r = 7 \times 12 \times 0.4 = 34$$

$$\text{Unit volume, small end} = 5 \times 10 \times 0.4 = 20$$

$$\text{Average unit volume} = (34 + 20) / 2 = 27 \text{ dm}^3$$

$$\text{Grade reduction volume} = 27 \times 3 \text{ m} = 81 \text{ dm}^3$$

$$\% \text{ of slab which can be manufactured} = \frac{266 - 81}{266} \times 100 = 69.5 \text{ percent}$$

6.4.2.5 Determining Trim Allowance

Trim allowance is included in the grade reduction and refers to the firmwood surrounding rot and other internal defects which is lost to lumber recovery when squaring up the areas adjacent to a defect. The standard trim allowance is 1 rad (2 cm) on all sides of the defect if the collar thickness requirements are met.

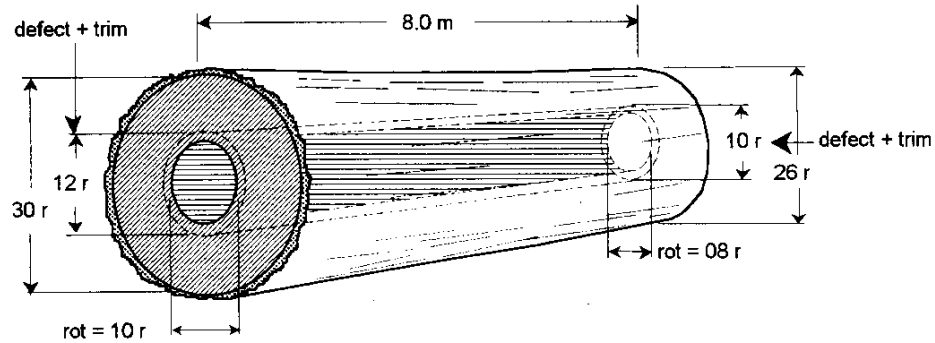
Once the trim allowance has been added, the total dimension is inserted into the appropriate formulae from Chapter 5 and the individual grade losses for the measured defects calculated. The individual losses are then summed to derive the total grade reduction.

The conventions associated with trim allowance are:

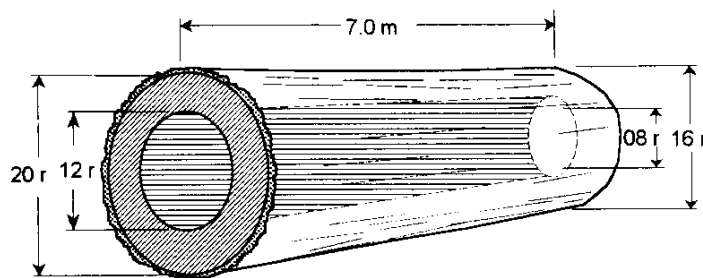
1. Trim allowance is added to internal defects such as heart rot, through running butt rot, pocket rot, ring rot, ring shake, water shake, heart shake, star shake, deep surface checks, and fractures.
2. Trim allowance is not added to external defects such as sap rot, cat face, missing wood, shallow surface checks, sweep, crook, pistol grip, char, and goitre.

3. Ring rot, ring shake, and water shake are characterized by having one or more *collars* of firmwood, interspersed by concentric rings or partial rings of defect surrounding one central *core* of firmwood. Trim allowance is applied to firmwood adjacent to the defect(s) as follows:
 - where the collar outside a ring defect and the core inside are both thick enough to produce lumber, a trim allowance is added to both the collar outside of the defect and the core inside of the defect in calculating the grade reduction,
 - where a sound collar does not meet the minimum thickness required to produce lumber, trim allowance is neither added to the collar nor to the core; the entire collar is included as grade reduction, and the entire core is considered to be available for manufacture (where the residual core is at least 5 rads or 10 cm in diameter),
 - where a sound core does not meet the minimum diameter of 5 rads (10 cm) trim allowance is not added to the core; the entire core is included as grade reduction, and trim allowance is added to the collar surrounding the core if it meets minimum thickness requirements.
 - where both the collar(s) and core do not meet the minimum thickness required to produce lumber, the length of the log affected is included as grade reduction, and
 - where there are multiple rings of defect, trim allowance is added to each collar which meets the minimum thickness required to produce lumber.
4. Trim allowance is added to the collar of firmwood surrounding the core of rot in heart rot and through running butt rot if the collar meets the minimum thickness required to produce lumber.
5. Trim allowance is added to all sides of pocket rot whether enclosed in a circle or a square or rectangle. Where numerous pockets are separated by less than 5 rads (10 cm) of firmwood, trim allowance is added around the group of pockets; the entire area of firmwood between the pockets is included as grade reduction.
6. Trim allowance is added to both sides of single shakes, deep checks, and fractures. If they are irregular, the total width of the irregularity is determined, and the trim allowance added to it.
7. Star shakes and multiple deep surface checks are trimmed out in their entirety. The average diameter of a circle or ellipse to just enclose the star shake or to just exclude the deep surface checks is used to determine the grade reduction.
8. Spiral checks are trimmed out in their entirety; the amount of twist in the check is observed or calculated over a given length.

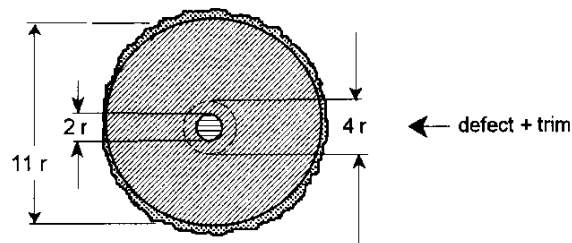
The following figures demonstrate examples of the principles of trim allowance in calculating grade reductions.



1. A log with heart rot and the collar is thick enough to produce lumber.



2. A log with heart rot and the collar is too thin to produce lumber.



3. Defect not more than 20% of the end diameter

Collar thickness is always measured exclusive of trim

Figure 6.4 The application of trim allowance around heart rot and hole.

In Figure 6.4, the first log has a rot diameter of 8 rads at the top and 10 rads at the butt. The grade reduction will be for a 10 rad top defect and a 12 rad butt defect after the 1 rad trim allowance is added around the defect. From the scale stick:

$$\begin{aligned}\text{Gross volume} &= 8 \text{ m}/26 \text{ r}/30 \text{ r} = (849 + 1131) = 1980 \text{ dm}^3 \\ \text{Grade reduction} &= 8 \text{ m}/10 \text{ r}/12 \text{ r} = (126 + 181) = 307 \text{ dm}^3 \\ \text{\% of log which can be manufactured} &= \frac{1980-307}{1980} \times 100 = 84.5 \text{ percent}\end{aligned}$$

The second log in Figure 6.4 has a collar thinner than the 5 rad minimum thickness requirement so the entire log is grade reduction. It is unnecessary to add trim allowance.

The following calculation is also unnecessary but is given to illustrate the principle of calculating a 100 percent grade reduction.

From the scale stick:

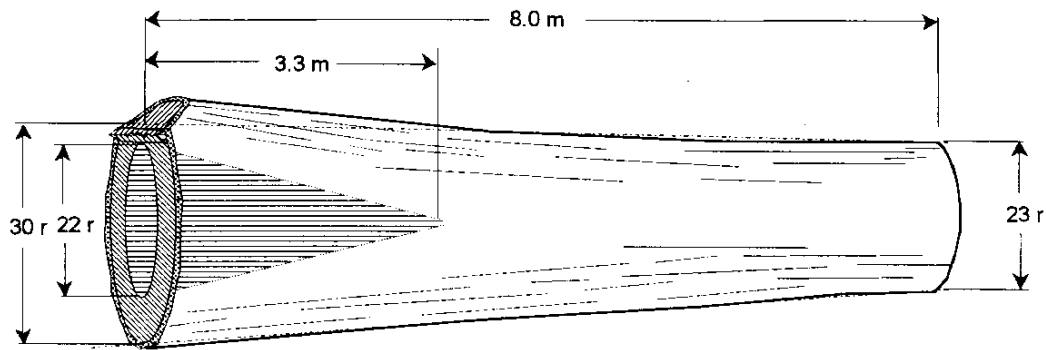
$$\text{Gross volume} = 7 \text{ m}/16 \text{ r}/20 \text{ r} = (281 + 440) = 721 \text{ dm}^3$$

$$\text{Grade reduction} = 7 \text{ m}/16 \text{ r}/20 \text{ r} = (281 + 440) = 721 \text{ dm}^3$$

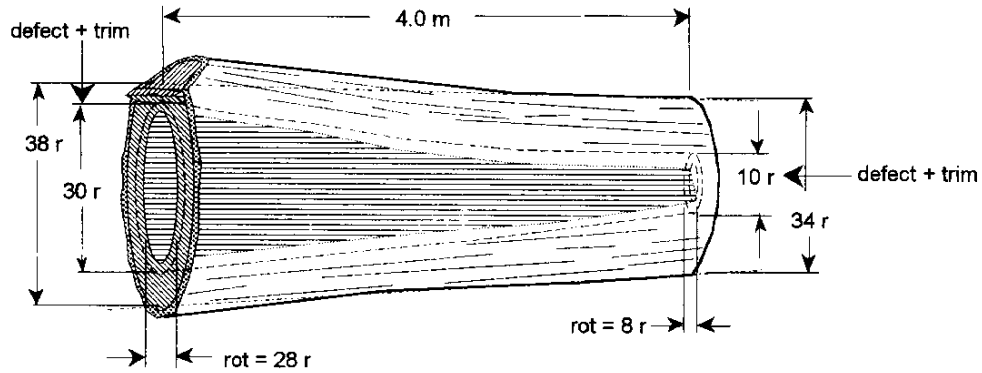
$$\text{\% of log which can be manufactured} = \frac{721-721}{721} \times 100 = 00.0\%$$

An exception to the grade rule is the third log in Figure 6.4. It has a heart defect diameter not more than 20 percent of end log diameter (2 rads divided by 11 rads times 100 = 18 percent) *and* the residual collar is less than 5 rads thick. If the heart defect is not more than 20 percent of the end diameter, collar thickness is not considered and trim allowance is added. Therefore, in this example, the grade reduction per metre of length from the scale stick is:

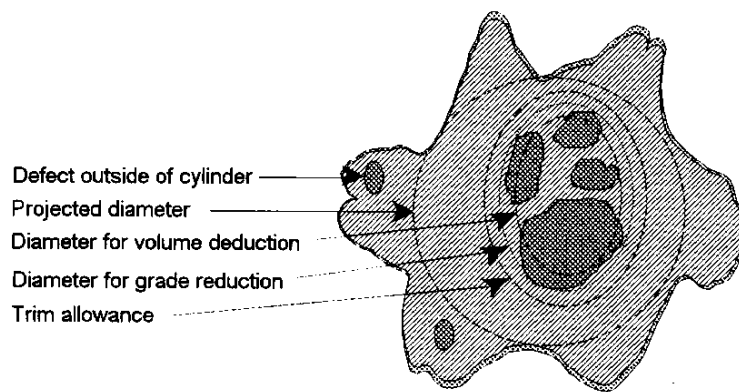
$$\begin{aligned}\text{Gross volume per metre (11 r)} &= \text{Unit volume: log} = 38 \text{ dm}^3 \\ \text{Grade reduction per metre (04 r)} &= \text{Unit volume: defect} = 5 \text{ dm}^3 \\ \text{\% of log which can be manufactured} &= \frac{38-05}{38} \times 100 = 86.8 \text{ percent}\end{aligned}$$



1. A log with simple butt rot estimated to penetrate 3.3 metres into the log ($22 \times 0.15 = 3.3\text{m}$)



2. A log with through running butt rot



3. Irregular butt defects in fluted butt log.

Figure 6.5 *The application of trim allowance around butt rot.*

The first example in Figure 6.5 is the exception to the convention of adding trim allowance to a collar of firmwood. Because conical butt rot has a much more variable and complex effect on grade reduction, a number of approaches to a reasonable solution have been tested. Of those methods, doubling the firmwood deduction is a reliable and simple convention, which allows for both trim allowance and minimum collar requirements.

With the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 8 \text{ m}/23 \text{ r}/30 \text{ r} = (665 + 1131) = 1796 \text{ dm}^3 \\
 \text{Cone volume} &= 3.3 \text{ m}/22 \text{ r} = \frac{(251 + 251)}{3} = 167 \text{ dm}^3 \\
 \text{Grade reduction} &= 167 \times 2 = 334 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1796 - 334}{1796} \times 100 = 81.4 \text{ percent}
 \end{aligned}$$

The second example of butt rot in Figure 6.5 follows the standard convention for adding trim allowance because the butt rot takes the form of heart rot. However, in the case of through running butt rot with the rot diameter at the butt more than 1.5 times the rot diameter at the top, an overstatement of the grade reduction may result from summing the half volumes or from finding the average unit volume. And, because of the neiloid or "golf tee" shape of the rot in this example, the grade reduction may be based on the average of the two diameters, which is nearer to the true volume of the defect. If the shape of the rot is presumed to be a frustum of a cone, it is necessary to increase the average diameter. If the shape is presumed to be parabaloid or "bullet" shape, half volumes or average unit volumes may be used. See the example in Chapter 5 showing a volume deduction for conoid through running butt rot.

With the scale stick:

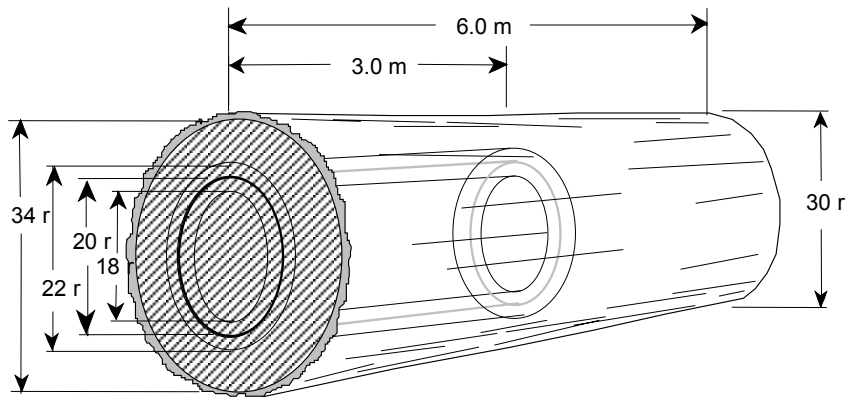
$$\begin{aligned}
 \text{Gross volume} &= 4 \text{ m}/34 \text{ r}/38 \text{ r} = (726 + 907) = 1633 \text{ dm}^3 \\
 \text{Average defect diameter} &= \frac{10 + 30}{2} = 20 \text{ rads} \\
 \text{Grade reduction} &= 4 \text{ m}/20 \text{ r}/20 \text{ r} = (251 + 251) = 502 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1633 - 502}{1633} \times 100 = 69.3 \text{ percent}
 \end{aligned}$$

In this example, it is assumed that the collar is thick enough to cut lumber. Where the collar does not meet the minimum thickness, the lineal portion of the log without collar must be included as grade reduction. The collar thickness is determined by actual measurement, *not* as 1/2 the difference between the projected butt diameter and the defect diameter.

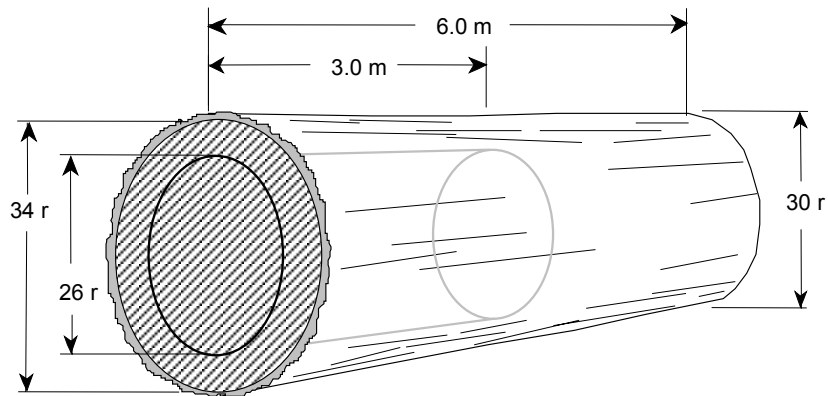
As with many procedures described in this manual, considerable field instruction is required to accurately apply these grade reduction procedures.

The third example in Figure 6.5 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:

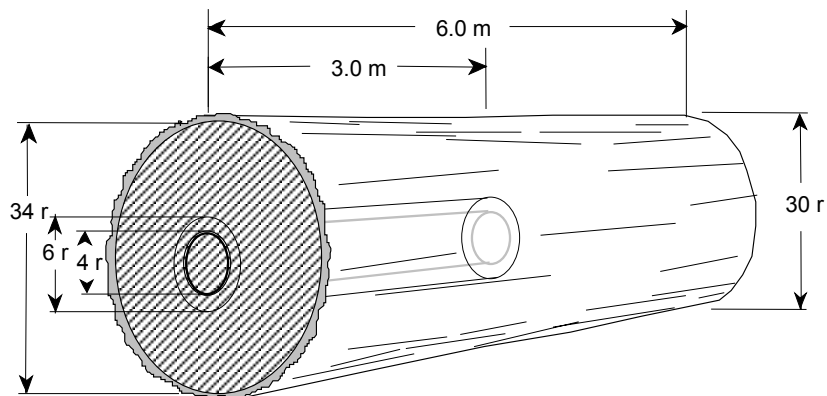
- any defects outside of the gross butt diameter (projected butt diameter) are not considered for either firmwood deduction or grade reduction, although these defects may serve to indicate the severity of a butt defect. i.e. the distance it penetrates up the log,
- the firmwood deduction diameter is *reduced* to account for firmwood in-between the scattered defects,
- 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.



1. A log with ring shake and the collar and core are thick enough to produce lumber.



2. A log with ring shake and the collar is not thick enough to produce lumber.



3. A log with ring shake and the core is not thick enough to produce lumber.

Figure 6.6 The application of trim allowance around ring shake.

Example 1 in Figure 6.6 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:

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

Example 2 in Figure 6.6 shows a log with the same gross dimensions as Example 1, but the ring shake is positioned so that the collar of firmwood is less than the minimum thickness requirement of 5 rads. Because the entire collar is a grade reduction, the entire core is considered suitable for recovery, and no trim allowance is added. From the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 6 \text{ m}/30 \text{ r}/34 \text{ r} = (848 + 1090) = 1938 \text{ dm}^3 \\
 \text{Grade reduction} &= \text{UV } 34 \text{ r} - \text{UV } 26 \text{ r for } 3 \text{ m} = (363 - 212) \times 3 = 453 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1938 - 453}{1938} \times 100 = 76.6 \text{ percent}
 \end{aligned}$$

Example 3 in Figure 6.6 shows a log with the same gross dimensions as the first two examples but the core of firmwood is less than the minimum core thickness of 5 rads. Because the core is a grade reduction, trim allowance is added only to the collar. From the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 6 \text{ m}/30 \text{ r}/34 \text{ r} = (848 + 1090) = 1938 \text{ dm}^3 \\
 \text{Grade reduction} &= 3 \text{ m}/6 \text{ r}/6 \text{ r} = (17 + 17) = 34 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1938 - 34}{1938} \times 100 = 98.2 \text{ percent}
 \end{aligned}$$

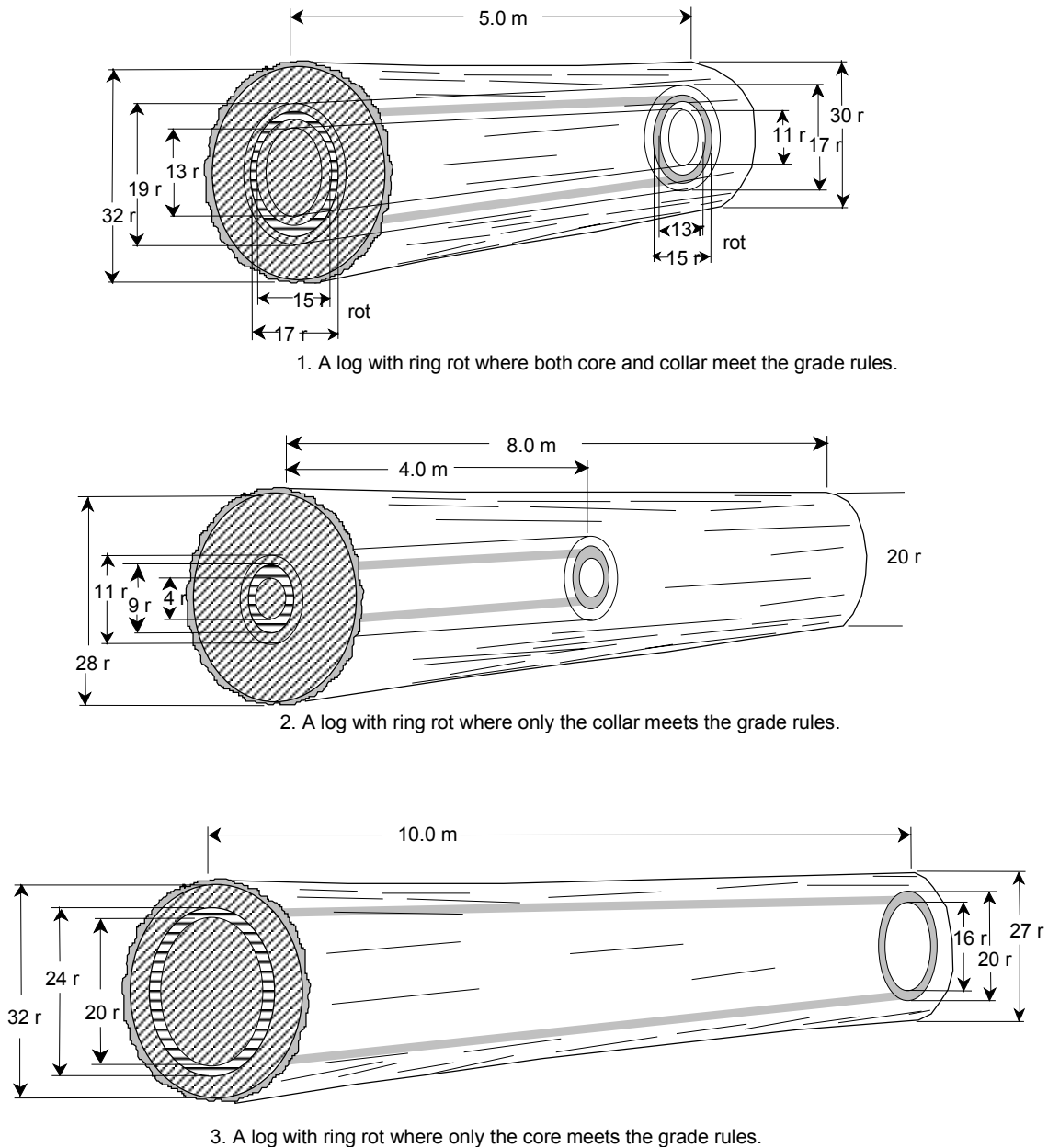


Figure 6.7 Application of trim allowance around ring rot.

The first example in Figure 6.7 shows a log with 1 rad of ring rot penetrating the full length and circumference of the log. Because both the collar and the residual core meet minimum thickness requirements, trim allowance is added to both the collar and the core.

From the scale stick:

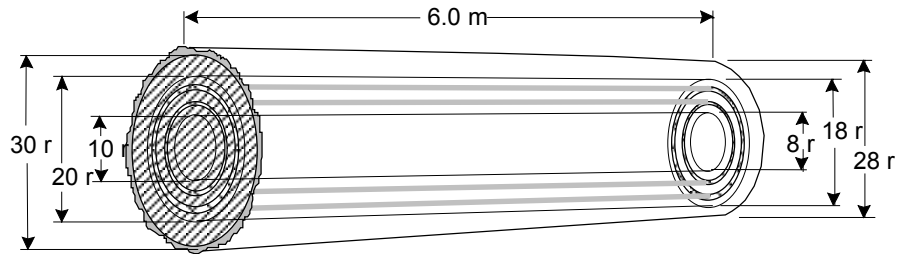
$$\begin{aligned}
 \text{Gross volume} &= 5 \text{ m}/30\text{r}/32 \text{ r} = (707 + 804) &= 1511 \text{ dm}^3 \\
 \text{Grade reduction} &= \text{Outside cylinder } 5 \text{ m}/17 \text{ r}/19 \text{ r} &= (227 + 284) = 511 \text{ dm}^3 \\
 \text{less} &= \text{Inside cylinder } 5 \text{ m}/11 \text{ r}/13 \text{ r} &= (95 + 133) = 228 \text{ dm}^3 \\
 &= (511 - 228) &= 283 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1511-283}{1511} \times 100 &= 81.3 \text{ percent}
 \end{aligned}$$

The second example in Figure 6.7 shows a log where the sound heart is only 4 rads, which is less than the 5 rads (10 cm) required to cut lumber. Because the entire core is a grade reduction, trim allowance is added only to the collar. With the scale stick:

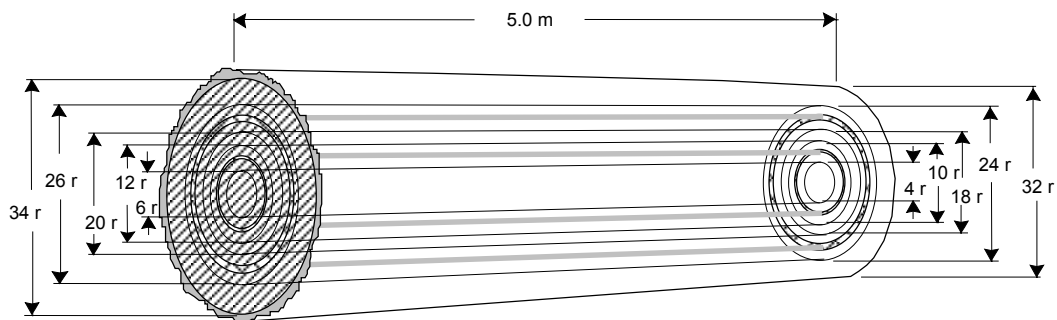
$$\begin{aligned}
 \text{Gross volume} &= 8 \text{ m}/20 \text{ r}/28 \text{ r} = (503 + 985) &= 1488 \text{ dm}^3 \\
 \text{Grade reduction} &= 4 \text{ m}/11 \text{ r}/11 \text{ r} = (76 + 76) &= 152 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1488-152}{1488} \times 100 &= 89.8 \text{ percent}
 \end{aligned}$$

The third example in Figure 6.7 shows a log where the sound collar is less than the minimum thickness required to cut lumber. Trim allowance is not added to either the collar or the core; the entire collar is grade reduction and the entire core is available for manufacture (when it is 5 rads or more in diameter).

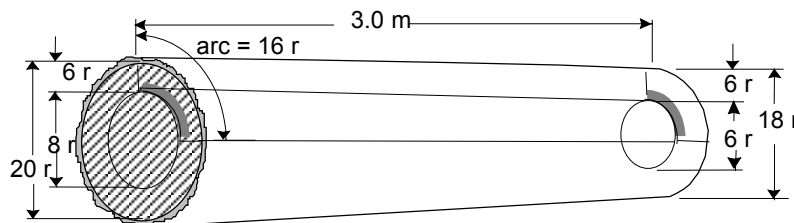
$$\begin{aligned}
 \text{Gross volume} &= 10 \text{ m}/27 \text{ r}/32 \text{ r} = (1145 + 1608) &= 2753 \text{ dm}^3 \\
 \text{Volume available} &= 10 \text{ m}/16 \text{ r}/20 \text{ r} = (402 + 628) &= 1030 \text{ dm}^3 \\
 \text{Grade reduction} &= 2753 - 1030 &= 1723 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{2753-1723}{2753} \times 100 &= 37.4 \text{ percent}
 \end{aligned}$$



1. A log with multiple ring rot and the firmwood between rings is less than 5 rads.



2. A log with multiple ring rot and the firmwood between rings is 5 rads or greater.



3. A log with partial ring rot 2 rads thick.

Figure 6.8 The application of trim allowance around multiple and partial rings.

The first example in Figure 6.8 shows a log with two 1 rad rings of rot penetrating the full length and circumference of the log. Because both the collar and the residual core meet minimum thickness requirements, trim allowance is added to both the outer collar and the core, but the residual collar between the two rings does not meet the requirements, and it is grade reduction. If the outer collar and core also did not meet the minimum requirements, the whole log would be grade reduction.

From the scale stick:

$$\begin{aligned}
 \text{Gross volume} &= 6 \text{ m}/28 \text{ r}/30 \text{ r} = (739 + 848) = 1587 \text{ dm}^3 \\
 \text{Grade reduction} &= \text{Outside cylinder } 6 \text{ m}/18 \text{ r}/20 \text{ r} = (305 + 377) = 682 \text{ dm}^3 \\
 \text{less} &= \text{Inside cylinder } 6 \text{ m}/08 \text{ r}/10 \text{ r} = (60 + 94) = 154 \text{ dm}^3 \\
 &= (682 - 154) = 528 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1587-528}{1587} \times 100 = 66.7 \text{ percent}
 \end{aligned}$$

The second example in Figure 6.8 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:

$$\begin{aligned}
 \text{Gross volume} &= 5 \text{ m}/32 \text{ r}/34 \text{ r} = (804 + 908) = 1712 \text{ dm}^3 \\
 \text{Outside ring:} \\
 \text{Grade reduction} &= \text{Outer cylinder } 5 \text{ m}/24 \text{ r}/26 \text{ r} = (452 + 531) = 983 \text{ dm}^3 \\
 \text{less} &= \text{Inner cylinder } 5 \text{ m}/18 \text{ r}/20 \text{ r} = (254 + 314) = 568 \text{ dm}^3 \\
 &= (983 - 568) = 415 \text{ dm}^3 \\
 \text{Inside ring:} \\
 \text{Grade reduction} &= \text{Outer cylinder } 5 \text{ m}/10 \text{ r}/12 \text{ r} = (79 + 113) = 192 \text{ dm}^3 \\
 \text{less} &= \text{Inner cylinder } 5 \text{ m}/04 \text{ r}/06 \text{ r} = (13 + 28) = 41 \text{ dm}^3 \\
 &= (192 - 41) = 151 \text{ dm}^3 \\
 \text{Sum of grade reduction} &= (415 + 151) = 566 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{1712-566}{1712} \times 100 = 66.9 \text{ percent}
 \end{aligned}$$

The third example in Figure 6.8 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 π 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 alternatives may be used. Degrees 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:

$$\text{Radius times } \pi = 20 \times 3.14159 = 63 \text{ r circumference}$$

$$\text{Defect arc factor} = 16 \text{ r arc} \div 63 = 1/4 \text{ or } 0.25 \text{ or } 25 \text{ percent}$$

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

$$\text{Position of hands} = 12:00 \text{ to } 3:00 = 15 \text{ minutes}$$

$$\text{Defect arc factor} = 15 \text{ divided by } 60 = 0.25 \text{ or } 25 \text{ percent}$$

Factor from a compass, major divisions in 8ths or 16ths (secondary divisions in 10 degrees or 36ths.):

$$\text{Position from North} = 90 \text{ degrees}$$

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

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:

$$\text{Gross volume} = 3 \text{ m}/18 \text{ r}/20 \text{ r} = (153 + 188) = 341 \text{ dm}^3$$

$$\text{less} = \text{Inside cylinder } 3 \text{ m}/06 \text{ r}/08 \text{ r} = (17 + 30) = 47 \text{ dm}^3$$

$$\text{Grade reduction} = 341 - 47 = 294 \times \text{factor of } 0.25 = 73.5 = 74 \text{ dm}^3$$

$$\% \text{ of log which can be manufactured} = \frac{341-74}{341} \times 100 = 78.3 \text{ percent}$$

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:

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

Example 1 in Figure 6.9 shows a log with an irregular heart shake 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:

$$\begin{aligned}
 \text{Grade reduction} &= 6/10 \text{ dm by } 20/10 \text{ dm by } 2.5 \text{ dm} \\
 &= 0.6 \times 2 \times 25 &= 30 \text{ dm}^3
 \end{aligned}$$

Either method will produce the same results:

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

Example 2 in Figure 6.9 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).

Example 3 in Figure 6.9 illustrates a log with 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:

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

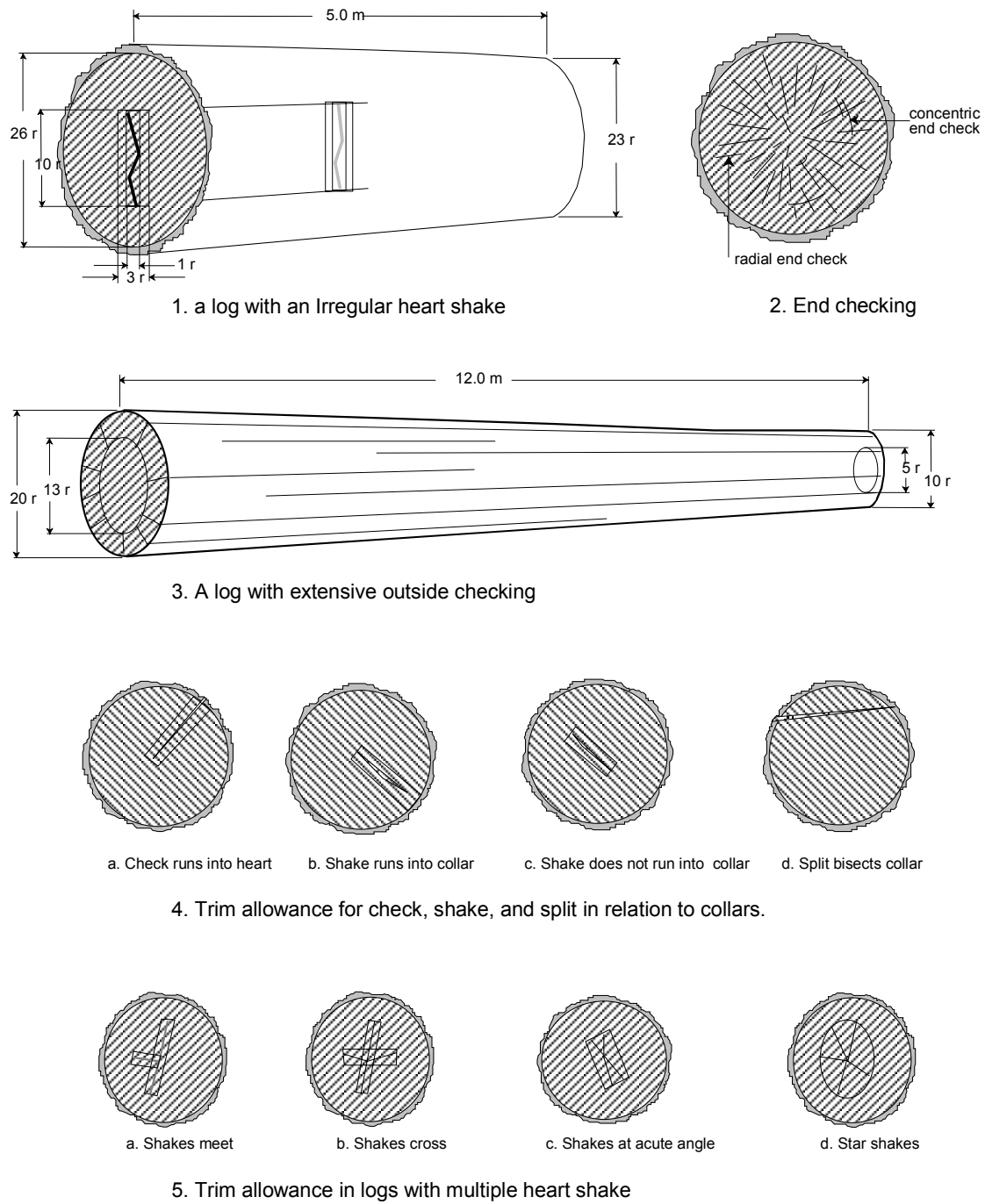


Figure 6.9 The application of trim allowance around checks and shake.

Example 4 in Figure 6.9 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.

Example 5 in Figure 6.9 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 which 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 which 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.

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. The Forest Service may order that it be ignored.

Although the two examples in Figure 6.10 are completely different types of defect, they are treated in a very similar manner to each other, where 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.

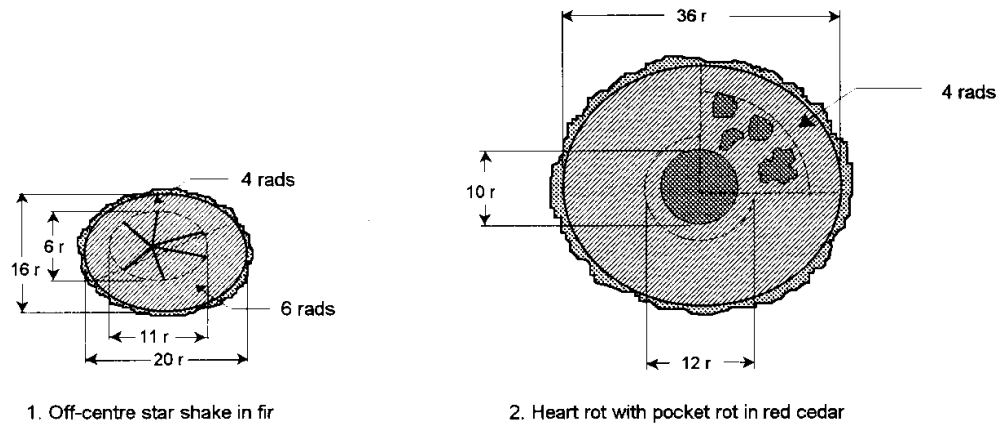


Figure 6.10 *The application of trim allowance to off-centre and overlapping defects.*

The first example in Figure 6.10 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. 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:

$$\begin{aligned}
 \text{Gross unit volume} &= \text{UV } 18 \text{ r} &= 102 \text{ dm}^3 \\
 \text{Grade reduction} &= (6 + 11)/2 &= \text{UV } 08 \text{ r} &= 20 \text{ dm}^3 \\
 \text{Net unit volume} &= 102 - 20 &= 82 \text{ dm}^3
 \end{aligned}$$

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):

$$\begin{aligned}
 \text{Grade reduction} &= 82 \times 0.5 \text{ (half)} &= 41 \text{ dm}^3 \\
 \text{Total reduction} &= 41 + 20 &= 61 \text{ dm}^3 \\
 \text{\% of log which can be manufactured} &= \frac{82-61}{82} \times 100 &= 25.6 \text{ percent}
 \end{aligned}$$

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.

The second example in Figure 6.10 shows a red cedar 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 are 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:

$$\begin{aligned}\text{Gross unit volume} &= \text{UV } 36 \text{ r} &= 407 \text{ dm}^3 \\ \text{Grade reduction} &= \text{UV } 12 \text{ r} &= 45 \text{ dm}^3 \\ \text{Net unit volume} &= 407 - 45 &= 362 \text{ dm}^3\end{aligned}$$

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):

$$\begin{aligned}\text{Grade reduction} &= 362 \times 0.25 &= 90 \text{ dm}^3 \\ \text{Total reduction} &= 45 + 90 &= 135 \text{ dm}^3 \\ \text{\% of log which can be manufactured} &= \frac{362-90}{362} \times 100 &= 66.8 \text{ percent}\end{aligned}$$

6.4.2.6 Determining Grade Reduction for Spiral Checks and Shakes

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

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.

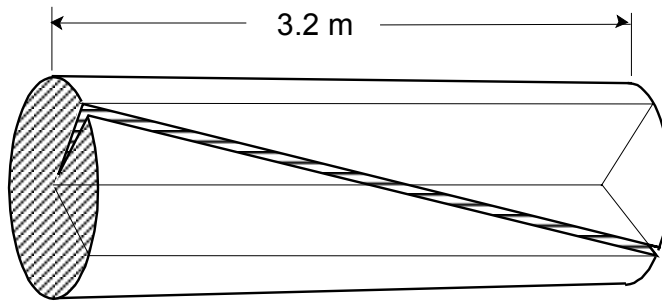
If a spiral surface check does not penetrate all the way into the heart, the grade reduction is of course less than for a full check, and it is important to understand the relationship between the depth of penetration and the effect on volume. For example, a check penetrating half-way to the heart would 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 shake on grade reduction for short and long logs, and ways of calculating grade reduction.

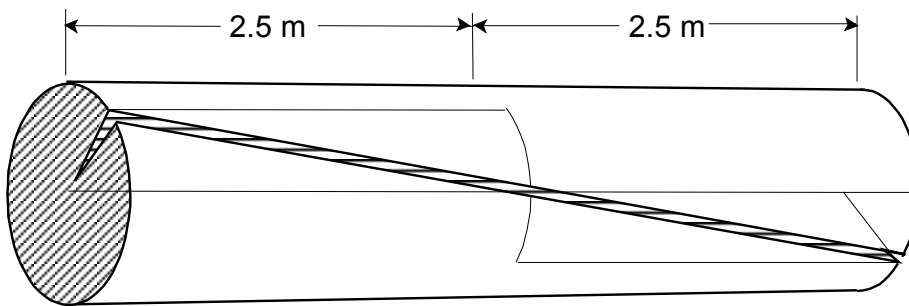
The first log in Figure 6.11 has a uniform spiral check running its full length. Because the log is less than 5 m long, assess the twist on the log length. In field practice, it is only necessary to observe the degree of spiral from one end to the other, and estimating the percentage of the log affected, in this case 25 percent of its circumference. Therefore the grade reduction on the log is also 25 percent.

The second log in Figure 6.11 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.

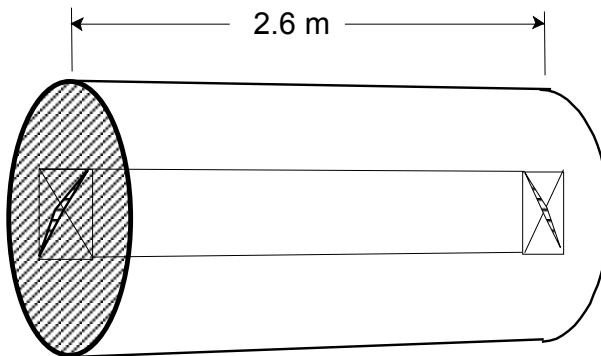
The third log in Figure 6.11 shows a a spiral heart shake. It may be treated similarly to acute or irregular heart shake, as shown in the examples in Figure 6.9, except that trim allowance is not added. That is, the grain deflection is projected to the opposite end of the log, the area affected is enclosed in a rectangle, and the grade reduction calculated from that.



1. Logs shorter than 5 m are assessed on their length.



2. Logs 5 m and longer are assessed in 2.5 m segments.



3. A log with spiral heart shake.

Figure 6.11 *The effect of spiral check and shake on grade.*

6.4.2.7 Determining Lengths for Purposes of Grade - 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 which 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.

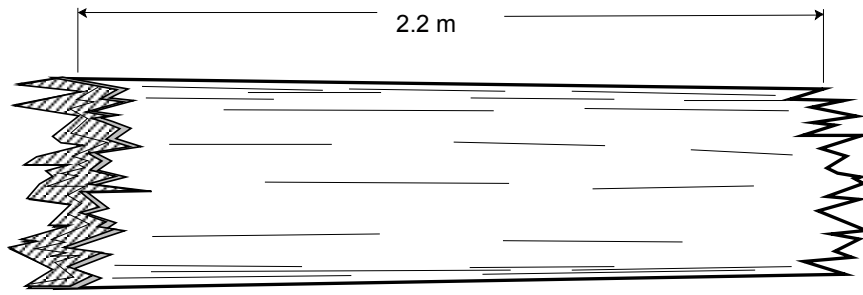
In all instances, breakage is always graded on the basis of its actual length (breakage is defined as any piece, meeting the minimum diameter of the cutting authority, which is shorter than 2.5 m in length and broken at the large end or at both ends).

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

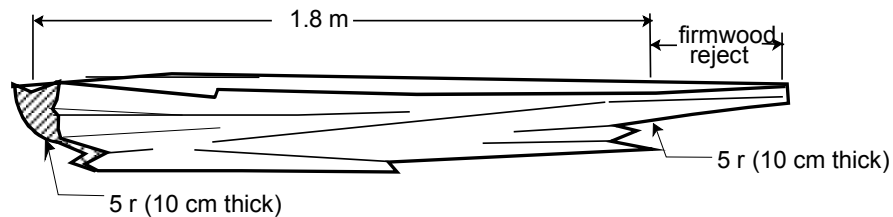
In general, deemed lengths are used in scaling short pieces for two purposes:

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



1. Log of any diameter over the utilization standard with broken ends.

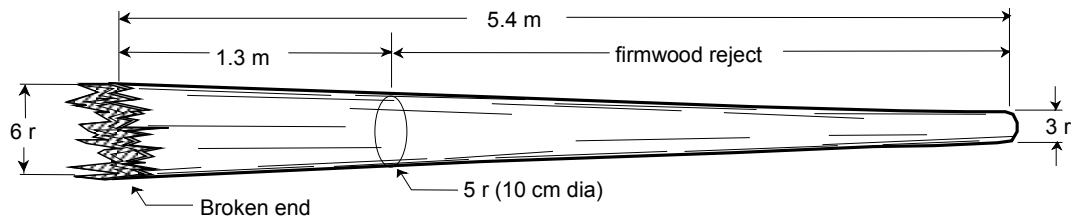


2. Slab with sharp ends cleaned up.

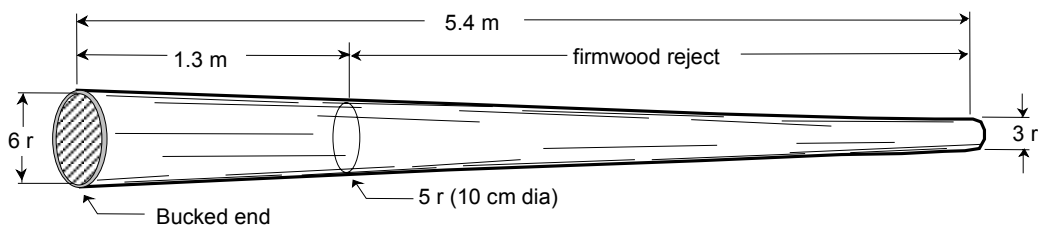
Figure 6.12 Short breakage pieces contained in a conventional load.

Figure 6.12 shows 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 after delivery 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, 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.



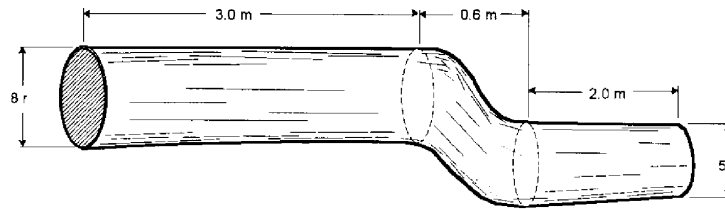
1. The 1.3 m portion of this log is graded on the basis of its actual length.



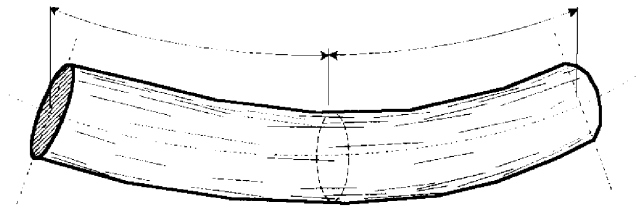
2. The 1.3 m portion of this log is deemed to be 2.5 m long or 5.2 m (coast).

Figure 6.13 Rat tail tops delivered with a short segment over the 10 cm utilization policy.

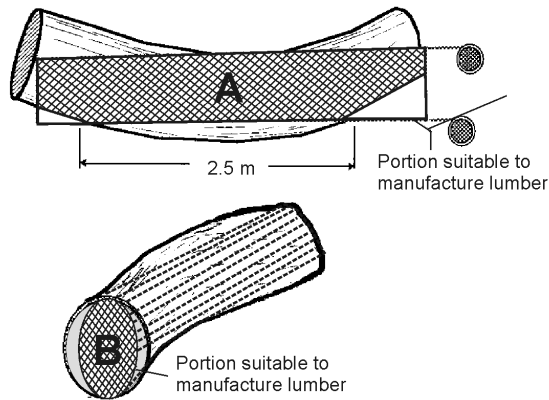
Figure 6.13 shows two similar "rat tail" logs which were delivered to a scale site. For both logs, the portion of the log less than 5 rads (10 cm) in diameter is graded as firmwood reject. The portions of the logs 5 rads (10 cm) and larger, however, are treated differently for grading purposes because 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.



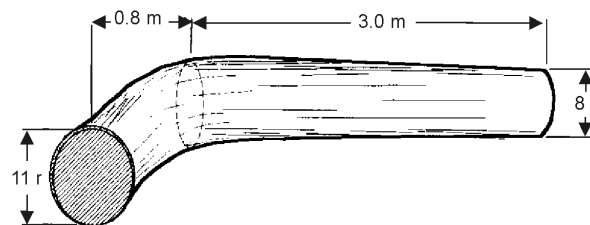
1. Visually bucking a log with crook to assess lumber recovery.



2. Visually bucking a log with sweep to assess lumber recovery.



3. Using a tape to evaluate sweep in logs or sections from the sides (A) and the ends (B) of the log.



4. Visually bucking a log with pistol grip to assess lumber.

Figure 6.14 Assessing grade in logs with sweep, crook and pistol grip.

The first log in Figure 6.14 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.

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 would be based on the NLGA requirements that would allow a minimum warp.

If a log is bucked or pencil bucked into two or more lengths, the lumber loss caused by the sweep could be greatly reduced. The scaler should assess the grade reduction accordingly. The scaler visualizes the log being milled from the ends and the sides in order to assess the grade reduction for the sweep.

The second log in Figure 6.14 has severe sweep which is uniform throughout the length of the log. If the second 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.

The third log is an example on how to use a measuring tape or scale stick to estimate the volume available to cut 2.5 m lumber that is straight enough. If this log was visually assessed from the ends and the sides the milling losses would be minimized.

The pistol grip in the fourth log in Figure 6.14 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.

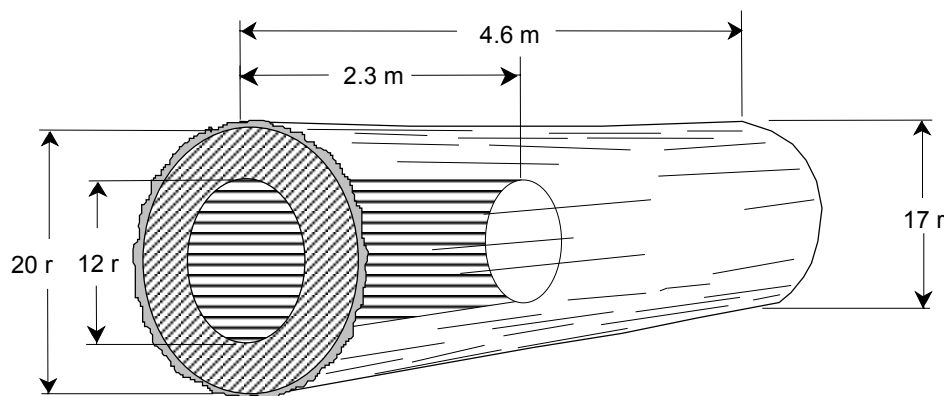


Figure 6.15 *Assessing grade in log with severe heart rot and residual length is too short to cut lumber.*

The log in Figure 6.15 has severe heart rot which is estimated to travel for half the length of the log. The 4 rad collar is too thin to cut lumber, and a normal grade reduction is made to include the rotten heartwood and the sound collar. That is, the gross volume attributable to the rotten end is a 100 percent grade reduction for 2.3 m. The other half of

the log is sound but is shorter than the 2.5 m required for manufacture, so it must also be included as 100 percent grade reduction for 2.3 m. As a result, the entire log is 100 percent grade reduction.

Although the following calculations are unnecessary in field practice, they are shown to illustrate the principle of a cumulative grade reduction.

From the scale stick:

The first grade reduction is the heart rot for one-half the length of the log:

$$\text{Gross volume} = 17 \text{ r}/20 \text{ r}/4.6 \text{ m} = (209 + 289) = 498 \text{ dm}^3$$

$$\text{Grade reduction} = 12 \text{ r}/12 \text{ r}/2.3 \text{ m} = (52 + 52) = 104 \text{ dm}^3$$

The second grade reduction is the collar which is too thin to produce lumber:

$$\begin{aligned} \text{Grade reduction} &= \text{UV } 20 \text{ r} - \text{UV } 12 \text{ r} \times 2.3 \text{ m} = (126 - 45) \times 2.3 \\ &= 81 \times 2.3 = 186 \text{ dm}^3 \end{aligned}$$

The third grade reduction is the sound half of the log which is too short to produce lumber:

$$\text{Grade reduction} = \text{UV } 17 \text{ r} \times 2.3 \text{ m} = (91 \times 2.3) = 209 \text{ dm}^3$$

The three grade reductions are totaled and the percentage of the log available for manufacture is calculated:

$$\text{Total Grade reduction} = 104 + 186 + 209 = 499 \text{ dm}^3$$

(Rounding conventions and log taper result in a total grade reduction of 1 dm³ more than the gross volume of the log, and because the grade reduction cannot exceed the gross volume, it is made equal to the gross volume).

$$\% \text{ of log which can be manufactured} = \frac{498 - 499}{498} \times 100 = 0 \text{ percent}$$

In field practice, significantly different results can be expected from cumulative grade reductions among scalers, depending on method. Although in most cases, the actual

grade of a log will not be affected, the assessment of borderline logs can become a concern, particularly in performance checks. The fault does not lie with the scaler, but in the suitability of the available methods to the size and shape of a particular log. Because grading is quite subjective, just as the determination of firmwood loss is, more emphasis should be placed on the actual grade classification by the scaler and the reasoning behind the grade call, rather than technicalities.

Figure 6.16 illustrates a number of examples 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.

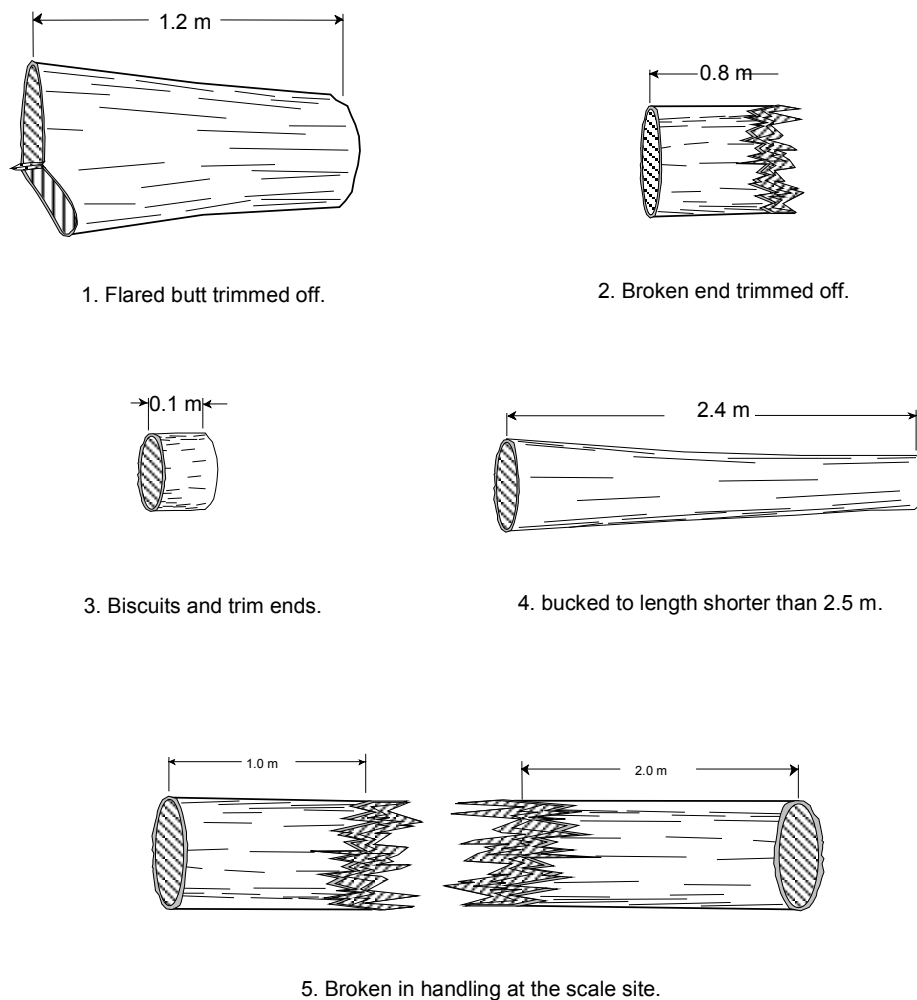
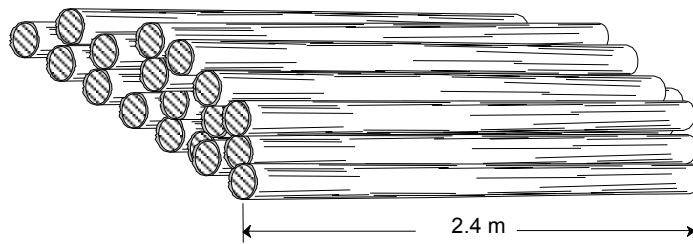
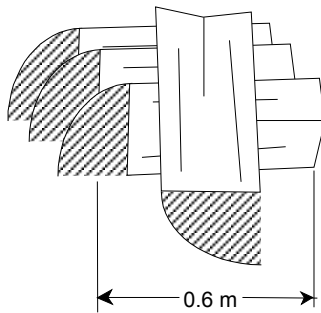


Figure 6.16 Examples of short logs left after bucking at the scale site and deemed to be 2.5 m long (interior) and 5.2 m long (coast).

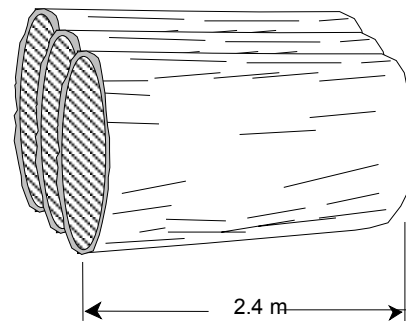
Where unscaled timber is bucked and delivered to a scale site or bucked at the scale site for the purpose of manufacturing special forest products prior to scaling, the timber is to be scaled and graded as logs unless it has been classified as a special forest product. The classification and scaling of special forest products are described in Chapter 8. Figure 6.17 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.



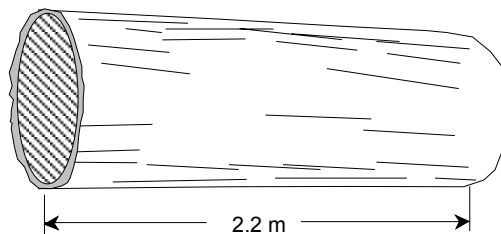
1. Fence posts



2. Shake blocks



3. Shingle bolts



4. Mining timber

Figure 6.17 Examples 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).

6.4.3 Assessing Product Quality

Section 6.4.2 looked at the grade reductions that tend to reduce the quantity of product that a given log is likely to yield. In log grading, we are also concerned with the quality of the products which can be produced from the log (i.e., its product out-turn).

In addition to the percentage of a log which can be manufactured into a given product, the grade rules also specify that a minimum percentage of the product manufactured from the log must be merchantable and/or clear.

Merchantability is determined by assessing the size and placement of knots, and the degree of any spiral or twist observed on the log. Merchantable lumber is considered to be lumber which grades out better than utility. There is no direct relationship between log grading and lumber grading, as lumber graders assess the finished product, whereas scalers must assess the round log from which the product is cut. For instance, the grain slope permitted by the *National Lumber Grades Authority* (NLGA is the organization responsible for writing, interpreting and maintaining Canadian lumber grading rules and standards) differ from the twist allowance in the log grading schedules; a scaler cannot presuppose the affect of grain slope on lumber, because sawing methods have a major impact on grain slope. The log grading rules therefore only gauge the recovery potential of a log under average sawing conditions.

Where the grade rules require that a percentage of the out turn be clear, it means that the stated proportion of the product must be free of knots and stain.

In addition to the quantity and the quality of the product out turn, some grade rules require a log to be fine grained. The fineness of grain relates to the separation between seasonal growth rings. Fine grained logs have a higher fibre density (i.e., proportionately more cellulose and lignin per unit volume) and will, therefore, produce stronger lumber and higher quality veneer.

6.4.3.1 Assessing Knots

Knots larger than 1 rad (2 cm) reduce lumber quality because the grain deflection around the knots weaken the recovered lumber, even though the actual knot fibres may be denser and stronger than its supporting tissue.

Maximum allowable knot size increases with the diameter of the log and are expressed in radius class units (rads) or centimetres of diameter. When taking this measurement, only the actual knot should be measured and not the shoulder surrounding it. Figure 6.18 shows a log section with typical knot forms. 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.

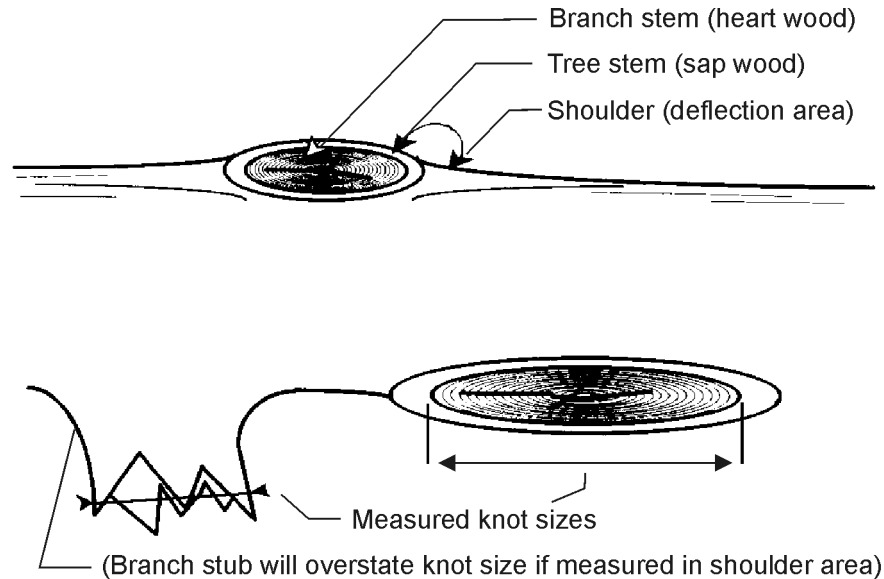


Figure 6.18 Measuring knot diameters at right angle to the log length.

Figure 6.19 shows the measurement of bunch knots. Bunch knots or cluster knots are defined as those circumstances where the majority of the log's grain deflects around, rather than through or between a close grouping of knots, reducing the strength of lumber produced. Where this occurs, the group of knots is assessed the same as an oversized knot; the smallest circle or ellipse that will surround the cluster is taken as the knot diameter.

Certain species such as Douglas-fir, larch, cedar, cypress and alder, when stressed, produce adventitious branches (sucker limbs) which, after a period of time, may come to take the appearance of knots or knot clusters. These sucker limbs do not, however penetrate very far into the log since they form much later in the tree's life cycle than regular branches. Therefore, they do not have nearly as much impact on the manufacturing potential of the log as their size might suggest. Scalers working with such logs should come to recognise this characteristic and observe some of these logs in the breakdown process.

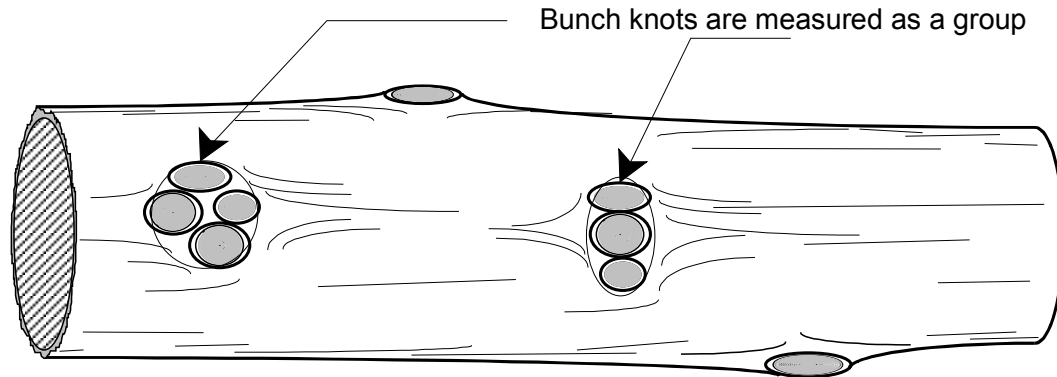
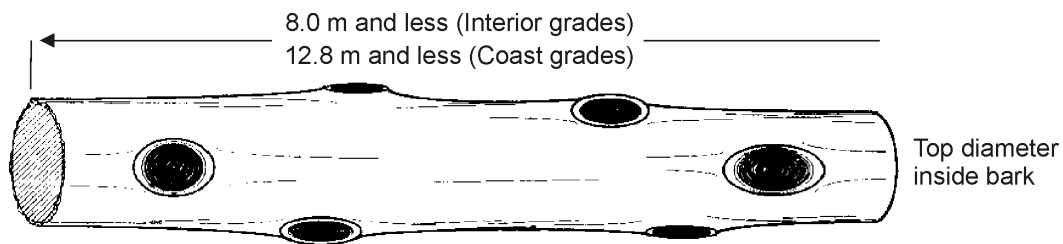


Figure 6.19 Measuring bunch (cluster) knots.

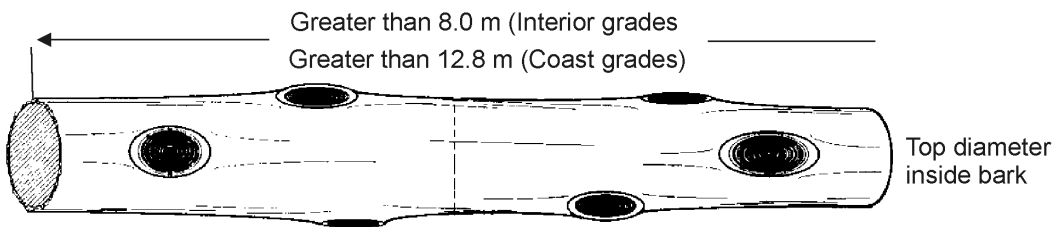
Knots which indicate the presence of conk or other stem rots should also be assessed in terms of their potential to indicate the extent of heart rot, rather than simply in terms of lowering lumber quality. For example, even though a knot may be under the maximum allowable size but is rotten, it indicates that there is a good chance of a grade reduction for heart rot. However, the firmwood loss from rot confined to the knot is not significant enough to warrant a volume deduction or grade reduction in most of the cases.

The conventions used to assess knots are:

- the specified knot size and distribution in the grade schedules for any log grade is always based on the gross log diameter inside bark before any deduction is made for sap rot or other defects,
- knots are measured at right angles to the log length except in peeler grades where the maximum diameter is used,
- for interior logs up to and including 8 m in length, and for coastal logs up to and including 12.8 m, knots are assessed against the top diameter of the log (Figure 6.20),
- for coastal logs greater than 12.8 m in length, knots are assessed against the diameter measured at 12.8 m from the butt end of the log,
- for interior logs greater than 8 m in length, a midpoint diameter must be taken. Knots on the butt half are assessed against the maximums specified for the midpoint diameter, and knots on the top half of the log are assessed against the maximums specified for the top diameter (Figure 6.20), and
- slabs are measured across their width for determining knot allowances. Widths for slabs of all shapes are illustrated in Chapter 5. For purposes of knot assessment, if the thickness exceeds the width, the wider measurement is used.



1. Coast & Interior: Knots are assessed against the gross top diameter of the log.



2. Interior only: Knots are assessed against midpoint diameter and top diameter.

Figure 6.20 *The relationship between log diameters and knot diameters.*

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.

Figure 6.21 illustrates three logs with identical gross dimensions with oversized knots distributed in three typical patterns;. In these figures, they are all closer together than the allowed 3 m (coast) or 2.5 m (interior) spacing.

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.

Once the scaler has:

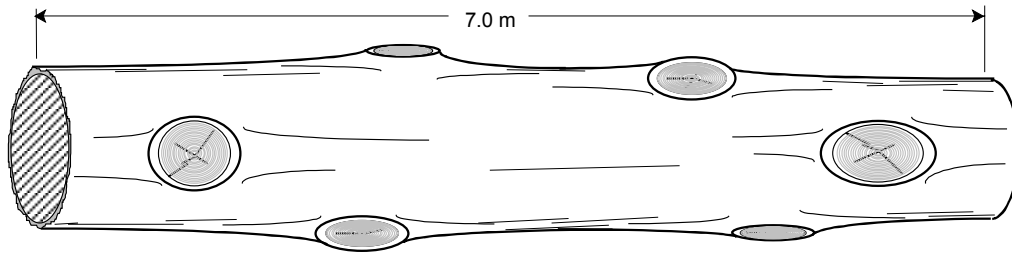
- identified the oversized knots from the top or top and mid-point diameters,
- determined that their spacing is less than 3 m for the coast and 2.5 m for the interior along the length,
- decided that a grade reduction is warranted, then
- it becomes necessary to observe the orientation and distribution of the knots in order to evaluate the affect on grade.

The first log in Figure 6.21 has its oversize 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.

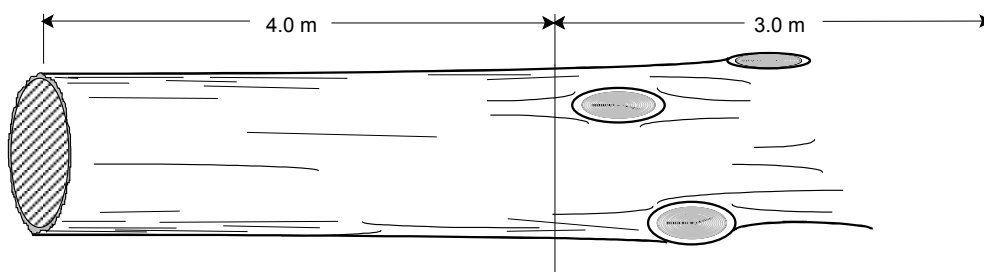
The second log has oversize knots concentrated near the top of the log. After the scaler notes that 3 m of the log will not produce merchantable lumber, the impact on the quality of the whole log is calculated to be about 43 percent of its total length, but somewhat less than 43 percent of it's volume.

The third log has its oversize 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 of the log is also a factor in the assessment. A 30 rad log may be broken down into quarters to maximize merchantability, where as 5 rad log cannot even be halved.

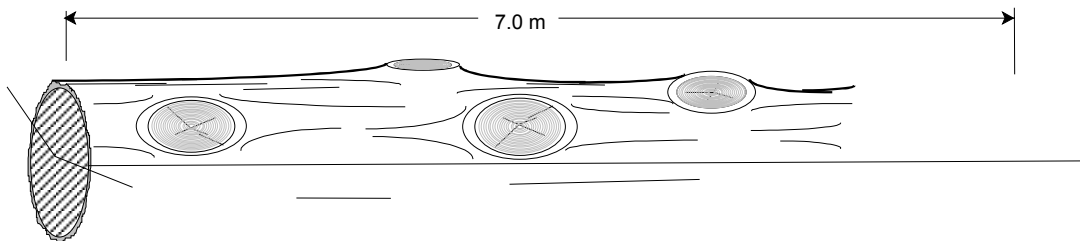
Of course, these examples are somewhat conceptual in that knots do not usually present themselves so obligingly. Although, in time, scalers will learn to quickly understand the impact of knot location and distribution, it is best for the beginner to pick out each of the elements in turn. For example, 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.



1. A log with oversized knots distributed over entire length.



2. A log with oversized knots concentrated near top end.



3. A log with oversized knots concentrated along one side.

Figure 6.21 *Typical knot distributions and their effect on grade.*

6.4.3.2 Twist (Spiral Grain)

Twist is measured over a representative 30 cm (15 rad) section of log length according to the principles outlined in Section 6.3. These are:

1. Twist is measured where it can be seen,
2. Assumptions are not made about portions of a log not visible, and
3. 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. Figure 6.22 demonstrates placing the scale stick, and Figure 6.23 shows one method for reading the deflection.

Specific twist requirements by grade are described in Section 6.5 (coast) and Section 6.6 (interior).

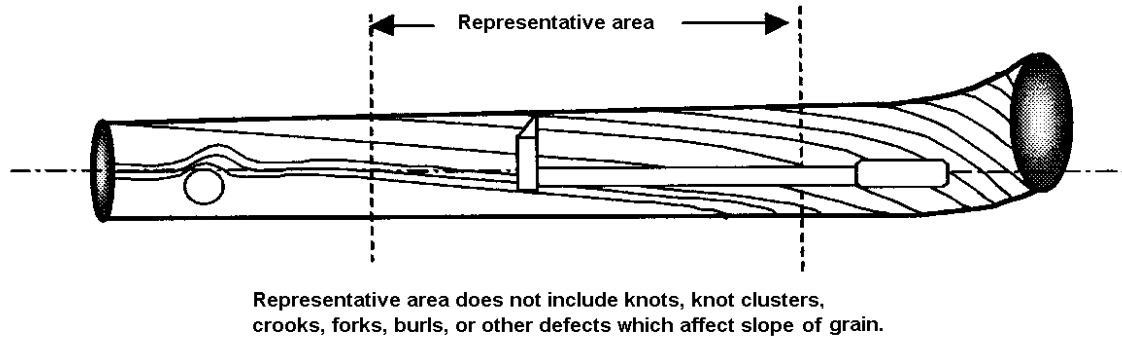


Figure 6.22 Measuring twist - placing the stick.

As shown in Figure 6.22, orient the scale stick parallel with log's longitudinal axis on an area where the grain deflection is representative.

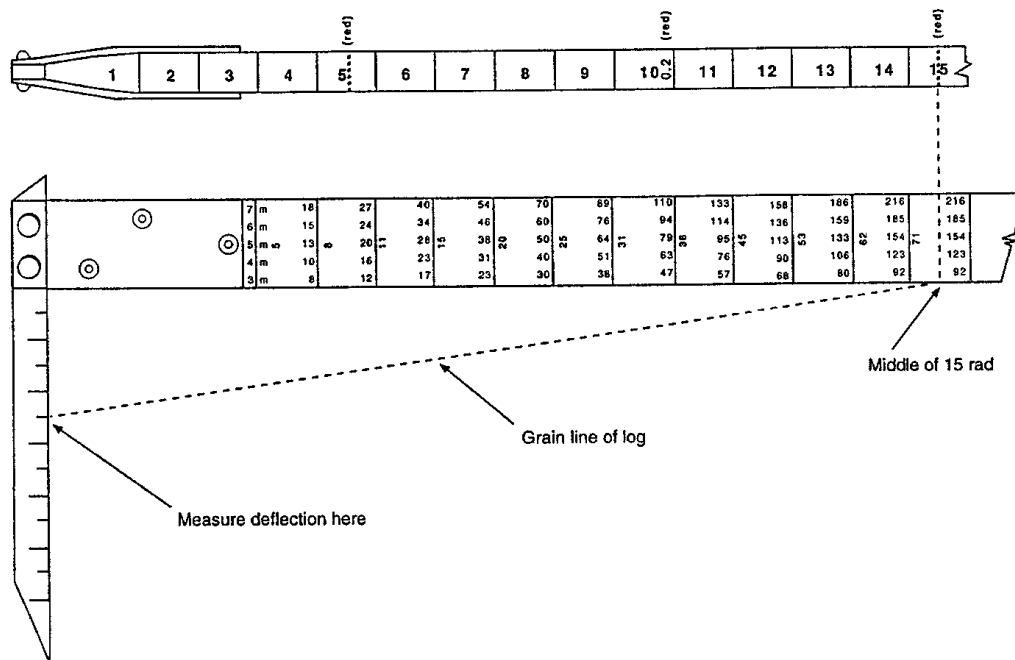


Figure 6.23 *Measuring twist - reading the deflection.*

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. 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 or 2.5 rads. Note: the tine of this stick is graduated in centimetres. Although not a requirement, scalers often mark them out to improve accuracy.

6.4.3.3 Grain Density (Ring Count) - Coastal Grading Only

The ring count of a log can greatly affect its value. The reason for this is that the narrower the separation between the rings, the denser the woody tissue. Denser woody tissue has more cellulose and lignin and is, therefore, stronger. In addition to this strength factor, fine grained logs are easier to peel into veneer on a rotary lathe and yield higher quality and stronger veneer.

The annual rings may all be of equal thickness and centred perfectly around the central pith of the log, or they may be of varying thickness as a result of variations in growth rates (usually attributable to factors such as variations in nutrient availability, temperature, rainfall, and sunlight). They also may be offset from the geometric centre of the log.

When growth is not equally distributed and the heart is offset, the log will not peel well on a rotary lathe and can not yield high quality veneer no matter how fine grained.

Growth rings are counted at a point $\frac{1}{3}$ of the radius in from the logs outer circumference at the small end. The rings are then to be counted in the one rad (2 cm) area from this point towards the outer circumference of the log. Where a log has an off-centre heart, the rings are to be counted where their separation is widest. For a centered heart, count the rings where representative of the ring density for the entire end.

6.4.3.4 Stain - Coastal Grading Only

As described in Chapter 4, the oxidation of phenolic compounds in tree tissues invaded and damaged or killed by micro-organisms (predominantly fungi) results in a pronounced discoloration of the woody tissue. This discoloration is commonly referred to as stain.

Some stains result soon after harvesting with the oxidation of newly exposed heartwood. Such stains are superficial and do not penetrate far into the log.

Also, the sawdust compacted between the cuts of logs bucked in the bush, but not separated, is often subject to staining fungus. These stains are also superficial and do not penetrate the log.

Stain does not cause any significant weakening of the wood fibre but it can detract from the appearance of the manufactured end products. Where these end products are for decorative or finishing purposes their value is lessened. For this reason the presence of stain is a grading consideration in some very valuable "clear lumber" coastal grades (refer to Section 6.5 for specific details).

Scalers must also be aware that some types of stain can be faded when logs are left exposed to the ultraviolet component of sunlight. Usually when this has happened the affected wood will still appear subtly different than the surrounding unaffected tissues.

6.4.3.5 Compression Wood –Interior Grading Only

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, while the other (larger segment) of the log has normal ring separation and is free of "compression" effects.

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, that indicate the displacement of the heart extends further in the log.

6.4.4 Factors Unique to Interior Grading

Application of the Interior Schedule of Timber Grades requires the scaler to consider one additional factors:

- was the log cut from a tree which was undersized based on merchantability specifications.

Interior grading rules must account for this factor.

One other principle applies:

- logs subjected to prolonged decking prior to scaling and logs cut from trap trees (an insect control measure) are graded as if they were cut without checks.

Surface checks 2 cm or less in depth are not entered in the grade reduction calculation.

In circumstances where surface and end checks are due to delays in processing, the Forest Service may order the checks to be disregarded.

6.4.4.1 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.

To be considered for the undersized grade:

- a log must show sufficient evidence such as an undercut, butt flare, 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 there is no evidence a log was cut from an undersized tree, it must not be graded as Grade 6.

The minimum diameters are 15 cm (7.5 rads) for lodgepole pine and 20 cm (10 rads) for all other species.

The minimum diameter is at 15 cm (7.5 rads) for lodgepole pine, and 20 cm (10 rads) for all other species.

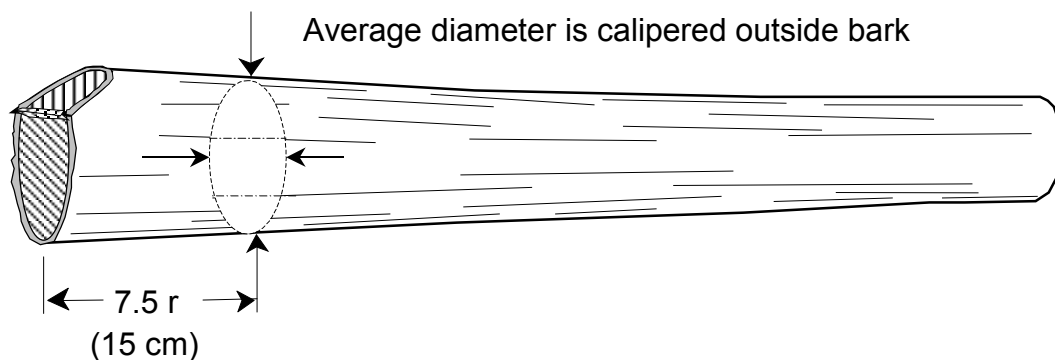


Figure 6.24 *Measuring diameter for interior undersize grade.*

6.5 Interpreting the Schedule of Coast Timber Grades

The Schedule of Coast Timber Grades is part of the *Scaling Regulation*. It is comprised of three parts. Part 1 applies to all species and describes the Firmwood Reject Grade (i.e., Grade Code Z). Part 2 describes the grades (other than Z) applicable to all commercial coniferous species except yew (i.e., *Taxus brevifolia*). Part 3 describes the grades (other than Z) applicable to all commercial broadleaf (i.e., deciduous or "hardwood") species, and yew.

6.5.1 Grade Applicability

Timber must be classified by grade in accordance with the Schedule of Coast Timber Grades if the timber is cut in a forest region (usually the Coast) or part of a forest region where the policies and procedures approved by the minister under the Act specify that log selling prices must be used to determine the rates of stumpage applicable to the timber.

The area of harvest and not the place of scaling determines the schedule of timber grades that must be used.

6.5.1.1 Grade Precedence

Timber that meets the requirements of more than one grade should ideally be placed in the grade of greater value. Since market demands affect values from day to day, a scaler may not know at any particular time which of two grades has the greater value. For this reason scalers are instructed to record a log against the first grade in order of presentation in the scaling regulation. The same order is followed in this chapter. Borderline logs should be taken one up and one down so as not to bias the scale. Some exceptions in the order of grade precedence are employed for shingle cedar, and are explained in this chapter.

6.5.2 Physical Characteristics Affecting Log Grades

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,
- what proportion of the log will produce end products (lumber, veneer, shakes or shingles, and chips),
- the quality of end products,

- the presence of non-permissible defects, and
- whether a round log or a slab.

Some aspects of the above factors have been explained earlier in this chapter, while others require further explanation specific to coastal grading.

6.5.2.1 Log Size

6.5.2.1.1 Radius or Diameter

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. As described in Chapter 5, a log which rounds up to the minimum diameter for a grade qualifies for that grade.
- For logs greater than 12.8 metres in length, the diameter for purposes of applying coast grade rules is the diameter measure inside bark at a point 12.8 metres above the large end, or butt, of the log.

6.5.2.1.2 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.

6.5.2.2 Potential for Manufacture of Product Quantity

The proportions of a log's gross scale which are suitable, and not suitable, for the manufacture of products are important factors in determining its commercial value.

All the grades higher than No. 7 Chipper (Y) specify percentages of the gross scale which must be suitable to cut out lumber, veneer for fir peelers or shingles and shakes for shingle cedar.

Log defects which reduce recovery of the above products are identified in Section 6.3, and procedures for calculating the amount of loss they cause (grade reduction) are outlined in Section 6.4, and in Appendix 6A.

In order to ensure standard application of grade reduction procedures, some additional information on assessment of defect in coastal timber is provided here.

6.5.2.2.1 Length of Defects

Where defects affect the heart of a log, scalers usually cannot see how far defects penetrate the length. In some cases experienced scalers can use various accepted indicators to accurately estimate this. In cases where there are no accepted indicators the following conventions are to be employed in order to maintain consistency among scalers in determining grade reduction.

1. 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.

2. Heart rot, pocket rot, ring rot, heart checks, ring shake 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 m, unless there is evidence to the contrary.
3. Conk, pin rot and Indian paint rot are grouped together as heart rots which often show in the knots of a log. Such knots are collectively known as "conk knots", and must not be confused with rotten knots which do not indicate the presence of heart rot.

Where one or more conk knots are present, but the rot does not show in the log end(s), the rot is presumed to travel 2.4 m above the uppermost conk knot and 3.6 m below the lowest conk knot.

Where conk shows in one log end and there are conk knots, the rot should be run the greater distance of half the log length to a maximum of 6 m, or 2.4 m above the uppermost conk or 3.6 m below the lowest conk knot.

Where conk, pin rot or Indian paint rot shows in one end of a log but there are no visible conk knots, the rot is presumed to travel half the length of the log to a maximum of 6 m. For example, penetration would be 2.5 m on a 5 m log, 6 m on a 12 m log, and 6 m on a 15 m log.

6.5.2.2.2 Grade Reduction for Conk, Pin Rot and Indian Paint Rot

Where there are conk knots present, but the conk does not show in the log ends, the entire length affected is grade reduction. It is assumed that no lumber can be cut from 2.4 m above and 3.6 m below the conk knots. Of course, residual sound end segments less than 2.5 m long must also be included as grade reduction:

- where conk shows in one or both ends and there are conk knots, it is presumed that no lumber can be cut from the length of log affected by the defect, with the following exceptions,
- where the defect showing in the end(s) and the conk knots are confined to the same half of the log's diameter, it is possible to cut lumber from the unaffected side. In such cases scalers should calculate a partial grade reduction for the affected log length based on the visual information available, or
- where the defect is visible in the log end(s) but there are no conk knots, the grade reduction should be calculated in the same manner as for other rots.

6.5.2.3 Potential Quality of Manufactured Products

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

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

The quality considerations of knots, twist, stain and annual ring count are described in Sections 6.3 and 6.4. Some additional considerations specific to coastal grades are described below.

6.5.2.3.1 Size of Knots

Clear knot free timber is highly valued. Knots less than 1 rad detract from the appearance and lessen the value of lumber. Knots larger than 1 rad will reduce the strength of the lumber. The larger the knot size the greater the loss in lumber strength, with extremely large knots making the cutting of merchantable lumber impossible.

Knots are measured at right angles to the log length except in peeler grades where the maximum diameter is used. The size of the knot does not include the shoulder.

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

6.5.2.3.2 Occasional Larger Knots

All sawlog grades can have occasional larger knots. Occasional larger knots are allowed to the extent of one per 3 m of log length and must be located where knot sizes for portions of logs are specified.

Interpretation:

If a grade requirement allows 4 cm knots over the entire log, occasional larger knots can be anywhere on the log. Where the requirement states 4 rads knots are allowed on the upper half of a log, the occasional larger knots must be confined to this area as well, with knots no larger than 1 rad permitted on the lower half of the log.

6.5.2.3.3 Pitch

Pitch may accumulate in pockets between the rings or within a ring shake. The presence of pitch will lower the value of clear lumber and veneer.

The requirements for the peeler grades and the premium and lumber grades for subject species include limits on the number and size of pitch pockets allowed. For butt cut logs, pitch pockets are assessed in the top end only.

6.5.2.3.4 Growth Rate (Ring Count)

As noted in Section 6.4, rings are counted at a point $\frac{1}{3}$ of the radius (or $\frac{1}{6}$ of the diameter) in from the outer circumference. The annual rings are then counted over 2 cm (1 rad) of distance from this point back toward the outer circumference.

Where logs have off centre hearts the rings are counted where they are widest. Where the heart is centred the rings are counted where they represent an average.

Ring counts are always taken at the top end of the log.

6.5.2.4 Slabs

Slabs are not permitted in the peeler B and C grades and the sawlog J grade.

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.

The minimum slab thicknesses for the shingle grades are specified in the grade rule for each grade.

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.

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.

Slab thicknesses specified are actual unrounded measurements.

Slab thickness for grading purposes is the maximum width at which a 4 cm (2 rads) thick board can be cut at right angles to the grain (annual rings).

6.5.3 Coast Grade Rules and Requirements

6.5.3.1 Firmwood Reject - all species - Grade Code Z (species code or code R)

The Y grade chipper or lumber reject grade is a log which is not considered viable for the production of any product other than chips. The Z grade firmwood reject is a log which is considered to have no commercial value, even for chips.

Firmwood rejects are the lowest grade on the scale, and are not considered for cut control purposes or charged stumpage. Despite their low value, some firmwood reject volumes are utilized in manufacturing processes.

The firmwood reject grade rule is identical for all species. When scaled in a weight scale sample Z logs can be identified by species code or the letter R in place of the species code.

6.5.3.2 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. Note that this is the only grade rule that specifies diameter in cm rather than radius in cm (which equals diameter in rads).

6.5.3.3 Coniferous Grades

The following sections present the grade rules for each species, as they appear in the Scaling Regulation. Following each grade rule is a section outlining the detailed requirements a log must meet to make the grade

Each grade rule except Y states dimensions, a minimum percentage of product recovery potential, and a product quality requirement. The following Log Requirements to Make the Grade deal primarily with the product quality requirement. Where a log meets the Log Requirements to Make the Grade it will meet the product quality requirement of the grade rule.

6.5.3.4 Balsam and Hemlock Grades

These two genera are graded the same and the grades apply to all four species of balsam and both species of hemlock found in the province.

6.5.3.5 No 1 Lumber Balsam and Hemlock, Grade Code D

6.5.3.5.1 Grade Rule

A log 5 m or more in length and 33 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.3.5.2 Log Requirements to Make the Grade

- 1. No konk, or konk stain is permitted.
- 2. There must be no fewer than six annual rings in each 2 cm of diameter.
- 3. Logs 33 to 37 cm in radius must have at least 90 percent of the visible surface clear with only a few well spaced knots or knot indications permitted on the upper 10 percent of two sides or the upper 20 percent of one side.

4. Logs 38 cm or over in radius must have at least 80 percent of the visible surface clear with only a few well spaced knots or knot indications permitted on the upper 20 percent of both sides or the upper 40 percent of one side.
5. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
6. Pocket rot is allowed. In balsam the pocket rot must be confined to the centre of the log within a circle $\frac{1}{3}$ of the log radius, measured from the pith.
7. Ambrosia, burls, butt rot, butt shake, checks, crook, goitre, heart rot, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.3.6 No. 2 Lumber Balsam and Hemlock, Grade Code F

6.5.3.6.1 Grade Rule

A log 5 m or more in length and 25 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 25 percent of that lumber will be clear.

6.5.3.6.2 Log Requirements to Make the Grade

1. No konk, or konk stain is permitted.
2. There must be no fewer than 6 annual rings in each 2 cm of diameter.
3. Logs 25 to 32 cm in radius must have at least 75 percent of the visible surface clear, with knots or knot indications permitted on the upper 25 percent of two sides or the upper 50 percent of one side.
4. Logs 33 cm or over in radius must have at least 50 percent of the visible surface clear, with knots or knot indications permitted on the upper 50 percent of two sides or the upper 75 percent of one side.
5. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
6. Pocket rot is allowed. In balsam the pocket rot must be confined to the centre of the log within a circle $\frac{1}{3}$ of the log radius measured from the pith.
7. Ambrosia, burls, butt rot, butt shake, checks, crook, goitre, heart rot, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.3.7 No. 2 Sawlog Balsam and Hemlock, Grade Code H

6.5.3.7.1 Grade Rule

A log 5 m or more in length and:

1. 19 cm or more in radius where at least 75 percent of the gross scale can be manufactured into lumber and at least 65 percent of that lumber will be merchantable.
2. Otherwise Grade Code D or F, 25 cm or more in radius, where at least 50 percent of the gross scale can be manufactured into merchantable lumber, and at least 25 percent of that lumber will be clear.

6.5.3.7.2 Log Requirements to Make the Grade

1. There must be no fewer than five annual rings in each 2 cm of diameter.
2. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50 percent of the visible surface, or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50 percent of the visible surface, or reasonably well-spaced knots up to 5 cm in diameter on the upper 66 2/3 percent of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
4. Maximum twist permitted over 30 cm in length is 7 percent of the diameter up to a maximum deviation of 8 cm.
5. Butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.3.8 No. 3 Sawlog Balsam and Hemlock, Grade Code I

6.5.3.8.1 Grade Rule

A log:

1. 3.8 m or more in length and 19 cm or more in radius where at least 75 percent of the gross scale can be manufactured into lumber, and at least 50 percent of that lumber will be merchantable, or

2. otherwise Grade Code H, 5 m or more in length and 19 cm or more in radius, where less than 75 percent but at least 50 percent of the gross scale can be manufactured into lumber and at least 65 percent of that lumber will be merchantable.

6.5.3.8.2 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
19 - 24 cm	8 cm
25 - 37 cm	9 cm
38 + cm	10 cm

2. Maximum twist permitted over 30 cm of length is 10 percent of the diameter up to a maximum deviation of 9 cm.
3. Butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversize knots, pocket rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

Grade codes J, U, X and Y rules and requirements are defined at the end of this section.

6.5.4 Cedar Grades

These grades apply only to red cedar.

6.5.5 Lumber Grades

The lumber grades identify logs with significant percentages of clear cutting as described in the grade rules.

Knot specifications for lumber quality slabs will be those appropriate to the original round log.

6.5.5.1 No. 1 Lumber Cedar, Grade Code D**6.5.5.1.1 Grade Rule**

1. A log 5 m or more in length and 30 cm or more in radius, or a slab 5 m or more in length, 25 cm or more in radius and 38 cm or more in thickness, where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.
2. a log 5 m or more in length and 60 cm or more in radius where at least $66 \frac{2}{3}$ percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.5.1.2 Log Requirements to Make the Grade

1. No powder worm damage is permitted.
2. Logs 30 to 37 cm in radius must have at least 75 percent of the visible surface clear with knots or knot indications permitted in the upper 25 percent of two sides or the upper 50 percent of one side.
3. Logs 38 cm or over in radius must have at least $66 \frac{2}{3}$ percent of the visible surface clear with knots or knot indications permitted on the upper $33 \frac{1}{3}$ percent of two sides or the upper $66 \frac{2}{3}$ percent of one side.
4. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
5. Adventitious knots, bark seams, burls, butt rot, catface, checks, crook, heart rot, pocket rot, oversized knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.5.2 No. 2 Lumber Cedar, Grade Code F

6.5.5.2.1 Grade Rule

A log 5 m or more in length and 25 cm or more in radius, or a slab 5 m or more in length, 25 cm or more in radius and 38 cm or more in thickness, where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 25 percent of that lumber will be clear.

6.5.5.2.2 Log Requirements to Make the Grade

1. No powder worm damage is permitted.
2. Logs 25 to 29 cm in radius must have the visible surface clear of knots and knot indications.
3. Logs 30 to 37 cm in radius must have at least $66 \frac{2}{3}$ percent of the visible surface clear with knots or knot indications permitted on the upper $33 \frac{1}{3}$ percent of two sides or the upper $66 \frac{2}{3}$ percent of one side.
4. Logs 38 cm or over in radius must have at least 50 percent of the visible surface clear with knots or knot indications permitted on the upper 50 percent of two sides or the upper 75 percent of one side.
5. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
6. Adventitious knots, bark seams, burls, butt rot, catface, checks, crook, heart rot, oversized knots, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.6 Sawlog Grades

The sawlog grades describe logs suitable for the manufacture of lumber (i.e., basically round, sound logs that will permit efficient handling by a sawmill). These grades will permit frequent small to medium size knots. Slabs qualifying for these grades must be 38 cm thick and a shape regular enough to cut efficiently on a sawmill carriage.

6.5.6.1 No. 2 Sawlog Cedar, Grade Code H**6.5.6.1.1 Grade Rule**

A log 5 m or more in length and 19 cm or more in radius where at least 75 percent of the gross scale can be manufactured into lumber and at least 65 percent of that lumber will be merchantable.

6.5.6.1.2 Log Requirements to Make the Grade

1. No powder worm damage is permitted.
2. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50 percent of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50 percent of the visible surface, or well-spaced knots up to 5 cm in diameter on the upper 66 2/3 percent of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
4. Maximum twist permitted over 30 cm of length is 7 percent of the diameter up to a maximum deviation of 8 cm.
5. Bark seams, burls, butt rot, catface, checks, heart rot, oversized knots, pocket rot, sap rot, shatter, splits, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.6.2 No. 3 Sawlog Cedar, Grade Code I**6.5.6.2.1 Grade Rule**

A log:

1. 3.8 m or more in length and 19 cm or more in radius where at least 75 percent of the gross scale can be manufactured into lumber and at least 50 percent of that lumber will be merchantable.
2. 9.8 m or more in length and 25 cm or more in radius where at least 50 percent of the gross scale can be manufactured into lumber and at least 50 percent of that lumber will be merchantable.
3. Otherwise grade code H, 9.8 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 65 percent of that lumber will be merchantable.

6.5.6.2.2 Log Requirements to Make the Grade

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

Log radius	Knot size diameter
19 - 24 cm	8 cm
25 - 37 cm	9 cm
38 + cm	10 cm

2. Maximum twist permitted over 30 cm in length is 10 percent of the diameter up to a maximum deviation of 9 cm.
3. Butt rot, catface, checks, crook, bark seams, heart rot, insect holes, loose knots, oversized knots, pocket rot, powder worm, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.6.3 No. 4 Sawlog Cedar, Grade Code J

See Grade Code J rules and requirements are defined at the end of this section.

6.5.6.4 Shingle Grades

Shingle grade logs will have fewer but possibly larger knots than sawlogs, so spaced to permit the production of shingle blocks. Shingle logs are generally not best utilized for the manufacture of lumber because of the nature of the knots or because they are irregular in shape, have excessive butt or heart rot, bark seams, open checks, rotten knots, shatter, or combinations of the above defects.

1. The shingle grade rules make no reference to the recovery of lumber. Scalers will judge the recovery percentage required to produce shingles or shakes.
2. Some very defective cedar logs should go into shingle grades.
3. 'D' quality logs with less than 75 percent suitable for lumber become 'K' grade, except D's 60 rads or larger which become K's if they have less than 66 2/3 percent suitable for lumber.
4. 'F' quality logs with less than 75 percent lumber become 'L' grade, except that those from 25 to 29 rads which become K's if they have less than 75 percent suitable for lumber.

6.5.6.5 Other Considerations

Other defective cedar logs may fit either into a sawlog or shingle grade. The following types of logs and slabs should be given serious consideration for the shingle grade.

1. Logs less than 7.8 m in length, broken at one end.
2. Logs less than 9.8 m in length, broken at both ends.
3. Those 'H' or 'I' quality logs at least 9.8 m in length containing 50 - 74 percent lumber, that are more suitable for quality shingle recovery and can meet grade 'L' requirements.
4. Logs less than 12.8 m in length and less than 75 percent lumber with a serious defect at both ends.
5. 'D' and 'F' quality logs cut too short for those grades.

6.5.6.6 No. 1 Shingle Cedar, Grade Code K

6.5.6.6.1 Grade Rule

A log 3.8 m or more in length and 25 cm or more in radius or a slab 3.8 m or more in length, 25 cm or more in radius and 38 cm or more in thickness, where at least 50 percent of the gross scale can be manufactured into shingles or shakes, and at least 75 percent of the shingles or shakes will be clear.

6.5.6.6.2 Log Requirements to Make the Grade

1. No powder worm damage is permitted.
2. Logs 25 to 29 cm in radius must have the visible surface clear of knots and knot indications.
3. Logs 30 to 37 cm in radius must have at least 75 percent of the visible surface clear with knots or knot indications permitted on the upper 25 percent of two sides or the upper 50 percent of one side.
4. Logs 38 cm or over in radius must have at least $66 \frac{2}{3}$ percent of the visible surface clear with knots or knot indications permitted on the upper $33 \frac{1}{3}$ percent of two sides or the upper $66 \frac{2}{3}$ percent of one side.
5. Maximum twist permitted over 30 cm in length is 4 percent of the diameter up to a maximum deviation of 6 cm.

6. Bark seams, burls, butt rot, catface, checks, crook, heart rot, oversized knots, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing that the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.6.7 No. 2 Shingle Cedar, Grade Code L

6.5.6.7.1 Grade Rule

A log 3.8 m or more in length and 19 cm or more in radius or a slab 3.8 m or more in length, 19 cm or more in radius and 26 cm or more in thickness where at least 50 percent of the gross scale can be manufactured into shingles or shakes and at least 50 percent of the shingles or shakes will be clear.

6.5.6.7.2 Log Requirements to Make the Grade

1. No powder worm damage is permitted.
2. Logs must have at least 50 percent of the visible surface clear, with knots and knot indications permitted on the upper 50 percent of two sides, or on all of one side.
3. Logs over 30 rads or slabs will permit large knots spaced so sufficient clear shingle blocks can be cut from the area between the knots to meet the grade rule. The large knots must have 30 rads (0.6 m) spacing to allow shingle blocks to be cut between them, and the blocks must be a quadrant.
4. Maximum twist permitted over 30 cm of length is 7 percent of the diameter up to a maximum deviation of 8 cm.
5. Bark seams, burls, butt rot, catface, checks, crook, heart rot, oversized knots, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.6.8 No. 3 Shingle Cedar, Grade Code M

6.5.6.8.1 Grade Rule

A log 3.8 m or more in length and 19 cm or more in radius or a slab 3.8 m or more in length, 13 cm or more in radius and 16 cm or more in thickness where at least 50 percent of the gross scale can be manufactured into shingles and at least 25 percent of the shingles will be clear.

6.5.6.8.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No powder worm is permitted.

2. Logs must have at least 25 percent of the visible surface clear, with knots and knot indications permitted on the upper 75 percent of two sides, or all of one side and the upper 50 percent of the other.
3. Logs over 25 rads or slabs will permit large knots spaced so sufficient clear shingle blocks can be cut from the area between the knots to meet the grade rule. The large knots must have 30 rads (0.6 m) spacing to allow shingle blocks to be cut between them, and the blocks must represent a quadrant.
4. Maximum twist permitted over 30 cm of length is 7 percent of the diameter up to a maximum deviation of 8 cm.
5. Bark seams, burls, butt rot, catface, checks, crook, heart rot, pocket rot, sap rot, shatter, splits, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

Grade codes U, X and Y rules and requirements are defined at the end of this section.

6.5.7 Cypress Grades

These grades apply to cypress, also known as yellow-cedar.

6.5.7.1 No. 1 Lumber Cypress, Grade Code D

6.5.7.1.1 Grade Rule

A log 4 m or more in length and 30 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.7.1.2 Log Requirements to Make the Grade

1. Logs 30 to 37 cm in radius must have at least 75 percent of the visible surface clear with knots or knot indications permitted on the upper 25 percent of two sides or the upper 50 percent of one side.
2. Logs 38 cm or over in radius must have at least $66 \frac{2}{3}$ percent of the visible surface clear with knots or knot indications permitted on the upper $33 \frac{1}{3}$ percent of two sides or the upper $66 \frac{2}{3}$ percent of one side.
3. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
4. Adventitious knots, burls, butt rot, catface, checks, crook, frost checks, heart rot, oversized knots, pocket rot, ring rot, sap rot, shatter, splits, stain, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.2 No. 2 Lumber Cypress, Grade Code F

6.5.7.2.1 Grade Rule

A log:

1. 4 m or more in length and 25 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 25 percent of that lumber will be clear, or
2. Otherwise grade code D, 6.2 m or more in length and 30 cm or more in radius where less than 75 percent but at least 50 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.7.2.2 Log Requirements to Make the Grade

1. Logs 25 to 29 cm in radius must have at least 75 percent of the visible surface clear with knots or knot indications permitted on the upper 25 percent of two sides or the upper 50 percent of one side.
2. Logs 30 cm or over in radius must have at least 50 percent of the visible surface clear with knots or knot indications permitted on the upper 50 percent of two sides or the upper 75 percent of one side.
3. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
4. Adventitious knots, burls, butt rot, catface, checks, crook, frost checks, heart rot, oversized knots, pocket rot, ring rot, sap rot, shatter, splits, stain, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.3 No. 2 Sawlog Cypress, Grade Code H**6.5.7.3.1 Grade Rule**

A log 4 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 65 percent of that lumber will be merchantable.

6.5.7.3.2 Log Requirements to Make the Grade

1. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50 percent of the visible surface, or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
2. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50 percent of the visible surface, or well-spaced knots up to 5 cm in diameter on the upper 66 2/3 percent of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. Maximum twist permitted over 30 cm of length is 7 percent of the diameter up to a maximum deviation of 8 cm.
4. Butt rot, catface, checks, frost checks, heart rot, oversized knots, pocket rot, ring rot, sap rot, shatter, splits, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.4 No. 3 Sawlog Cypress, Grade Code I

6.5.7.4.1 Grade Rule

A log 4 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 50 percent of that lumber will be merchantable.

6.5.7.4.2 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
19 - 24 cm	8 cm
25 - 37 cm	9 cm
38 + cm	10 cm

2. Maximum twist permitted over 30 cm in length is 10 percent of the diameter up to a maximum deviation of 9 cm.
3. Butt rot, catface, checks, crook, frost checks, heart rot, insect holes, loose knots, oversized knots, pocket rot, ring rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

Grade codes J, U, X and Y rules and requirements are defined at the end of this section.

6.5.8 Fir and Pine Grades

With the exception that pine has no peeler grades, these two genera are graded the same. The grades apply to all species of pine found in the province.

6.5.8.1 No. 1 Lumber Fir and Pine, Grade Code D

6.5.8.1.1 Grade Rule

A log 5 m or more in length and 38 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.8.1.2 Log Requirements to Make the Grade

1. No conk or conk stain is permitted.
2. Pocket rot is allowable only if it is contained within a circle $\frac{1}{3}$ the log radius, measured from the pith.
3. There must be no fewer than six annual rings in each 2 cm of diameter.
4. Logs must have at least 90 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 10 percent of two sides or the upper 20 percent of one side.
5. Maximum twist permitted over 30 cm in length is 4 percent of the diameter up to a maximum deviation of 6 cm.
6. Only small pitch pockets ranging in numbers per end from three for logs 38 cm in radius to six for logs 76 cm or over in radius are permitted.
7. No ring shakes (full or partial) are permitted in that part of the log between 8 cm and 20 cm of the bark.
8. A ring shake within 8 cm of the bark is only permitted if the log inside the shake is at least 38 rads, and the log meets the rest of the grade rule.
9. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
10. Ambrosia, butt rot, burls, checks, crook, heart rot, ring shake, sap rot, shatter, splits, sweeps, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.2 No. 2 Lumber Fir and Pine, Grade Code F

6.5.8.2.1 Grade Rule

A log 5 m or more in length and 30 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 25 percent of that lumber will be clear.

6.5.8.2.2 Log Requirements to Make the Grade

1. No conk or conk stain is permitted.
2. Pocket rot is allowed only if it is contained within a circle $\frac{1}{3}$ of the log radius, measured from the pith.
3. There must be no fewer than six annual rings in each 2 cm of diameter.
4. Logs 30 to 37 cm of radius must have at least 75 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 25 percent of two sides or the upper 50 percent of one side.
5. Logs 38 cm and over in a radius must have at least 50 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 50 percent of two sides or upper 75 percent of one side.
6. Maximum twist permitted over 30 cm in length is 4 percent of the diameter at the top of the log to a maximum deviation of 6 cm.
7. Only small pitch pockets ranging in number per end from two for logs 30 cm in radius up to six for logs 76 cm or over in radius are permitted.
8. A ring shake that encircles half or more of the circumference of the ring is not permitted in that portion of the log between 4 rads and 10 rads of the bark. A ring shake within 4 rads of the bark is only permitted if within that part of the log inside the shake is at least 30 rads and the log meets the rest of the grade rule.
9. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
10. Ambrosia, butt rot, burls, checks, crook, heart rot, ring shake, sap rot, shatter, splits, sweeps, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.3 No. 2 Peeler Fir, Grade Code B

6.5.8.3.1 Grade Rule

A log 5.2 m or more in length and 30 cm or more in radius where at least 80 percent of the gross scale can be manufactured on a rotary lathe into veneer.

6.5.8.3.2 Log Requirements to Make the Grade

1. No heart rot, conk, conk stain, or pocket rot is permitted.
2. There must be no fewer than six annual rings in each 2 cm of diameter.
3. Logs 30 to 37 cm in radius must have the 2.6 m butt block free of knots or knot indications.
4. Logs 38 cm or over in radius must have the 2.6 m butt block free of knots, - indications permitted.
5. No knots over 4 cm are permitted and knots or knot indications 4 cm or less in diameter must be well-spaced. Bunch knots that can be encircled in a 4 cm diameter are permitted.
6. Maximum twist permitted over 30 cm of length is 7 percent of the diameter up to a maximum deviation of 8 cm.
7. Butt rot must not be present in logs less than 8 m in length.
8. The diameter of butt rot in logs 8 m to less than 10.4 m in length must not exceed 33 1/3 percent of the measured butt diameter after excluding flare.
9. The diameter of butt rot in logs 10.4 m or over in length must not exceed 50 percent of the measured butt diameter after excluding flare.
10. Butt star checks must not be longer than half the top diameter of the log.
11. No more than one heart check or split which must not affect the outer 25 percent of the radius is permitted at either end of log. A check appearing in both ends of the log must be considered to be the same check to be allowed.
12. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
13. An angular heart check will be allowed if it does not vary more than 45 degrees from a straight line and does not affect the outer 25 percent of the radius.
14. Only small pitch pockets ranging in numbers per end from three for logs 30 cm in radius to seven for logs 76 cm or over in radius are permitted.

15. One partial ring shake which does not extend around half the circumference of the ring and does not have checks at right angles to the shake, or a full ring shake with a diameter not exceeding $33 \frac{1}{3}$ percent of the diameter of the log is permitted. An allowable shake in the outer $66 \frac{2}{3}$ percent of the diameter is permitted in one end only. An allowable shake in the inner $33 \frac{1}{3}$ percent of the diameter is permitted in both ends.
16. Ring shake with a check is permitted if both can be contained in the centre of a log by a circle not exceeding $\frac{1}{3}$ the diameter of the log.
17. Logs can exhibit sap rot or sun checks to a depth of 4 percent of the top diameter of the log. The maximum depth of a sap rot or sun checks shall not exceed 5 cm.
18. At the top end of a log, off centre heart is permitted only where distance from true centre does not exceed 10 percent of the top diameter of the log.
19. Sweep is permitted to the following extent:
 - a. logs 5.2 m to less than 8 m in length allow up to a 0.6 m consideration for sweep, with no mental bucking to reduce loss for sweep permitted in peelers less than 8 m long,
 - b. logs 8 m to less than 10.4 m in length allow up to a 1.2 m consideration for sweep, with one mental buck allowed for logs 8 m to less than 12.8 m long,
 - c. logs 10.4 m and over in length allow up to a 2 m consideration for sweep, with two mental bucks allowed for logs over 12.8 m long.
20. Crook (a definite kink) and pistol grip (a sharp bend near the large end of a butt log) is permitted to the following extent:
 - a. logs 5.2 m to less than 8 m in length, no loss is allowed,
 - b. logs 8 m to less than 10.4 m in length, up to a 1.2 m consideration is allowed,
 - c. logs 10.4 m and over in length, up to a 2 m consideration is allowed.
21. On logs 10.4 m and over in length bucking breaks, splits and broken ends are allowed provided the defect can be eliminated in a length equal to the top diameter.
22. Burls are permitted to the extent of one medium or large size burl for every 2.6 m of log length.

6.5.8.4 No. 3 Peeler Fir, Grade Code C

6.5.8.4.1 Grade Rule

A log 5.2 m or more in length and 19 cm or more in radius where at least 80 percent of the gross scale can be manufactured on a rotary lathe into veneer.

6.5.8.4.2 Log Requirements to Make the Grade

1. No heart rot, conk, conk stain, or pocket rot is permitted.
2. There must be no fewer than six annual rings in each 2 cm of diameter.
3. No knots over 4 cm in diameter are permitted and knots 4 cm or less in diameter must be well spaced. Bunch knots that can be encircled in a 4 cm diameter are permitted.
4. Maximum twist permitted over 30 cm of length is 7 percent of the diameter up to a maximum deviation of 8 cm.
5. Butt rot must not be present in logs less than 8 m in length.
6. The diameter of butt rot in logs 8 m to less than 10.4 m in length must not exceed $33 \frac{1}{3}$ percent of the measured butt diameter after excluding flare.
7. The diameter of butt rot in logs 10.4 m or over in length must not exceed 50 percent of the measured butt diameter after excluding flare.
8. Butt star checks must not be longer than half the top diameter of the log.
9. No more than one heart check or split that must not affect the outer 25 percent of the radius is permitted at either end of the log.
10. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
11. An angular heart check will be allowed if it does not vary more than 45 degrees from a straight line but must not affect the outer 25 percent of the radius.
12. Only small pitch pockets ranging in numbers per end from two for logs 19 cm in radius to seven for logs 76 cm or over in radius are permitted.
13. One partial ring shake that does not extend around half the circumference of the ring and does not have checks at right angles to the shake, or a full ring shake with a diameter not exceeding $33 \frac{1}{3}$ percent of the diameter of the log is permitted. An allowable shake in the outer $66 \frac{2}{3}$ percent of the diameter is permitted in one end only. An allowable shake in the inner $33 \frac{1}{3}$ percent of the diameter is permitted in both ends.

14. Ring shake with a check is permitted if both can be contained in the centre of a log by a circle not exceeding one third the diameter of the log.
15. No sap rot or sun checks are allowed in logs less than 25 cm in radius. Logs 25 cm in radius and greater can exhibit sap rot or sun checks to a depth of 4 percent of the top diameter of the log. The maximum depth of sap rot or sun check shall not exceed 5 cm.
16. At the top end of a log, off centre heart is permitted only where distance from true centre does not exceed 10 percent of the top diameter of the log.
17. Sweep is permitted to the following extent:
 - a. logs 5.2 m to less than 8 m in length allow up to a 0.6 m consideration for sweep, with no mental bucking to reduce the loss for sweep permitted in peelers less than 8 m long,
 - b. logs 8 m to less than 10.4 m in length allow up to a 1.2 m consideration for sweep, with one mental buck allowed for logs 8 m to less than 12.8 m long, and
 - c. logs 10.4 m and over in length allow up to a 2 m consideration for sweep, with two mental bucks allowed for logs over 12.8 m long.
18. Crook (a definite kink) and pistol grip (a sharp bend near the large end of a butt log) is permitted to the following extent:
 - a. logs 5.2 m to less than 8 m in length, no loss is allowed,
 - b. logs 8 m to less than 10.4 m in length, up to a 1.2 m consideration is allowed, and
 - c. logs 10.4 m and over in length, up to a 2 m consideration is allowed.
19. On logs 10.4 m and over in length bucking breaks, splits, and broken ends are allowed provided the defect can be eliminated in a length equal to the top diameter.
20. Burls are permitted to the extent of one medium or large size burl for every 2.6 m of log length.

6.5.8.5 No. 2 Sawlog Fir and Pine, Grade Code H

6.5.8.5.1 Grade Rule

A log 5 m or more in length and

1. 19 cm or more in radius where at least 75 percent of the gross scale can be manufactured into lumber.

2. 25 cm or more in radius where at least 50 percent of the gross scale can be manufactured into lumber, and at least 65 percent of that lumber will be merchantable.

6.5.8.5.2 Log Requirements to Make the Grade

1. There must be no fewer than five annual rings in each 2 cm of diameter.
2. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50 percent of the visible surface, or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50 percent of the visible surface, or reasonably well-spaced knots up to 5 cm in diameter on the upper 66 2/3 percent of the visible surface or reasonably well spaced knots up to 4 cm in diameter over all the visible surface.
4. Maximum twist permitted over 30 cm in length is 7 percent of the diameter up to a maximum deviation of 8 cm.
5. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
6. Butt rot, checks, conk, conk stain, crook, heart rot, oversized knots, pitch pockets, pocket rot, ring shake, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of log free from these defects is sufficient to meet the grade rule.

6.5.8.6 No. 3 Sawlog Fir and Pine, Grade Code I

6.5.8.6.1 Grade Rule

A log:

1. 3.8 m or more in length and
 - a. 19 cm or more in radius where at least 75 percent of the gross scale can be manufactured into lumber, or
 - b. 25 cm or more in radius where at least 50 percent of the gross scale can be manufactured into lumber
 - c. and at least 50 percent of that lumber will be merchantable, or
2. otherwise grade code H, 5 m or more in length and 19 to 24 cm in radius, where less than 75 percent but at least 50 percent of the gross scale can be manufactured into lumber and at least 65 percent of that lumber will be merchantable.

6.5.8.6.2 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
19 - 24 cm	8 cm
25 - 37 cm	9 cm
38 + cm	10 cm

2. Maximum twist permitted over 30 cm of length is 10 percent of the diameter up to a maximum deviation of 9 cm.
3. Bunch knots, butt rot, checks, conk, conk stain, crook, heart rot, insect holes, loose knots, oversized knots, pitch pockets, pocket rot, ring shake, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

Grade codes J, U, X and Y rules and requirements are defined at the end of this section.

6.5.9 Spruce Grades

Wavy grain or "Horse Mane" is a grain defect peculiar to spruce. If present to more than a slight amount or in conjunction with spiral grain, the log must be degraded. For spruce 'D, E and F wavy grain is permitted only to a slight degree. Spruce 'G' wavy grain is permitted to a slightly greater extent in larger logs.

6.5.9.1 No. 1 Premium Spruce, Grade Code D**6.5.9.1.1 Grade Rule**

A fine grained log 4 m or more in length and 50 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.9.1.2 Log Requirements to Make the Grade

1. No conk or conk stain is permitted.
2. Pocket rot is permitted if it is contained in a circle $\frac{1}{3}$ the log radius, measured from the pith.
3. There must be no fewer than 12 annual rings in each 2 cm of diameter.

4. Logs 50 - 59 cm in radius must have at least 90 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 10 percent of two sides or the upper 20 percent of one side.
5. Logs 60 cm or more in radius must have at least 80 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 20 percent of two sides or the upper 40 percent of one side.
6. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
7. Only small pitch pockets ranging from three for logs 50 cm in radius to six for logs 76 cm and over in radius are permitted.
8. Insect or worm holes other than ambrosia must not penetrate beyond the sapwood.
9. Ambrosia, burls, wavy grain (horse mane), butt rot, checks, crook, heart rot, sap rot, shatter, splits, sweep, bell butt, flared butt, or other defects are permitted providing the portion free from these defects is sufficient to meet the grade rule.

6.5.9.2 No. 2 Premium Spruce, Grade Code E

6.5.9.2.1 Grade Rule

A fine grained log:

1. 4 m or more in length and 38 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 25 percent of that lumber will be clear or,
2. Otherwise grade code D, 6.2 m or more in length and 50 cm or more in radius, where less than 75 percent but at least 66 2/3 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.9.2.2 Log Requirements to Make the Grade

1. No conk or conk stain rot is permitted.
2. Pocket rot is permitted if it is contained within a circle 1/3 the log radius, measured from the pith.
3. There must be no fewer than 12 annual rings in each 2 cm of diameter.
4. Logs 38 - 49 cm in radius must have at least 75 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 25 percent of two sides or the upper 50 percent of one side.

5. Logs 50 cm in radius and over will allow a few well-spaced knots or knot indications on the upper 50 percent of two sides or the upper 75 percent of one side.
6. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
7. Only small pitch pockets ranging from two per end for logs 38 cm in radius to six for logs 76 cm and over are permitted.
8. Insect or worm holes other than ambrosia must not penetrate beyond the sapwood.
9. Ambrosia, burls, wavy grain (horse mane), butt rot, checks, crook, heart rot, sap rot, shatter, splits, sweep, butt, flared butt, or other defects are permitted providing the portion free from these defects is sufficient to meet the grade rule.

6.5.9.3 No. 1 Lumber Spruce, Grade Code F

6.5.9.3.1 Grade Rule

A log 4 m or more in length and 38 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.9.3.2 Log Requirements to Make the Grade

1. No conk or conk stain is permitted.
2. Pocket rot is permitted if it is contained within a circle $\frac{1}{3}$ the log radius, measured from the pith.
3. There must be no fewer than six annual rings in each 2 cm of diameter.
4. Logs must have at least 90 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 10 percent of two sides or the upper 20 percent of one side.
5. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
6. Only small pitch pockets ranging from three per end for logs 38 cm in radius to six for logs 76 cm or over in radius are permitted.
7. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
8. Ambrosia, burl, wavy grain (horse mane), butt rot, checks, crook, heart rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.4 No. 2 Lumber Spruce, Grade Code G

6.5.9.4.1 Grade Rule

A log 4 m or more in length and 30 cm or more in radius where at least 75 percent of the gross scale can be manufactured into merchantable lumber and at least 25 percent of that lumber will be clear.

6.5.9.4.2 Log Requirements to Make the Grade

1. No conk or conk stain is permitted.
2. Pocket rot is permitted if it is contained within a circle $\frac{1}{3}$ the log radius, measured from the pith.
3. There must be no fewer than six annual rings in each 2 cm of diameter.
4. Logs 30 to 37 cm in radius must have at least 75 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 25 percent of two sides or the upper 50 percent of one side.
5. Logs 38 cm or more in radius:
 - a. must have at least 50 percent of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 50 percent of two sides or the upper 75 percent of one side, or
 - b. will permit large knots spaced so clear lumber, 2.5 m in length, shop type, can be cut from the area between the knots on at least 75 percent of the log's surface.
6. Logs 50 cm and over in radius will permit large knots spaced so clear lumber, 2.5 m in length, shop type, can be cut from the area between the knots on at least 50 percent of the log's surface.
7. Maximum twist permitted over 30 cm of length is 4 percent of the diameter up to a maximum deviation of 6 cm.
8. Only small pitch pockets ranging from two per end for logs 30 cm in radius to six for logs 76 cm or over in radius are permitted.
9. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
10. Ambrosia, burls, wavy grain (horse mane), butt rot, checks, crook, heart rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.5 No. 2 Sawlog Spruce, Grade Code H**6.5.9.5.1 Grade Rule**

A log:

1. 4 m or more in length and 19 cm or more in radius where at least 75 percent of the gross scale can be manufactured into lumber and at least 65 percent of that lumber will be merchantable or,
2. Otherwise grade code D, E, F or G, 4 m or more in length and 30 cm or more in radius, where less than 75 percent but at least 50 percent of the gross scale can be manufactured into merchantable lumber and at least 25 percent of the lumber will be clear.

6.5.9.5.2 Log Requirements to Make the Grade

1. There must be no fewer than five annual rings in each 2 cm of diameter.
2. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50 percent of the visible surface, or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50 percent of the visible surface, or reasonably well-spaced knots up to 5 cm in diameter on the upper $66 \frac{2}{3}$ percent of the visible surface, or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
4. Maximum twist permitted over 30 cm of length is 7 percent of the diameter up to a maximum deviation of 8 cm.
5. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
6. Butt rot, checks, conk, conk stain, crook, heart rot, oversized knots, pitch pockets, pocket rot, ring shake, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.6 No. 3 Sawlog Spruce, Grade Code I

6.5.9.6.1 Grade Rule

A log 4 m or more in length and

1. 19 cm or more in radius where
 - a. at least 75 percent of the gross scale can be manufactured into lumber and at least 50 percent of that lumber will be merchantable, or
 - b. otherwise grade code H, where less than 75 percent but at least 50 percent of the gross scale can be manufactured into lumber and at least 65 percent of that lumber will be merchantable, or
2. 25 cm more in radius where at least 50 percent of the gross scale can be manufactured into lumber and at least 50 percent of that lumber will be merchantable.

6.5.9.6.2 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
19 - 24 cm	8 cm
25 - 37 cm	9 cm
38 - 49 cm	10 cm
50 + cm	13 cm

2. Maximum twist permitted over 30 cm of length is 10 percent of the diameter up to a maximum deviation of 9 cm.
3. Bunch knots, butt rot, checks, conk, conk stain, crook, heart rot, insect holes, loose knots, oversized knots, pitch pockets, pocket rot, ring shake, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.7 No. 4 Sawlog All Coniferous, Grade Code J

6.5.9.7.1 Grade Rule

For a cypress and spruce log 4 m or more in length, for all other coniferous 5 m or more in length and 8 to 18 cm in radius where at least 75 percent of the gross scale can be manufactured into lumber and at least 50 percent of that lumber will be merchantable.

6.5.9.7.2 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
8 - 13 cm	4 cm
14 - 18 cm	6 cm

2. Maximum twist permitted over 30 cm of length is 10 percent of the diameter.
3. Butt rot, butt shakes, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.8 No. 5 Utility All Coniferous, Grade Code U**6.5.9.8.1 Grade Rule**

A log:

1. 5 m or more in length, and
 - a. 5 to 7 cm in radius where at least 75 percent of the gross scale can be manufactured into lumber, or
 - b. 8 to 18 cm in radius where at least 66 2/3 percent of the gross scale can be manufactured into lumber, or
2. 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.

6.5.9.8.2 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
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.

6.5.9.9 No. 6 Utility All Coniferous, Grade Code X

6.5.9.9.1 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.

6.5.9.9.2 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
38 - 49 cm	14 cm
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.

6.5.9.10 No. 7 Chipper All Coniferous, Grade Code Y

6.5.9.10.1 Grade Rule

A log lower in grade than utility and higher in grade than firmwood reject.

6.5.10 Broadleaf Species And Yew**6.5.10.1 Applicability**

The grades apply to all hardwood (i.e., deciduous) species harvested on the coast and to yew (*Taxus brevifolia*).

6.5.10.2 Sawlog, Grade Code W**6.5.10.2.1 Grade Rule**

A log 2.6 m or more in length and 5 cm or more in radius, where at least 50 percent of the gross scale can be manufactured into merchantable lumber.

6.5.10.2.2 Log Requirements to Make the Grade

1. By log radii, maximum knot size 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 + cm	14 cm

2. Maximum twist permitted over 30 cm in length is 10 percent of the diameter up to a maximum deviation of 9 cm.
3. Adventitious knots, bunch knots, burls, butt rot, checks, conk, conk stain, crook, heart rot, insect holes, loose knots, oversize knots, pocket rot, ring shake, rotten knots, sap rot, shatter, splits, sweep, or other defects, are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.10.3 Chipper, Grade Code Y

6.5.10.3.1 Grade Rule

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

6.6 Interpreting the Schedule of Interior Timber Grades

The Schedule of Interior Timber Grades is part of the Scaling Regulation. It consists of five grades, the firmwood reject code Z, the undersized log grade code 6, premium sawlog code 1, sawlog code 2 and lumber reject code 4.

6.6.1 Grade Applicability

Timber must be classified by grade in accordance with the Schedule of Interior Timber Grades, if timber is cut in a forest region (usually Northern and Southern Interior) or part of a forest region where the *Interior Appraisal Manual* applies.

The area of harvest and not the place of scaling determines the schedule of timber grades that must be used.

6.6.1.1 Grade Precedence

The Grade precedence is also part of the Scaling Regulation. For this reason scalers are instructed to record a log against the first grade in order of presentation in the Scaling Regulation.

As per the Scaling Regulation, where a log meets the criteria of more than one grade, the following grade precedence must be applied.

1. A log or portion of a log that qualifies as Firmwood Reject (Grade code Z) takes precedence over all other grades.
2. A log that qualifies as Undersized Log Grade (Grade code 6) takes precedence over premium sawlog, sawlog and lumber reject. (Grades code 1, 2 and 4).
3. A log that qualifies as a Premium Sawlog (Grade code 1) takes precedence over Sawlog and Lumber Reject. (Grades code 2 and 4).
4. A log that qualifies as a Sawlog (Grade code 2) takes precedence over Lumber Reject. (Grade code 4).

6.6.2 Physical Characteristics Affecting Log Grades

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 (section 6.6.2.1),
- Whether it is a round log or slab (section 6.6.2.2),
- What proportion of the log will produce lumber and chips (section 6.6.2.3),
- The quality of end products (section 6.6.2.4), and
- The presence of non-permissible defects. (section 6.6.2.5).

Some aspects of the above factors have been explained earlier in this chapter, while others require further explanation specific to interior grading.

6.6.2.1 Log Size

6.6.2.1.1 Radius or 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.

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 firwood reject where the measurement is expressed in centimetres of diameter.

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.

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 at 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.
- For logs that require more than one diameter measurement, the diameter for the purpose of grading is the rounded gross diameter for the small end of the log or the mid-point, as described in Chapter 5. A log that rounds up to the minimum diameter for a grade qualifies for that grade.

6.6.2.1.2 Length

Length measurements specified in the grade rules are the actual unrounded gross measurements. See length measurements section 5.4.4.

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.

6.6.2.2 Slabs

Slabs must be at least:

- 20 cm thick and 20 cm in width to qualify for grade code 1,
- 15 cm thick and 15 cm wide to qualify for grade code 2, and
- 10 cm thick and 10 cm wide to qualify for grade code 4.

Slab thickness specified is the actual unrounded measurement. Slab thickness for grading purposes is the maximum width at which a 4 cm (2 rads) thick board can be cut at right angles to the grain (annual rings). See section 6.4.2.4 slab thickness and grading.

6.6.2.3 Potential for Manufacture of Product Quantity

The proportions of a log's gross scale that are suitable and not suitable, for the manufacture of products, are important factors in determining its commercial value.

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

Log defects that reduce recovery of products are identified in Section 6.3, and procedures for calculating the amount of loss they cause (grade reduction) are outlined in Section 6.4.

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

6.6.2.3.1 Length of Defects

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 section 5.6 may be employed. That is in order to maintain consistency amongst scalers in determining grade reduction.

6.6.2.3.2 Grade Reduction for Conk, Pin Rot and Indian Paint Rot

The assessment of conk, pin and indian paint rot is as per section 5.6.3.3.

6.6.2.3.3 Assessment of Collar around the defects

The collar is determined as per section 6.4.2.1.

6.6.2.4 Potential Quality of Manufactured Products

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.

The quality considerations of knots and twist are described in Sections 6.3 and 6.4. Some additional considerations specific to interior grades are described below.

6.6.2.4.1 Size of Knots

Knots larger than 1 rad will reduce the strength of the lumber. The larger the knots size the greater the loss in lumber strength.

Knots are measured at right angles to the log length.

The Grade Rule requirements stating maximum knot sizes and minimum spacing must be met.

6.6.2.4.2 Occasional Oversize Knots

All sawlog grades can have occasional oversize knots. Knots, which exceed the maximum, are considered as oversize.

Interior grading allows one oversize knot for every 2.5 m of log length. An exception occurs with small diameter logs in the range of 5 (10 cm) to 7 rads (15 cm) where it is not permitted. If a section of a log within this diameter range has an oversized knot, then the segment of the log containing the oversize knot is added to the deduction for the merchantability requirements.

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

Refer to Sections 6.3.2.2 and 6.4.3.1 for a more complete discussion.

6.6.2.4.3 Twist (Spiral Grain)

Measure twist over a representative 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.

Sections of log displaying excessive twist are deemed to be unsuitable for the manufacture of merchantable lumber. See Sections 6.3.2.1 and 6.4.3.2 principles and application of twist measurement.

6.6.2.4.4 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 allow 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.

6.6.2.4.5 Wood Compression

Compression wood can cause problems in processing the wood. It can cause bow and spring.

It is a heart pith displacement of 20% or more from the geometrical centre of the log. A grade reduction is calculated for grade code 1 only. The volume of grade reduction is calculated based on the defect shape of the compressed area for a 2.0 m length.

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% calculate the grade reduction. First measure the area affected by the compressed area from the pith to the outside edge. Second run the defect up to a maximum of 2.0 metres, unless there is indication that the defect runs shorter or longer. Third, calculate the volume of grade reduction for grade code 1 only.

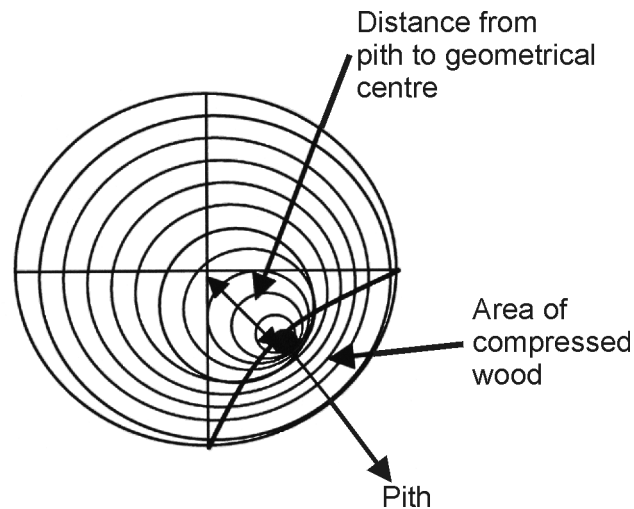


Figure 6.25 Measuring Compression Wood.

6.6.2.5 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. Example of defect which is not permitted in certain grades is oversize knots.

Some grades permit certain defects only to a clearly defined limited extent. Example is insect holes. When the defect is not confined to the stated limit, it is treated as a non-permissible defect for that grade.

Most of the above defects are defined by log grade under the Log Requirements to Make the Grade, section 6.6.6.

6.6.3 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 handheld data collector.

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

6.6.3.1.1 Firmwood Reject – all species – 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 either by species code or by the letter R. For piece scale loads, the species code are used.

6.6.3.1.2 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.

6.6.3.1.3 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 code is always entered against all grades for piece scale and can also be entered for weigh scale.
3. The letter R can be used for sample and weigh scale.

6.6.3.2 Undersized Log Grade- Grade Code 6

6.6.3.2.1 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.

6.6.3.2.2 Log Requirements to Make the Grade

The criteria outlined under Section 6.4.4.2 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, or other butt characteristics to indicate that it comprises a tree and not a top cut or second cut from a larger tree,
- 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.

6.6.3.3 Premium Sawlog- Grade Code 1

6.6.3.3.1 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.

6.6.3.3.2 Log Requirements to Make the Grade

1. Internal rot defect is not allowed for cedar slabs.
2. Sap rot, 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 a log with five or more insect holes per running metre, penetrating the sapwood and/or heartwood of the tree is not allowed.

4. Ambrosia holes are allowed.
5. Surface beetle galleries are allowed.
6. Outside surface check 4 cm or more in depth is not allowed.
7. Outside surface checks 2 cm or less in depth are not accounted for in the grade reduction.
8. Recent weather checks and/or checks associated with delay in scaling are allowed.
9. Section of a log with catface, with minimum dimensions of 2 cm in depth, by 2 cm in width, by 2 cm in length, is not allowed.
10. Heart pith displacement of more than 20% from the geometrical centre of the log is not allowed and the affected shape of the compression wood defect for up to 2.0 m length is assessed for merchantability.
11. Section of a 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.
12. 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. Less than 30 cm spacing between knots measured lengthwise between knot centres is not allowed. This applies to all knots 3 cm or larger. One knot less than 30 cm in spacing is allowed per 2.5 m. Adventitious knots are not considered for knot spacing.
13. Less than 10 cm spacing between knots distant from side to side is not allowed. This applies to all knots 3 cm or larger. One knot less than 10 cm in spacing is allowed per 2.5 m. Adventitious knots are not considered for knot spacing.
14. 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.
15. Stain is allowed.

6.6.3.4 Sawlog- Grade Code 2

6.6.3.4.1 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, and
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, and
5. at least 50 percent of the lumber will be merchantable.

6.6.6.4.2 Log Requirements to Make the Grade

1. Section of log where two or more defects are positioned such that there is less than 10 cm collar or residual core of usable fibre available between the defects is not allowed.
2. Section of log with one check or more, 4 cm or more in depth, in a portion of log 5 cm to 7 cm in radius, is not allowed.
3. Section of log with two checks or more, 4 cm or more in depth, with less than a 10 cm residual core or collar, in a portion of log 8 cm or more in radius, is not allowed.
4. Recent weather checks and/or checks associated with delay in scaling are allowed.
5. Outside surface checks 2 cm or less in depth are not accounted for in the grade reduction.
6. 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.

7. 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

8. Section of log with one oversize knot in a portion of log 5 cm to 7 cm in radius, is not allowed.
9. 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.
10. Stain is allowed.
11. Beetle galleries and woodborers holes are allowed.

6.6.3.5 Lumber Reject Grade Code 4

6.6.3.5.1 Grade Rule

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

6.6.6.5.2 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.

This page is intentionally left blank.

Glossary of Terms

The following definitions apply in 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	used to describe a plant part, means that it develops outside the usual order of time or position, or both (e.g., adventitious branching on trees).
Airdry	the condition at which the moisture content of wood is closely in equilibrium with conditions outdoors, but undercover (usually at about 12% moisture content).
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 outside cambium and 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.
Bird holes	holes and damage caused by woodpeckers and other species of birds.
Bole	the trunk of a tree (seedling and saplings have stems, not boles).

Bolt	any short log specially cut to length, usually for the manufacture of a specific product (e.g., shake bolt).
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 stem 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 fat 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.
Calipering	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 (or Heart Check)	a separation of the wood, at a right angle to the annual rings, which runs through the heart of the log. Is also called heart shake.
Chipper	a machine for cutting wood into wood chips, and includes chipper canters, chipper edgers, chipping headrigs, and portable debarker chippers.
Church door fire scar	a defect on the surface of a butt log caused by a ground fire, resulting in a tapered piece of sound wood missing from the butt end of the log.

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 Cascades).
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 $CV = s/x$.
Collars	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 shells).
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.
Confidence interval	the interval within which the true value of an estimate is said to be with a given probability of the statement being correct (e.g., at 2 confidence intervals there is a 95% [or 19 lines out of 20] probability the estimate will be within ± 2 sampling errors of the true value).
Continuous variable	a variable that is characterized by being related to some numerical scale of measurement, any interval of which may, if desired, be subdivided into an infinite number of values, such as length, height, volume, and mass.
Contraindicators	log characteristics where presence deem the log to be cut from a living tree.
Crook	an abrupt bend or curvature 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 the side of the living tree.
Decay	the decomposition of wood substance cause by the action of wood-destroying fungi, resulting in softening, loss of strength and mass, and often change of texture and colour.

Defect	any abnormality or irregularity which lowers the commercial value of wood. Typically defects may reduce a logs firmwood volume and/or log grade.
Diameter, small end	the average diameter, inside bark, at the upper end of the log.
Diameter breast height (DBH)	<p>the stem diameter of a tree measured outside bark at breast height (1.30 m above ground level).</p> <p>DBH is used for standing trees, usually in the context of cruise data. The minimum butt diameter is usually used in the context of utilization standards.</p>
Diameter deduction	a method of compensating for through-running firmwood defects by reducing the recorded radius or radii of a log or slab.
Diameter tape	a tape measure specially graduated so that the diameter may be read directly when the tape is placed round a tree stem, bole, or piece of roundwood.
Discrete variable	a qualitative variable represented by an integral value or ratio of integral values, such as number of logs in a stacked cubic metre, that cannot be expressed as a proportion. By increasing the number of values that a discrete variable can assume, it is often possible to handle such data by continuous variable methods.
Dryland sorts	flat areas, usually paved where loads of logs are lifted out of the water or off loaded from logging trucks and spread onto the ground for scaling, grading and subsequent sorting.
Earlywood	that part of the growth ring which is produced at the beginning of the growing season (usually it is less dense and lighter in colour than late wood). It is also called springwood.
End Check	a type of weather check caused by rapid drying at the cut faces of a green cut log. They are usually multiple and normally penetrate only a short distance into a log.
Estimate (of a sample)	a value for a characteristic or parameter derived through using a sampling method.

Face (of a pile)	one of the surfaces of a pile of logs showing only the cut ends of the logs.
Figure	any design or distinctive markings on the long surfaces of wood.
Fire scar	a healing or healed-over injury, caused or aggravated by fire, on a woody plant.
Firm redheart	a form of incipient decay characterized by a reddish colour produced in the heartwood that does not render the wood unfit for the majority of uses. Firm redheart contains none of the white pockets that characterize the more advanced stage of decay (not to be confused with natural red heartwood).
Firmwood deductions	deductions made from the gross volume of a log to account for rot, hole, char and missing wood.
Flare	a rapid increase in the taper of a log at the butt end of the log due to swell.
Foreign material	any material extraneous to roundwood such as earth, ice, snow, and branches, any of which add mass to the load.
Forest	a plant community consisting predominantly of trees and other wood vegetation, growing together.
Fork	a division of a log or a stem of a tree into two or more branches.
Fuelwood	roundwood, whole or split, produced for burning.
Grade deduction	in log grading, the process of determining the portion of the log not suitable for the manufacture of various products.
Grain	the general direction of the longitudinal wood elements in the tree.
Grain density	used in some log grading, refers to the spacing between the annual rings and measured as a ring count over a set distance.
Gross oven dry weight	the gross weight (or mass) of wood, bark, and defect less their moisture content.

Gross scale	the volume of a log inside bark and includes unsound wood and holes in the log.
Gross volume	total inside bark volume and includes any defects.
Gross weight	the weight of a load before any deduction for moisture content and, when present, bark, defect, and foreign material.
Hardwoods	trees of the botanical group Angiospermae that generally have broad leaves in contrast to the conifers. The term has no reference to the actual hardness of the wood.
Heart	see Heartwood.
Heart rot	any rot characteristically confined to the heartwood. It generally originates in the living tree.
Heart shake	a shake that originates at the pith of a log and extends across the annual rings (also called heart check and reft crack).
Heartwood	the inner core of a woody stem wholly composed of non-living cells and usually differentiated from the outer enveloping layer (sapwood) by its darker colour. It is usually more decay resistant than sapwood.
Hole	any opening in a log, other than check, shake, or split. It may extend partially or entirely through a log and be from any cause.
Honeycomb decay	see Pocket rot.
Incipient decay	the early stage of decay in which the decomposition has not proceeded far enough to soften or otherwise change the hardness of the wood noticeably. It is usually accompanied by a slight discolouration of the wood (see also Firm redheart).
Insect holes	voids made by insects or insect larvae.
Interior	for the purpose of scaling, interior is defined as the area where a lumber based stumpage appraisal is used (generally east of the Cascades).

Intermediate decay	a more advanced stage of decay than incipient decay characterized by a change in the colour of the wood and some slight decomposition and loss of strength that do not, however, render the wood unfit for general purposes (see also White specks).
Knot indication	<p>a characteristic feature showing in the bark of a log which indicates a branch once grew there, but has since been shed and the residual knot covered with new growth wood. Sometimes knot indications will also show on the sapwood surface when the bark has been removed.</p> <p>These features indicate that the new growth wood covering the knot is shallow, and for log grades which must cut clear lumber they are treated the same as knots. The peeler B grade also treats indications the same as knots -----. Where knot indications are to be treated as knots, this is specified in the requirements following the grade rules in Section 6.5.4.1. When not mentioned in the requirements knot indications are not a factor in grade determination.</p> <p>As with most defects, considerable field training and experience is required for scalers to correctly identify knot indications, and distinguish them from other irregularities on the surfaces of logs.</p>
Latewood	the denser, smaller-celled, usually darker, later formed part of an annual ring, also called summerwood.
Length deduction	a method of compensation for firmwood defects by reducing the recorded length of a log or slab.
Linear measure	a measure of length.
List of permissible defects	are those common to the species and a defect may not appear as it is not a common defect or does not affect that species.
Local volume table	a table showing, for one or more species, the average cubic contents for tree lengths by diameter classes, within a smaller geographic region.
Log	any section of the bole, or of the thicker branches, of a felled tree, after trimming and cross cutting.

Log rule	a table showing the estimated or calculated volume of wood that is contained in logs of given length, form, and end diameter inside bark.
Lumber	<p>lumber must be 2.5 m long, free of rot and fractures.</p> <p>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 NLGA)</p>
Mass	the same as the weight.
Mean	the average of a set of measurements derived by summing all values and dividing by the total number of measurements.
Merchantable lumber	good, strong, general purpose lumber graded as better than utility or number 3, and not less than 2.5 m long (this is assessed on the basis of knots and twist).
Minimum collar thickness	same as minimum shell thickness. The collar of firmwood surrounding heart defects considered in grading to be the minimum thickness for the manufacture of lumber.
Missing wood	wood that is absent from a log or part of a log that otherwise would usually be regarded as naturally complete. It may be caused by advanced decay, fire, or the operation of a machine to tool.
Moisture content	the mass of water in wood expressed as a percentage of its total weight.
Mould or mildew	a superficial fungal growth usually appearing in the form of a woolly or furry coating of varying colour.
Net firmwood volume	the volume remaining after all allowable firmwood deductions for defects from gross volume have been made; in stacked measure, deductions include voids.

Normal taper	the regular decrease in diameter of a log from its large to small end, exclusive of butt swell.
Otherwise grade	a log meets all the requirements of the higher grade, including being free of non-permissible defects, but has more grade reduction than allowed for the higher grade.
Out of round	used to describe a shape and means that it departs from what is usually regarded as approximately circular.
Outside checks	checks or fractures on the outside part of the log which extend through the bark into the adjacent sapwood. Severe checking will extend into the heartwood.
Oven dry weight	the weight of wood obtained by drying it in an oven at 105° C until there is no further weight loss.
Parameters	certain constants, characterizing a population or a whole, to be studied in a survey.
Parcel	any quantity of grouped logs.
Peeled	all or most of the bark has been removed.
Out of round	used to describe a shape and means that it departs from what is usually regarded as approximately circular.
Peeler block	Peeler block is a segment of a log's length, usually 2.6 m, suitable for the manufacture of veneer on a rotary lathe.
Piece product	a product scaled by the number of separate pieces of one kind.
Piece scale	the scaling method whereby each piece is scale by recording the timber mark, species and by taking its length, top and butt diameter, deducting for firmwood defects, and assigning a grade.
Pile	for scaling purposes, an orderly arrangement of logs that are longer than the 2.6 m class.
Pile divider	in tree-length scaling, the surface formed by butt ends that have been piled with the butts all aligned in a nearly vertical plane.
Pipe	a hole, the product of decay, running through the centre of a log.

Pistol grip	a pronounced bend at the butt end of a log and resembling the handle of a pistol.
Pitch ring (or silt shake)	<p>an accumulation of pitch or resin fully or partially around the circumference of an annual ring, where there is no visible wood separation.</p> <ol style="list-style-type: none">1. Where a pitch ring appears at only one end of a log, no loss for lumber or plywood is considered.2. Where a pitch ring appears at both ends of a log it is treated as a tight ring shake, and the log is graded accordingly. <p>Pitch rings are also called silt shakes, as the ring was made more visible when the grunge in the Fraser River clung to the pitch, and some individuals also call it "silk" shake.</p>
Pith	the small cylinder of primary tissue of a tree stem around which the annual rings form.
Pocket rot	in wood, any rot localized in small areas, generally forming rounded or lens shaped cavities.
Pocket rot	see Decay.
Population	the aggregate of all units from which samples are selected to make estimates about the aggregate.
Precision	the closeness, to each other of repeated measures of the same quantity. When precision is achieved, values will be clustered around their mean.
Probability statement	a statement that gives a range of a characteristic within which the true value lies, with a stated probability that the statement is correct (e.g., there is a 95% probability that value X will be within 2 sampling errors of the actual value).
Pulpwood	wood cut and prepared primarily for manufacture into wood pulp.
Punky	a soft, weak, often spongy wood condition caused by decay.

Punky	see Decay.
Quality considerations	in log grading, the factors which reduce the log's quality in terms of its potential product recovery and is usually confined to the size and placement of knots and the degree of any twist observed on the log.
Radius and diameter	<p>log radius in the grade rules is expressed as centimetres of radius, which is equal to and interchangeable with, rads of diameter.</p> <p>An exception should be noted in the grade rule for firmwood reject where the measurement is expressed in centimetres of diameter.</p>
Ring rot	any rot localized mainly in the earlywood of the annual rings, giving a concentric pattern of decayed wood in cross section.
Ring shake	a separation of the wood following the circumference, or part of the circumference, of an annular ring.
Rot	see Decay.
Round (adjective)	approximately correct; of an approximate circular cross section.
Round (transitive verb)	to express as a round number.
Rounding	the process of approximating to a number by omitting certain of the end digits, replacing by zeros if necessary, and adjusting the last digit retained so that the resulting approximation is as near as possible to the original number. It the last digit is increased by unity, the number is said to be rounded up; if decreased by unity, it is rounded down. When both are under consideration, the process is said to be one of rounding off.
Roundwood	any section of the stem, or of the thicker branches, of a tree of commercial value that has been felled or cut but has not been processed beyond removing the limbs or bark, or both, or splitting the section (for fuelwood).
Sample	a unit or part selected from a population that is representative of that population.

Sample scaling	the method of scaling where only a portion of the total production is piece scaled. Weight scaling is the most prominent example of sample scaling. Sample scaling is also used to scale some special forest products.
Sample size	the number of samples to be taken to sample the population to meet the sampling objectives.
Sampling error	a statistic which defines how reliable (or precise) sampling results are (the same as the standard error of the estimate, or the standard error of the mean and the standard error).
Sap rot	any rot characteristically confined to the sapwood.
Sapwood	the living wood of pale colour near the outside of the log. Under most condition the sapwood is more susceptible to decay than heartwood.
Scale (noun)	the measured or estimated quantity, expressed as the volume, or area, or length, or mass, or number of products obtained from trees and measured or estimated after they are felled.
Scale (verb)	to measure or estimate the quantity, expressed as the volume, or area, or length, or mass, or number of products obtained from trees after they are felled.
Scale stick	a graduated stick for measuring the end diameters of logs or felled trees inside bark. Of many types, it usually has a shaped handle on one of its ends, a tine at the other, and a log rule reproduced on its length; it also means a graduated stick for measuring the external dimensions of stacked wood.
Scaler	a person who is licenced or appointed to scale timber under the <i>Forest Act</i> .
Scales	an instrument or machine for determining weight.
Schedule of Coast Timber Grades	the set of coast grade rules appended to the <i>Scaling Regulation</i> .
Schedule of Interior Timber Grades	the set of interior grade rules appended to the <i>Scaling Regulation</i> .

Second cut log	this refers to logs cut after the butt log.
Segregated tally	a tally sheet that is segregated into sections for timber with the same species and grade. It can be used as an input document into the Harvest Data Base system (HDBS) to generate an invoice.
Shake	one or more separations along the grain of a log or tree, normally radiating outward from the pith (i.e., heart shake, [also called heart check]); caused by stresses during growth. Where several such separations radiate outward, they are referred to as "star shake" (see "Ring Shake").
Shells	see Collars.
Shingles	must be at least 23 rads long, 4 rads wide, have no knots larger than 7 cm or 3.5 rads and have no knots on any of the four edges.
Shop grade (coast)	Refers to clear lumber at least 2.5 m long, which is cut out from between large knots.
Side	regardless of whether on land or in the water, the surface of a log has two visible sides, one on each side of a vertical plane that passes through the centre of each end of the log.
SI units	only the base, supplementary, and derived units of measure included within the International System of Units (SI) (see CSA Standard CAN3-Z234.2).
Significant digit	any digit that is necessary to define the specific quantity or value.
Slab	a piece of timber that has fractured along a plane roughly parallel to the longitudinal axis of the original log.
Softwood	generally, one of the botanical groups of trees that in most cases have needle- or scale-like leaves; the conifers; also the wood produced by such trees. The term has no reference to the actual hardness of the wood.
Solidwood Equivalent	the firmwood volume of logs required to produce a given quantity of a specified product.

Sound wood	wood free from defect.
Special Forest Products and Special Forest Products Regulation	as defined under the Forest Act to include: poles, post, pilings, shakes, shingle, bolts, Christmas trees, building logs, mining timbers, props and caps, cribbing, firewood and fuel logs, hop poles, orchard props, car stakes, round stakes, sticks and pickets, split stakes, pickets, palings and logging, shake bolts, blocks, and blanks and shingle blocks.
Spiral check	wood separations starting on a log's surface and travelling toward the pith. If the natural grain of the log twists, the checks will follow and spiral around the log's axis.
Spiral grain	see Twist.
Split	cleft completely and lengthwise along the grain of a log; usually results from falling, bucking or handling damage.
Springwood	see Earlywood.
Stack	for scaling purposes, an orderly arrangement of bolts less than or equal to the 2.6 m class in length.
Stacked cubic metre (symbol m^3 [stacked])	the total amount of wood, bark, and airspace contained in a stack of roundwood, as determined by its external dimensions, equal to 1 m^3 .
Stacked cubic metre peeled (symbol m^3 [stacked] peeled)	the total amount of wood and airspace contained in a stack of peeled roundwood, as determined by its external dimensions, equal to 1 m^3 .
Stacked scaling	the act or process of measuring or estimating the total amount of wood, bark, and airspace contained in a stack of roundwood, where the bolt length is less than or equal to the 2.6 m class as determined by its external dimensions.
Standard deviation	the square root of the variance. It is symbolized by s .
Stem	the principle axis of a plant, from which buds and shoots develop.
Stratum	a subdivision of the entire population.

Sun check (or outside check)	a separation of wood which penetrates from the outside diameter in toward the heart of the log. Caused by drying of logs or standing dead trees. Is also called surface check.
Sweep	a gradual curve in the length of a log, as distinct from an abrupt bend or curvature.
Tally	a form completed by a scaler used to capture timber details such as timber marks, species, grade, volume, products, and dimensions. It also identifies the time and place of scale, as well as who the ownership timber is scaled for. It is used as a basis for stumpage collection.
Tally number	also called a raft or return number. It is a unique number (in conjunction with the scaler's licence number and date), and is assigned to a parcel of timber by a scaler. The scaler assigns #001 to the first parcel scaled each year and continues consecutively through to 999. If the scaler scales more than 999 parcels of timber in a year they then restart with 001. The dates will then determine the uniqueness of the number.
Taper	the progressive decrease or increase in the diameter of a log from one end or point on its length to another.
Tare	the weight of the unloaded vehicle or container.
Tier	one of a set of layers or rows arranged one above another.
Tolerance	the total range of variation permitted for a required size.
Tracheid	an imperforate wood cell with bordered pits to congeneric elements.
Tree	a woody perennial plant, typically large and with a single well-defined stem carrying a more or less definite crown.
Tree length	the trimmed bole of a tree that has been felled and had the top removed.
Trim allowance	the sound wood surrounding rot and other defects made in grade deductions to account for loss in lumber recovery because defects must be squared out by a sawyer.

Trunk	see Bole.
Twist	a quality consideration in log grading where the logs grain is aligned in a helical orientation around the axis of the log. It is the same as spiral grain and its measurement is often referred to as the slope of grain.
Unit of measurement for lumber	board foot is the unit of measurement of lumber. A board foot is the quantity of lumber contained in or derived by drying, dressing or working from a piece of rough lumber 1 inch thick, 1 foot wide, and 1 foot long, or its equivalent in thicker, wider, narrower or longer lumber. (source NLGA)
Upper	closest to the small end, or top end, of a log.
Variable	a characteristic of a population that may vary from one unit to another.
Variance (of a population)	a measure of the dispersion of individual unit values about their mean.
Vessel	an axial series of cells that have coalesced to form an articulated tube-like structure of indeterminate length; the pits of congeneric elements are bordered.
Void	an unnecessary airspace in a stack of roundwood, large enough to accommodate the average size of log or bolt in the stack.
Weather check	a type of check caused by rapid drying of the outer surface of a green cutlog. They are usually multiple where exposed to the drying effect of the wind and sun, and may eventually develop into one or more deep checks (see "End check").
Weigh	to measure the weight of an object.
Weighing machine	any device for measuring weight (or mass).
Weight	a measure of the force of gravity (or heaviness).
White specks	the intermediate stage of Fomes pini decay, characterized by small white pits or streaks in the wood.

Wood	the hard fibrous substance, basically xylem, that makes up the greater part of the stems and branches of trees or shrubs, beneath the bark.
Wood Chips	as a collective term, the total material that is produced from passing wood fibre through a chipper. Unless specified otherwise, the wood fibres being subjected to the chipping process must have passed through a debarking procedure.
Wood chip	a small, thin, flat piece of wood cut from a larger piece of wood by knife action, mechanically operated. A wood chip must show two knife cuts and its width must be greater than its thickness.
Wood fibres	any long, narrow cells of xylem, other than vessel elements or parenchyma; it also means (as a loose term) wood elements in general.
Wood pulp	wood fibres separated by mechanical means for use in manufacturing paper, textiles, and many other products derived from cellulose.
Worm holes	see Borer holes.
Worm holes	voids (or holes) made by insects or insect larvae.
Xylem	the woody part of the tree which functions chiefly in conduction but also in support and storage.

This page is intentionally left blank.