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 which are set by the *Scaling Regulation*.

Timber is graded to make the volume information of the scale more meaningful and useful to the sellers and purchasers of timber, and to managers of the forest resource. The quality and potential end use of logs has significant influence on their worth. A scale without grade does not provide enough information for transactions for industry or assessing Crown revenues for government.

In addition to monetary values, log grade can also determine whether or not logs are accounted for cut control purposes, and whether their utilization is mandatory or optional.

Grading is a key component in marketing finished products such as lumber, shingles and plywood. Instead of evaluating finished products, the challenge of the scaler is one of assessing the visible characteristics of each log, and with strict reference to schedules of log grades, visualize what can be recovered from the log given its size and other characteristics.

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 todays grading rules are very similar to the practices and conventions used in applying some of the official scales developed over 100 years ago.

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

6.1.1 Coast Grading

Because of its valuable old growth forests, marine transport opportunities and historic settlement patterns, logging and lumbering first flourished on the coast.

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.

Coastal grades have changed over the years in response to varying needs. 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 commence 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.

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 a legal requirement and an integral component of the scale.

The legal authority for grading falls under the *Scaling Regulation*. This regulation prescribes two grading schedules; one for the coast and one for the 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 details how timber is graded in accordance with the schedules of timber grades.

Other than poles, pilings and building logs, special forest products are not graded. Poles, pilings and building logs must be scaled in log form and graded in accordance with the appropriate schedule of timber grades.

6.3 Principles of Timber Grading

Grade rules typically include three components:

- minimum and/or maximum gross log dimensions,
- a requirement that a percentage of the logs 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:

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

The challenge for the scaler is to assess the visible characteristics of each log, and with strict reference to the schedule of grades, visualize what can be recovered from the log given the log's size and other characteristics.

The potential product recoveries in grading are:

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

The process of visualizing 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 being graded. 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 whole 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 from growth stresses are referred to as shake, and those from seasoning are referred to as check. 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 checking occurs on the ends of logs and usually does not penetrate very far into a log. The loss in lumber recovery is considerably increased where shakes 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. The most common situations where spiral checks 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 in 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 surface checks be ignored.

Breakage (splits and shatter), as a consequence of normal harvesting and log handling operations must be accounted for in the process of grading.

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

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. 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.

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. If bits or fragments of wood can be picked more easily with the tine of the scale stick from the area in question than from the surrounding area, then the wood is rotten, not firm, and both a firmwood deduction and a grade reduction is made (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 often spiral about their central axis. When these twisted trees are manufactured, the resulting boards have a slope to the grain that reduces their strength and, therefore, the quality of the lumber. When twist is excessive no merchantable lumber can be milled from a log. Therefore, twist may not exceed 15 percent of the reference diameter.

Twist is measured over a representative 30 cm (15 rad) portion of the length of the log. Since the twist of a log is rarely uniform, scalers must carefully select the place to make the measurement. A spot that represents the degree of twist affecting the majority of the log's volume must be selected. Areas around large knots, clusters of knots or other irregularities such as crooks, forks, and burls should be avoided.

Twist is measured by carefully laying the scale stick on the surface of the log parallel to the central axis of the log, and measuring the side deflection of the grain over the indicated 30 cm (15 rads) of length.

On the coast, this deflection is then calculated as a percentage of the top radius class. In the interior, the measured deflection is calculated as a percentage of the top radius class for logs up to and including 8 m, and as a percentage of the measured mid-point radius class for logs over 8 m.

For example, a 5 m log with a 24 rad top showing 3 rads of grain deflection is calculated as having a 12.5 percent twist (i.e., $\frac{3}{24} x 100\% = 12.5\%$). Many scalers prefer to use centimetres, to avoid "half rads". For example, a 48 cm (24 rad) top showing 9 cm (4.5 rads) of grain deflection is calculated as having an 18.75 percent twist (i.e., $\frac{9}{48} x 100\% = 18.75\%$).

The 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. As such, knots are a key consideration in applying the grade rules.

6.3.2.2.1 Size of Knots

The presence of any knots in lumber disqualifies it from being classified as clear. 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.

Individual grade definitions specify maximum knot sizes by top diameter class. In the interior, an exception is made for logs over 8 m in length where both the top diameter and midpoint diameters are referred to for knot assessment. For these longer, interior logs the top half is assessed using the top diameter while the bottom half is assessed against the measured mid point diameter.

6.3.2.2.2 Types of Knots

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

Sound 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 most of 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 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 6.4.3.3.

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.

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

(Where Gross Volume = Defect Free Vol. + Defect Volume)

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 usually 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:

- 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 using Smalians 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 discussed in Chapter 5, Smalians formula may yield unreliable results if there is excessive taper between the top and butt of the log. The same caveat applies to the use of field methods.

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.

Appendix 6A is considered reliable for the purpose of applying the Coastal Schedule of Timber Grades.

6.4.2 Assessing Product Recovery

Grade rules require that a certain specified percentage of the gross log volume must be available for manufacture. This requires the grade reduction volume to be calculated. The net log volume, available for manufacture, 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 or shingles 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 species except interior red cedar and interior hemlock, 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 interior red cedar and interior hemlock, the minimum 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)*. The reasons for the exception are tied to the economic considerations in logging interior hemlock and cedar stands, lower predictability of rot patterns in these species, and a higher susceptability to shatter.

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 about 12 rads in diameter (with 5 rad collar requirement) or logs up to about 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:

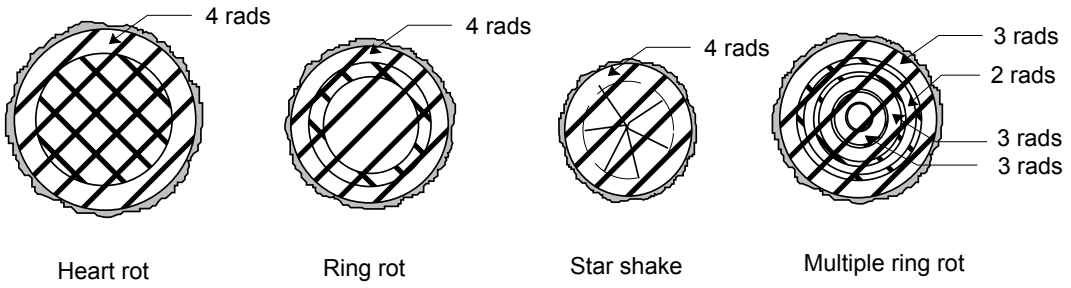
- on logs with excessive butt flare, this method will often considerably under-estimate the true collar thickness since the butt diameter has been reduced by calipering to compensate for the flare, but the defect is not. Experience has shown that defects usually follow the growth rings, so it is more 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 check 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.

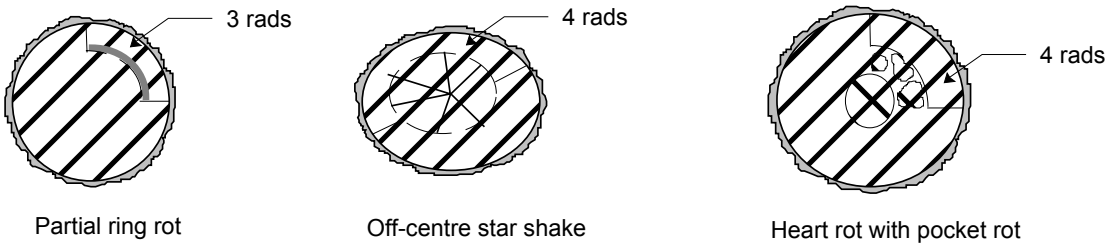
The following conventions are used to help ensure consistency in assessing collars:

- 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 downgraded 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



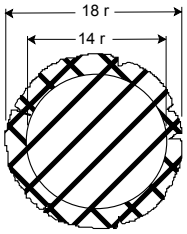
2. Examples of logs with a portion of the collar too thin to produce lumber.

3. Examples of logs with sufficient collar to produce lumber.
(trim allowance is added to the collar surrounding the defect when calculating grade reduction).

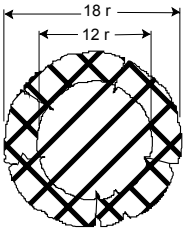
Figure 6.1 Examples of collars around internal defects.

6.4.2.2 Determining Grade Reduction for Sound Hearts (Residual Cores)

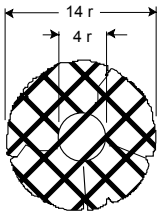
Sound hearts inside defects such as sap rot, charred wood, ring rot and ring shake are considered suitable for lumber production if they are 5 rads (10 cm) or more in diameter. Hearts less than 5 rads are included in the grade reduction. The treatment of sap rot is illustrated in Figure 6.2. Examples of grading residual cores inside ring shake and ring rot are provided in Section 6.4.2.5 (trim allowance section).



1. Sap rot



2. Advanced Sap rot



3. Residual core is grade reduction.

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:

Gross unit volume = UV 18 r = 102 dm^3

Grade reduction = UV 18 r - UV 14 r = (102 - 62) = 40 dm^3

% of log which can be manufactured = $\frac{102-40}{102} \times 100$ = 60.8 %

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:

Gross unit volume = UV 18 r = 102 dm^3 per metre

Grade reduction = UV 18 r - UV 12 r = (102 - 45) = 57 dm^3 per metre

% of log which can be manufactured = $\frac{102-57}{102} \times 100$ = 44.1 percent

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 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 dm^3 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 dm^3 per metre

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

Grade reduction = UV 4 r = 5 dm^3 per metre

Total grade reduction = (57 + 5) = 62 dm^3 per metre

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

6.4.2.3 Determining Grade Reduction for Multiple Defects

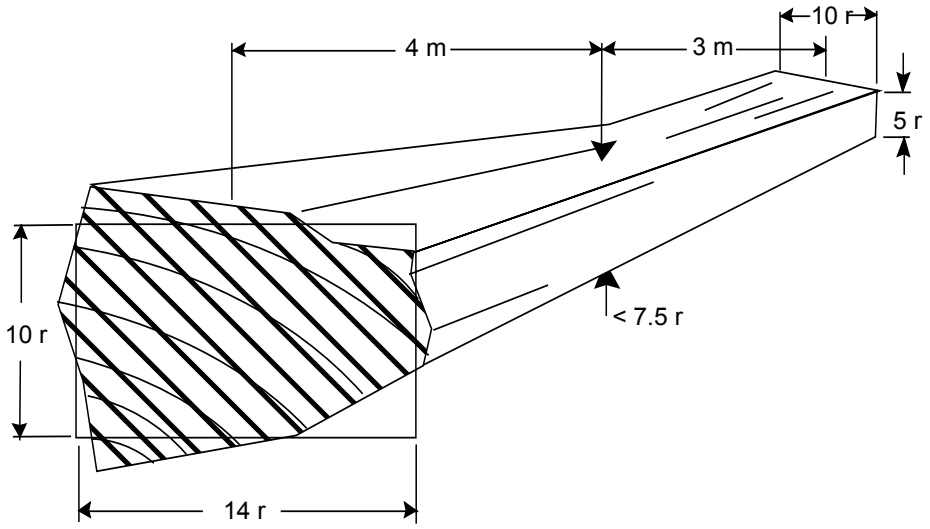
Occasionally, scalers will encounter log ends with two or more defects positioned such that there is less than 5 rads (10 cm) of usable fibre available between the defects. In these situations, simply adding the trim around each defect and calculating the grade reduction would understate the loss in 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 Determining Grade Reduction for Slabs

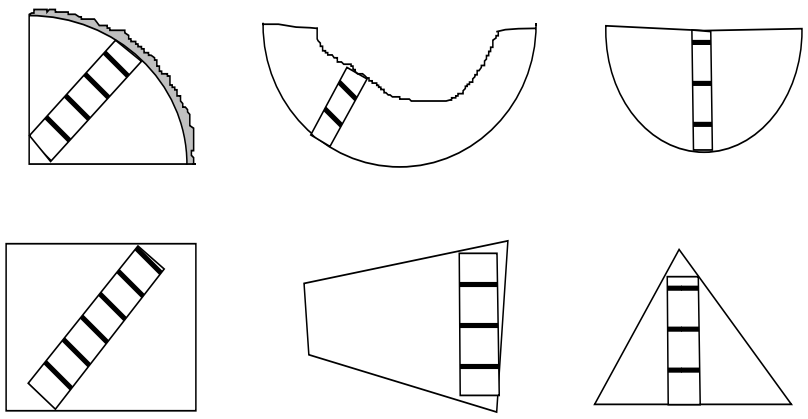
To be considered suitable for manufacture into lumber in the interior grades,, slabs must be at least 7.5 rads (15 cm) thick. For coastal grading, the maximum thickness at right angles to the grain where a 2 rad board can be sawn is used to determine whether a slab qualifies for a particular grade. Grades D, E, F, G, H, I, and K require 19 rads; L requires 13 rads; M and U require 8 rads; X requires 5 rads, and no slabs are allowed in B, C, and J grades.

The specified minimum thicknesses are the actual, unrounded measurements.

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.



2. Maximum thickness is at right angles to the grain (coast).

Figure 6.3 Slabs with portions meeting the grade rule.

The slab in Figure 6.3 was measured for firmwood content according to the method 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:

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

The portion of the slab which is 7.5 rads or greater in thickness runs out 4 m up the slab, so 3 m of the slab is grade reduction.

Grade reduction	=	38 by 3 m	=	114 dm^3
% of slab which can be manufactured	=	$\frac{266-114}{266} x 100$	=	57.1 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 (checks which would remain after slabbing off), 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, twist, 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.

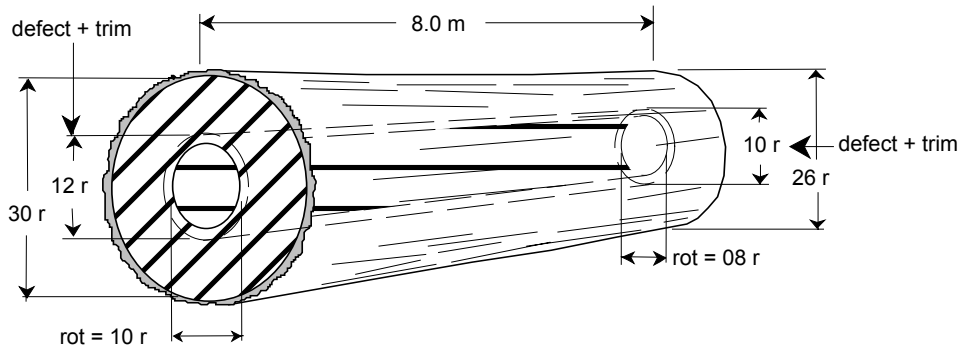
6. Trim allowance is added to both sides of single shakes, deep checks, and fractures. If they are irregular, the total width of the irregularity is determined, and the trim allowance added to it.

7. Star shakes and multiple deep surface checks (checks which would remain after slabbing off) 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.

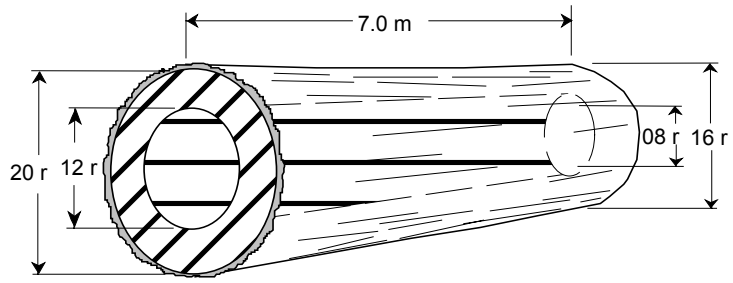
8. Spiral checks are trimmed out in their entirety; the amount of twist in the check is observed or calculated over a given length.

Note:

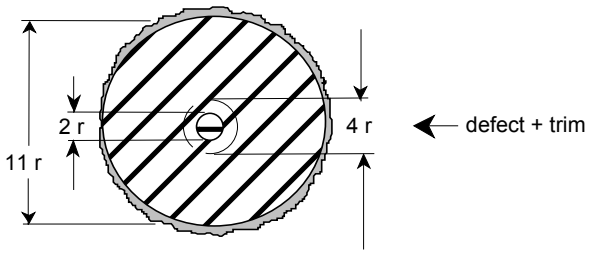
The following figures demonstrate examples of the principles of trim allowance in calculating grade reductions.



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 less 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:

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

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.

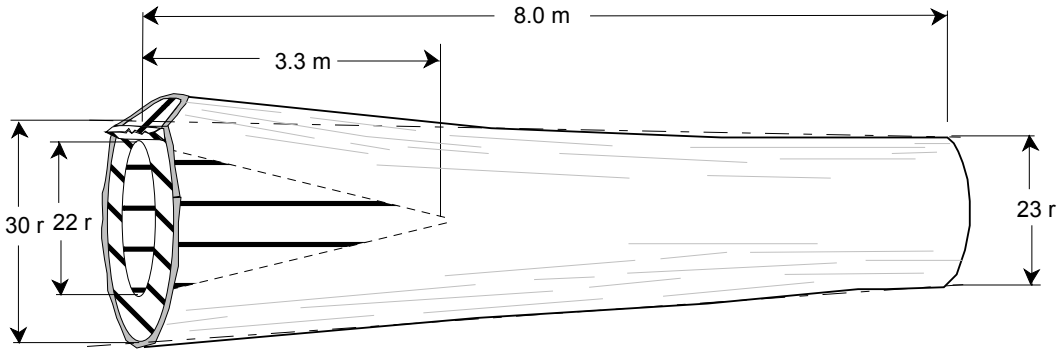
The following calculation is also unnecessary but is given to illustrate the principle of calculating a 100 percent grade reduction.

From the scale stick:

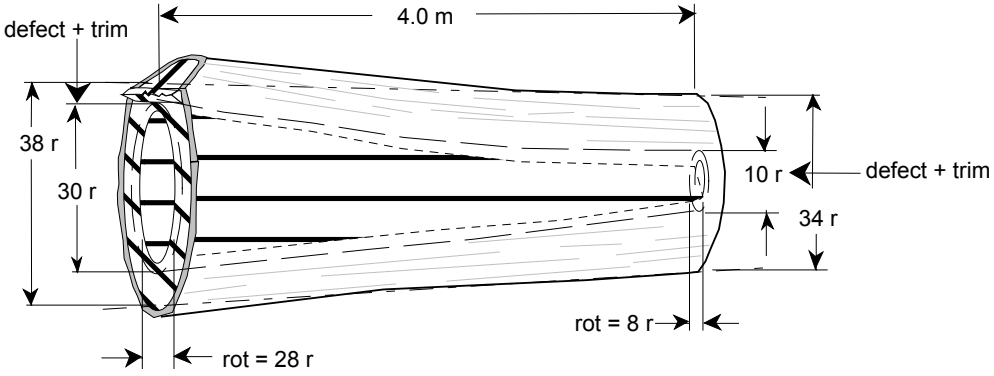
Gross volume	=	7 m/16 r/20 r	=	(281 + 440)	=	721 dm^3
Grade reduction	=	7 m/16 r/20 r	=	(281 + 440)	=	721 dm^3
% of log which can be manufactured	=			$\frac{721-721}{721} \times 100$	=	00.0 %

An exception to the grade rule is the third log and in Figure 6.4. It has a heart defect diameter less than 20 percent of the 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 less than 20 percent of the log 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:

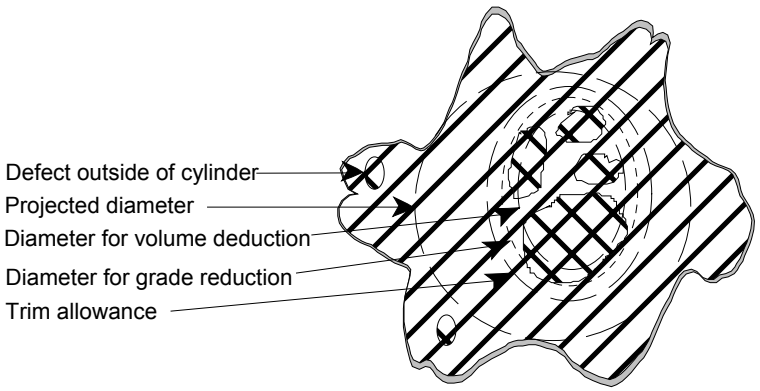
Gross volume per metre (11 r)	=	Unit volume: log	=	38 dm^3		
Grade reduction per metre (04 r)	=	Unit volume: defect	=	5 dm^3		
% of log which can be manufactured	=	$\frac{38-05}{38} \times 100$	=	86.8 percent		



1. An interior log with simple butt rot estimated to penetrate 3.3 metres into the log (22 x 0.15 = 3.3m)



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:

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

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 but 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:

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

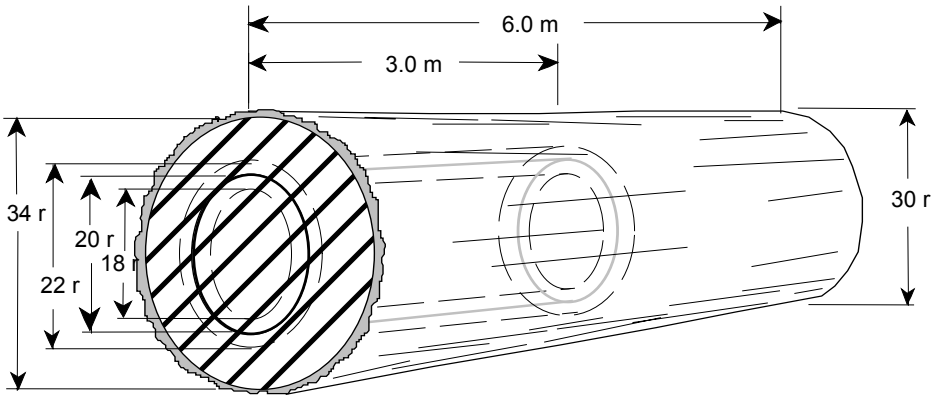
In this example, it is assumed that the collar is thick enough to cut lumber. Where the collar does not meet the minimum thickness, the lineal portion of the log without collar must be included as grade reduction. The collar thickness is determined by actual measurement, *not* as 1/2 the difference between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

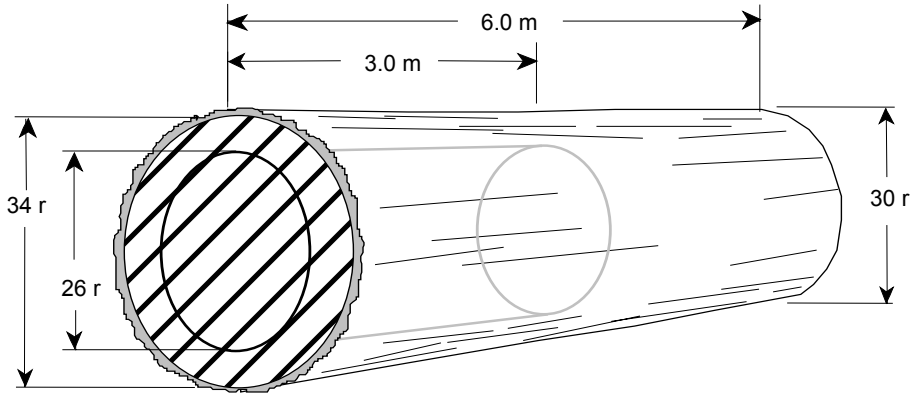
The third example in Figure 6.5 shows scattered butt rot. Irregular or sporadic rot and water shake and those with defect extending into the collar will require a significantly larger initial measurement (before adding trim) than what would be used for a firmwood deduction. The illustration includes 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.

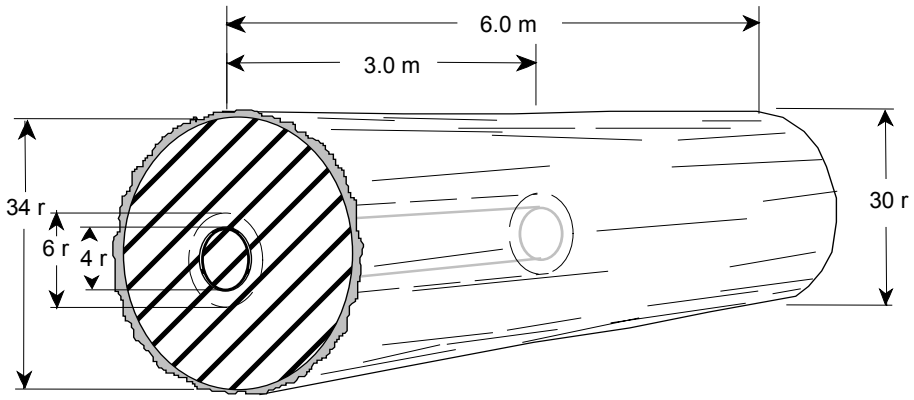
Notes:



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:

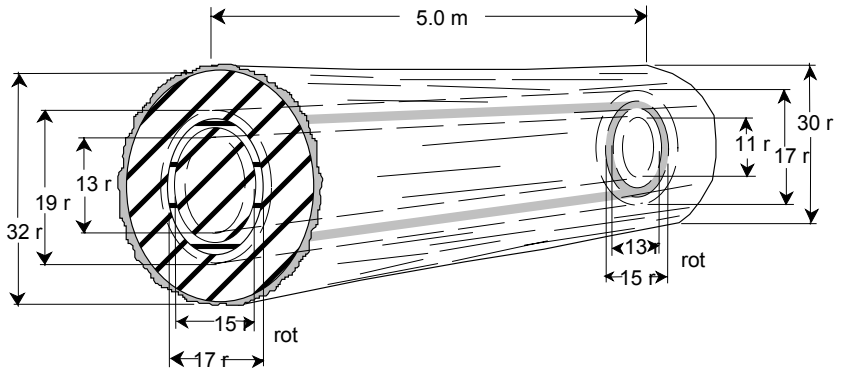
Gross volume	=	6 m/30 r/34 r	=	(848 + 1090)	=	1938 dm^3
Grade reduction	=	UV 22 r - UV 18 r for 3 m	=	(152 - 102) x 3	=	150 dm^3
% of log which can be manufactured			=	$\frac{1938-150}{1938}$ x100	=	92.3 percent

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:

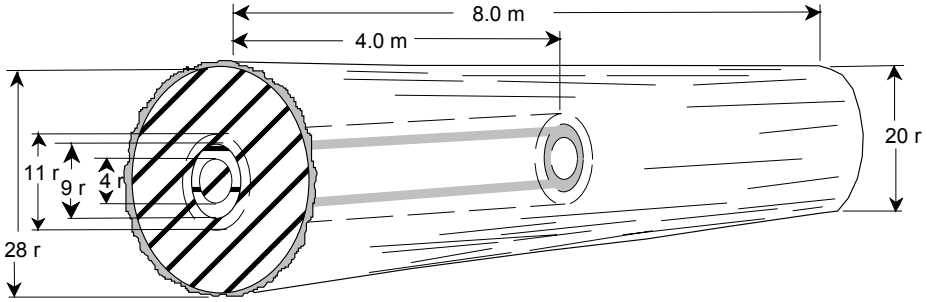
Gross volume	=	6 m/30 r/34 r	=	(848 + 1090)	=	1938 dm^3
Grade reduction	=	UV 34 r - UV 26 r for 3 m	=	(363 - 212) x 3	=	453 dm^3
% of log which can be manufactured			=	$\frac{1938-453}{1938}$ x100	=	76.6 percent

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:

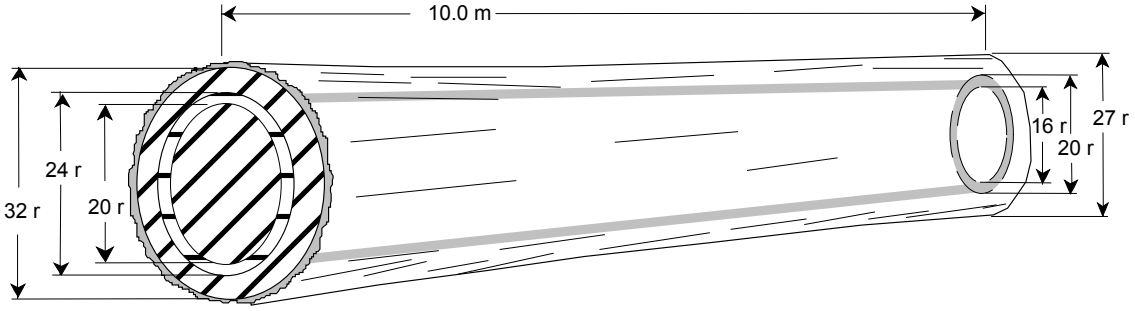
Gross volume	=	6 m/30 r/34 r	=	(848 + 1090)	=	1938 dm^3
Grade reduction	=	3 m/6 r/6 r	=	(17 + 17)	=	34 dm^3
% of log which can be manufactured			=	$\frac{1938-34}{1938}$ x100	=	98.2 percent



1. A log with ring rot where both core and collar meet the grade rules.



2. A log with ring rot where only the collar meets the grade rules.



3. A log with ring rot where only the core meets the grade rules.

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:

Gross volume	=	5 m3/0 r/32 r = (707 + 804)		=	1511 dm^3
Grade reduction	=	Outside cylinder 5 m/17 r/19 r		=	(227 +284) = 511 dm^3
less	=	Inside cylinder 5 m/11 r/13 r		=	(95 + 133) = 228 dm^3
	=	(511 - 228)	=	283 dm^3	

% of log which can be manufactured = $\frac{1511-283}{1511} \times 100$ = 81.3 percent

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:

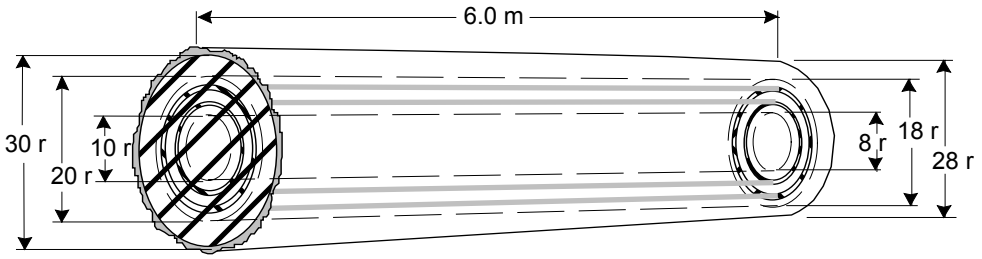
Gross volume	=	8 m/20 r/28 r	=	(503 + 985)	= 1488 dm^3
Grade reduction	=	4 m/11 r/11 r	=	(76 + 76)	= 152 dm^3

% of log which can be manufactured = $\frac{1488-152}{1488} \times 100$ = 89.8%

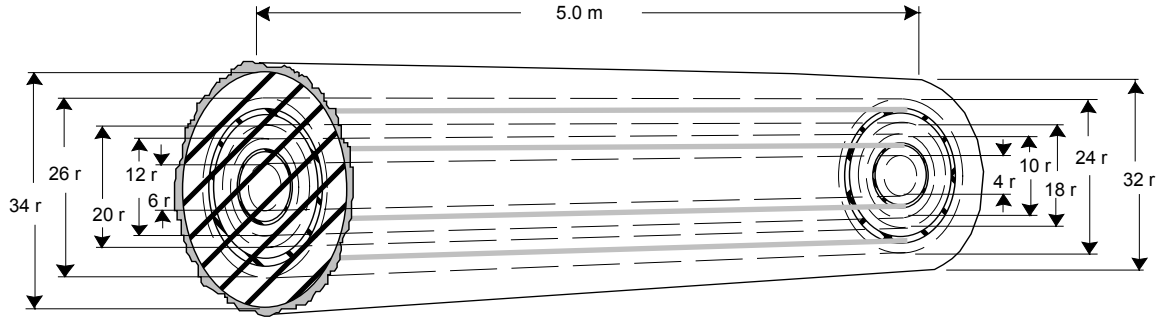
The third example in Figure 6.7 shows a log where the sound collar is less than the minimum thickness required to cut lumber. Trim allowance is not added to either the collar or the core; the entire collar is grade reduction and the entire core is available for manufacture (when it is 5 rads or more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

Gross volume	=	10 m/27 r/32 r	=	(1145 + 1608) =	2753 dm^3
Volume available	=	10 m/16 r/20 r	=	(402 + 628)	= 1030 dm^3
Grade reduction	=	2753 - 1030	=	1723 dm^3	

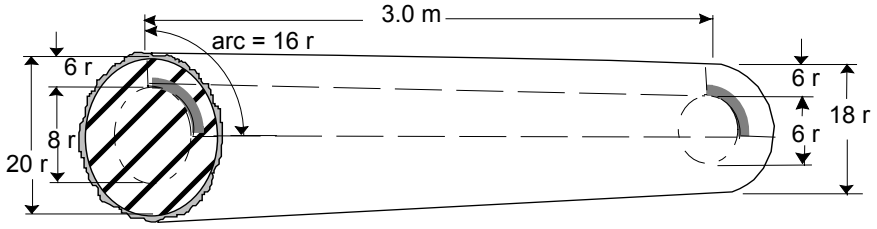
% of log which can be manufactured = $\frac{2753-1723}{2753} \times 100$ = 37.4 percent



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:

Gross volume	=	6 m/28 r/30 r	=	(739 + 848)	=	1587 dm^3
Grade reduction	=	Outside cylinder 6 m/18 r/20 r = (305 + 377) = 682 dm^3				
less	=	Inside cylinder 6 m/08 r/10 r = (60 + 94) = 154 dm^3				
	=	(682 - 154)	=	528 dm^3		
% of log which can be manufactured			=	$\frac{1587-528}{1587}$ x100 = 66.7 percent		

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:

Gross volume	=	5 m/32 r/34 r	=	(804 + 908)	=	1712 dm^3

Outside ring:

Grade reduction	=	Outer cylinder 5 m/24 r/26 r = (452 + 531) = 983 dm^3				
less	=	Inner cylinder 5 m/18 r/20 r = (254 + 314) = 568 dm^3				
	=	(983 - 568)	=	415 dm^3		

Inside ring:

Grade reduction	=	Outer cylinder 5 m/10 r/12 r = (79 + 113) = 192 dm^3				
less	=	Inner cylinder 5 m/04 r/06 r = (13 + 28) = 41 dm^3				
	=	(192 - 41)	=	151 dm^3		
Sum of grade reduction			=	(415 + 151)	=	566 dm^3
% of log which can be manufactured			=	$\frac{1712-566}{1712}$ x100	=	66.9 percent

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:

Radius times π	=	20 *x* 3.14159	=	63 r circumference
Defect arc factor	=	16 r arc ÷ 63	=	1/4 or 0.25 or 25%)

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

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

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

Position from North	=	90 degrees		
Defect arc factor	=	90 divided by 360	=	0.25 or 25%

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:

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

Gross volume = 3 m/18 r/20 r/ = (153 + 188) = 341 dm^3

Grade reduction = UV log (20 r) - UV core (8 r) x factor (.25) x length (1.2)

= (126 - 20) x 0.25 x 1.2 = 106 x 0.25 x 1.2 = 32 dm^3

% of log which can be manufactured = $\frac{341-32}{341} x100$ = 90.6 percent

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:

Gross volume = 5 m/23 r/26 r/ = (415 + 531) = 946 dm^3

Grade reduction = 3 r x 10 r x factor of 0.4 x 2.5 m

= 3 x 10 x 0.4 x 2.5 = 12 x 2.5 = 30 dm^3

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:

Grade reduction = 6/10 dm by 20/10 dm by 25 dm

= 0.6 x 2 x 25 = 30 dm^3

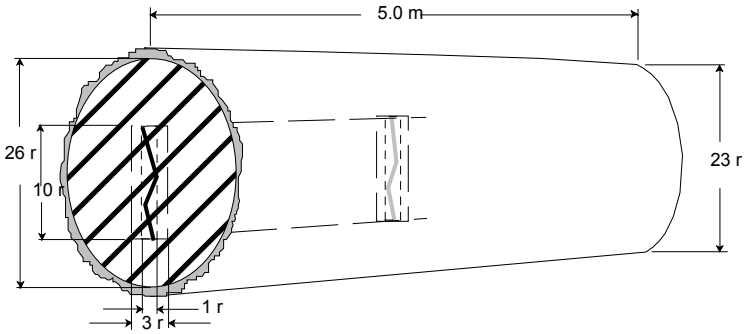
Either method will produce the same results:

% of log which can be manufactured = $\frac{946-30}{946} x100$ = 96.8 percent

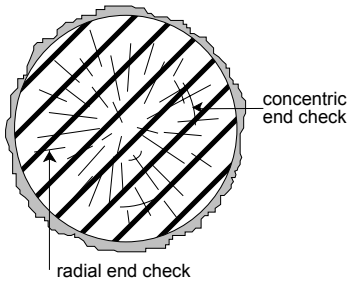
Example 2 in Figure 6.9 shows typical end checking. It is caused by rapid seasoning at the ends of logs after they are bucked green, and normally penetrates only a short distance into the log. It is typified by being numerous, usually following the wood rays (radiating out from the heart, and are not 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:

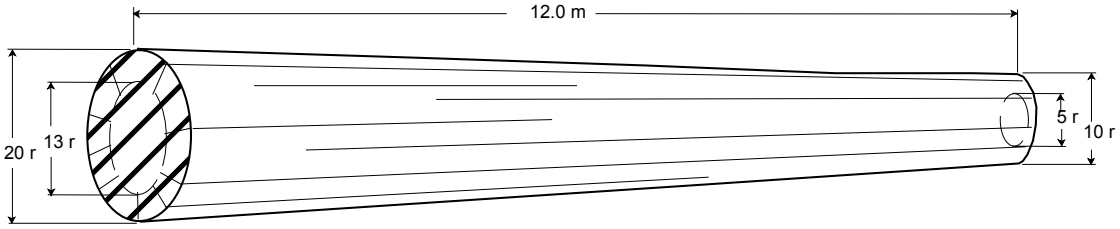
Gross volume	=	12 m/10 r /20 r	=	(188 + 754)	=	942 dm^3
Volume available	=	12 m/5 r/13 r	=	(47 + 319)	=	366 dm^3
Grade reduction	=	942 - 366	=	576 dm^3		
% of log which can be manufactured			=	$\frac{942-576}{942} \times 100$	=	38.8 percent



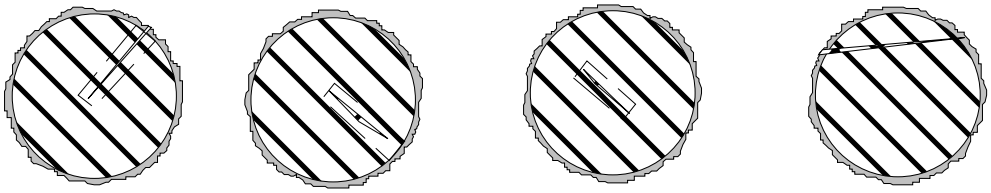
1. a log with an Irregular heart shake



2. End checking

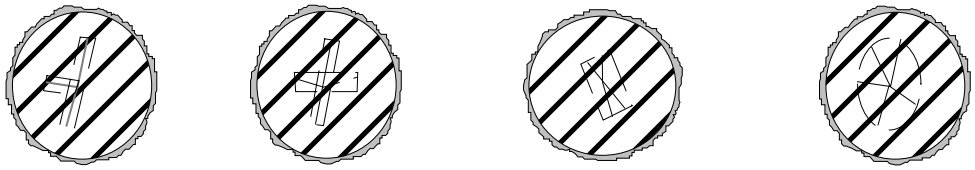


3. A log with extensive outside checking



a. Check runs into heart b. Shake runs into collar c. Shake does not run into collar d. Split bisects collar

4. Trim allowance for check, shake, and split in relation to collars.



a. Shakes meet b. Shakes cross c. Shakes at acute angle d. Star shakes

5. Trim allowance in logs with multiple heart shake

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.

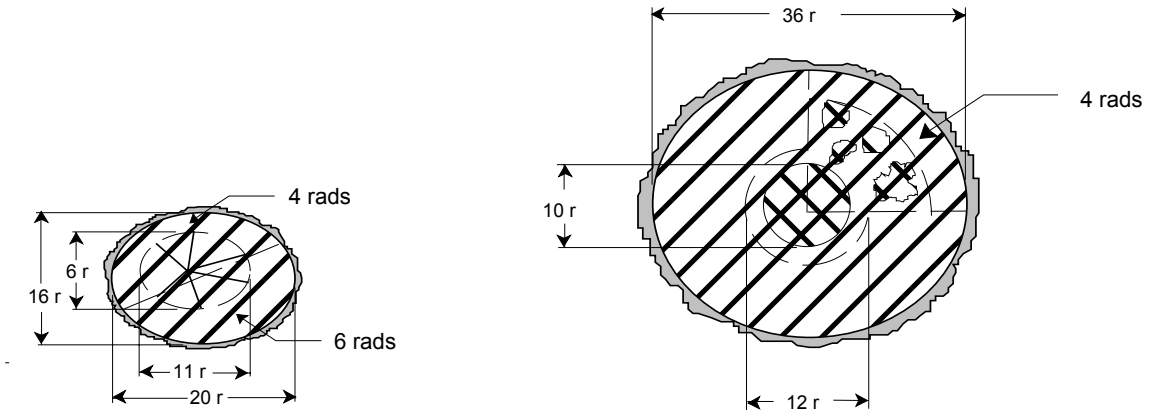
Example 5 in Figure 6.9 shows four log ends with multiple heart shake. It is necessary to apply trim allowance in a manner which best accommodates the forms which the shake takes. Two conventions allow for the full range of heart shakes.

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 end checking 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.



1. Off-centre star shake in fir

2. Heart rot with pocket rot in interior red cedar

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:

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

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

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

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

The second example in Figure 6.10 shows an interior 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:

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

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

Grade reduction	=	362 x 0.25	=	90 dm^3
Total reduction	=	45 + 90	=	135 dm^3

% of log which can be manufactured = $\frac{407-135}{407} x 100$ = 66.8 percent

Notes:

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.

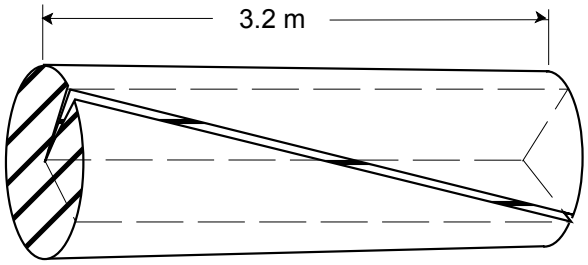
If a spiral surface check does not penetrate all the way into the heart, the grade reduction is of course less than for a full check, and it is important to understand the relationship between the depth of penetration and the effect on volume. For example, a check penetrating half-way to the heart would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

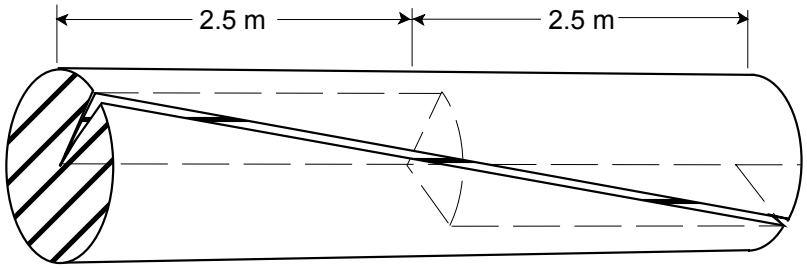
The first log in Figure 6.11 has a uniform spiral check running its full length. Because the log is less than 5 m long, assess the twist on the log length. In field practice, it is only necessary to observe the degree of spiral from one end to the other, and estimating the percentage of the log affected,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

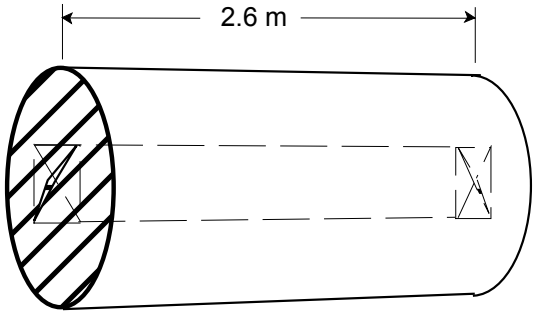
The third log in Figure 6.11 shows a a spiral heart shake. It may be treated similarly to acute or irregular heart shake, as shown in the examples in Figure 6.9, except that trim allowance is not added. That is, the grain deflection is projected to the opposite end of the log, the area affected is enclosed 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 log's actual length which is 5 rads 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.

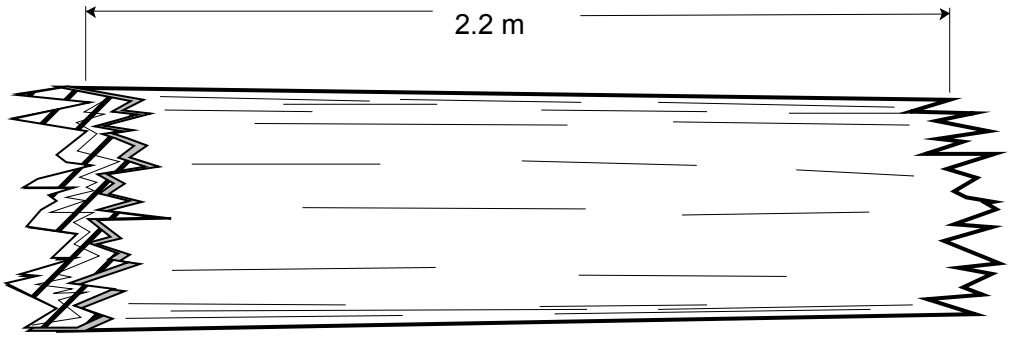
In all instances, breakage is always graded on the basis of its actual length (breakage is defined as any piece, meeting the minimum diameter of the cutting authority, which is shorter than 2.5 m in length and broken at the large end or at both ends).

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

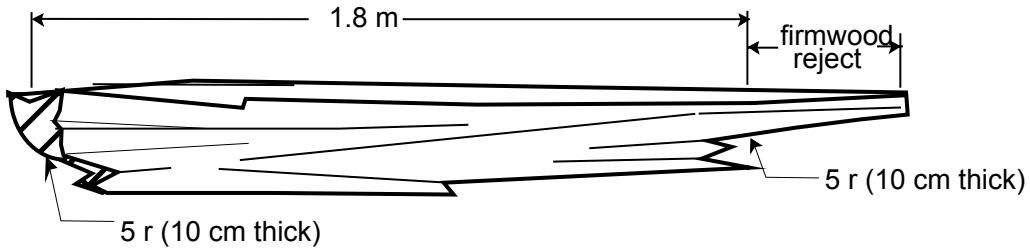
In general, deemed lengths are used in scaling short pieces for two purposes:

- they help to ensure that scaling is consistent with the utilization policy, 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.

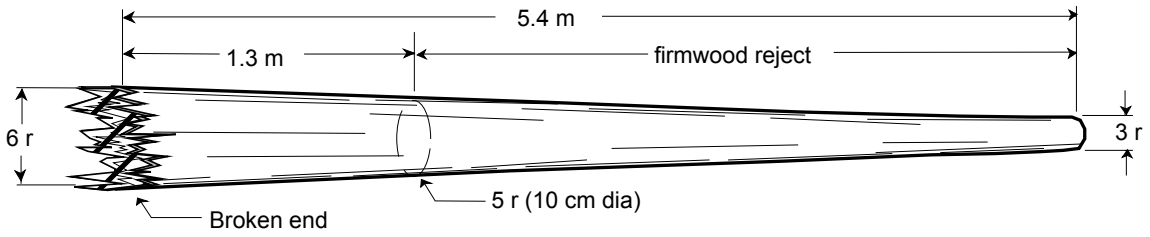


2. Slab with sharp ends cleaned up.

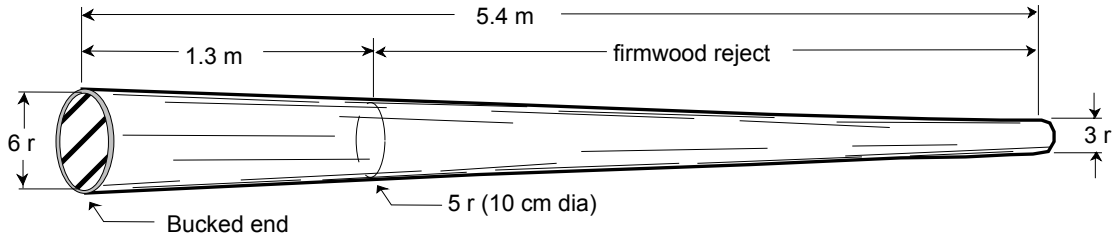
Figure 6.12 Short breakage pieces contained in a conventional load.

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 subsequent to delivery, however, they would be deemed to be 2.5 m (interior), and 5.2 m (coast) for the purpose of grading, excluding the firmwood reject portions.

In breakage, log ends may or may not be "cleaned up" when they arrive at a scale site. It is shown in the second example, 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.

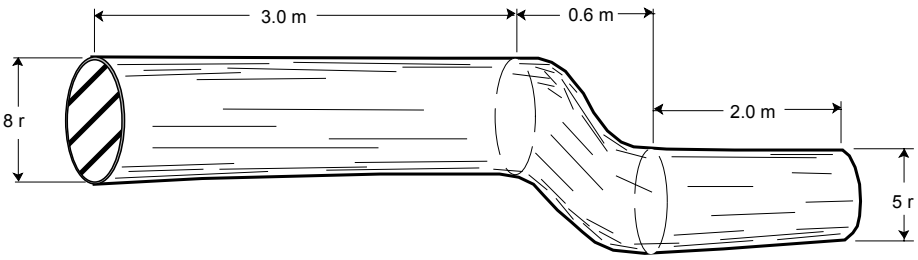


2. The 1.3 m portion of this log is deemed to be 2.5 m long.

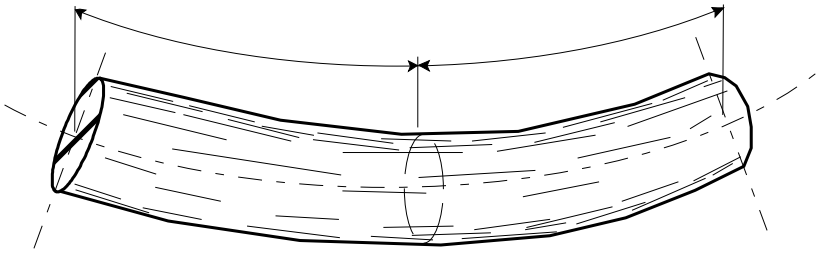
Figure 6.13 Rat tail tops delivered with a short segment over the 10 cm utilization policy.

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 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 in diameter.

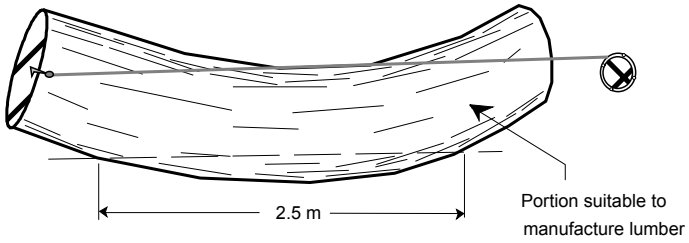
Notes:



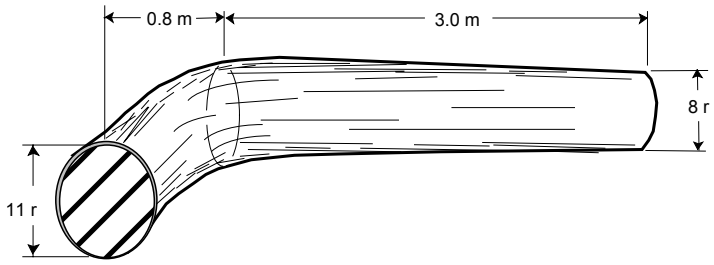
1. Visually bucking a log with crook to assess lumber recovery..



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



3. Using a tape to evaluate sweep in logs < 5 m.



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

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.

The second log in Figure 6.14 has severe sweep which is *uniform throughout* the length of the log. If a log can be bucked into two or more lengths before milling, the lumber loss caused by the sweep can be greatly reduced, and scalers should assess the grade reduction accordingly: the scaler visualizes the log being milled after bucking in order to assess the grade reduction for the sweep. Depending on the length of the log, two situations can occur:

1. If this log were 5 m long or more, visually bucking the log at its mid-point would produce two logs of adequate length and reduced sweep which would be suitable to produce lumber. Therefore milling losses are minimized.

2. If this log were less than 5 m long, visually bucking the log at its mid-point would produce two logs which are now too short to produce lumber even though each section has reduced sweep. Visually bucking at any other point would produce one log with too much sweep and one log which is too short. Therefore milling losses are not minimized and the log is assessed for loss over its full length.

The pistol grip in the third 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.

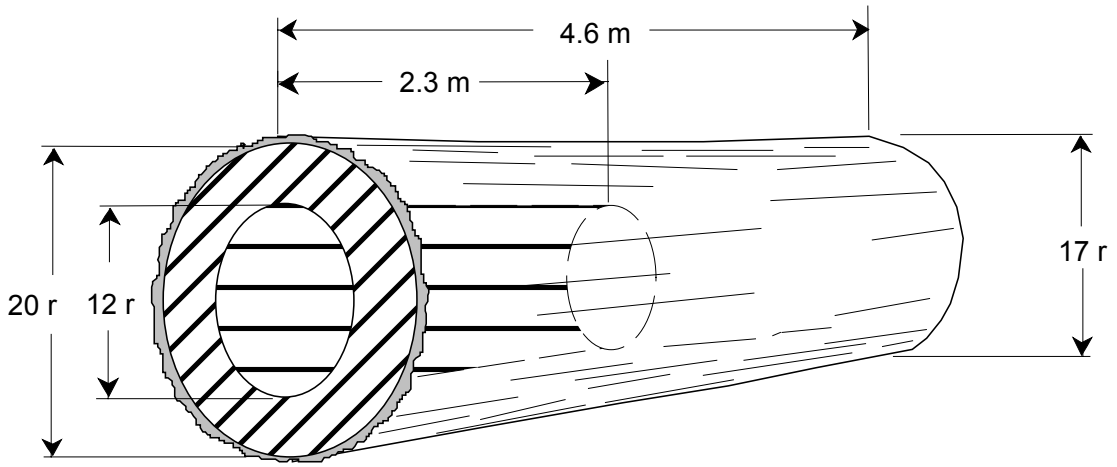


Figure 6.15 Assessing grade in log with severe heart rot and residual length is too short to cut lumber.

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:

Gross volume = 17 r/20 r/4.6 m = (209 + 289) = 498 dm^3

Grade reduction = 12 r/12 r/2.3 m = (52 + 52) = 104 dm^3

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

Grade reduction = UV 20 r - UV 12 r x 2.3 m = (126 - 45) x 2.3

= 81 x 2.3 = 186 dm^3

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

Grade reduction = UV 17 r x 2.3 m = (91 x 2.3) = 209 dm^3

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

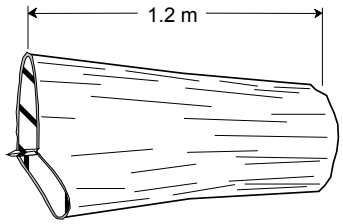
Total Grade reduction = 104 + 186 + 209 = 499 dm^3

(Rounding conventions and log taper result in a total grade reduction of 1 dm^3 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).

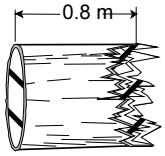
$$\% \text{ of log which can be manufactured} = \frac{498 - 498}{498} \times 100 = 0 \text{ percent}$$

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.

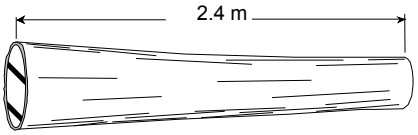


1. Flared butt trimmed off.

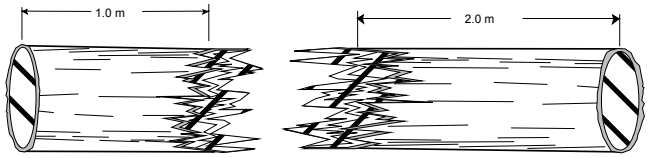


2. Broken end trimmed off.

3. Biscuits and trim ends.



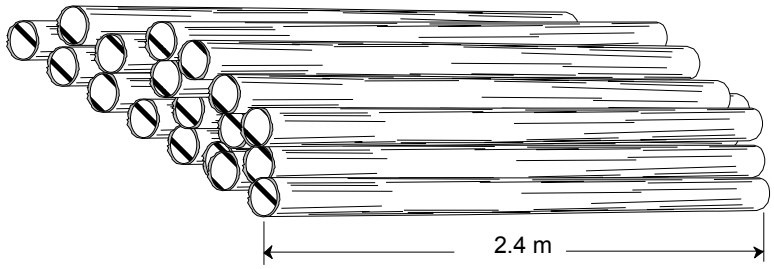
4. bucked to length shorter than 2.5 m.



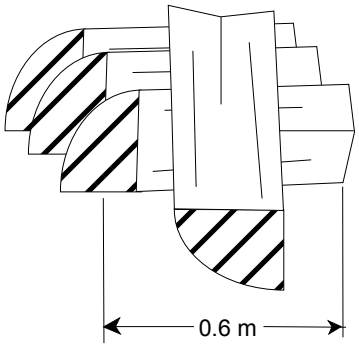
5. Broken in handling at the scale site.

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).

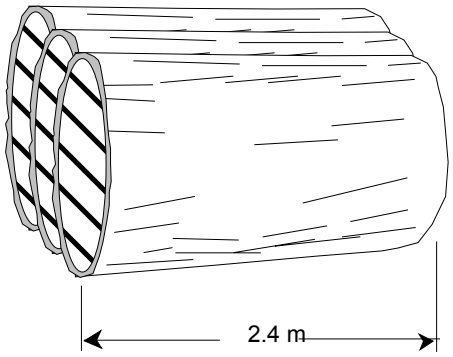
Where unscaled timber is bucked and delivered to a scale site or bucked at the scale site for the purpose of manufacturing special forest products prior to scaling, the timber is to be scaled and graded as logs unless it has been classified as a special forest product. The classification and scaling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



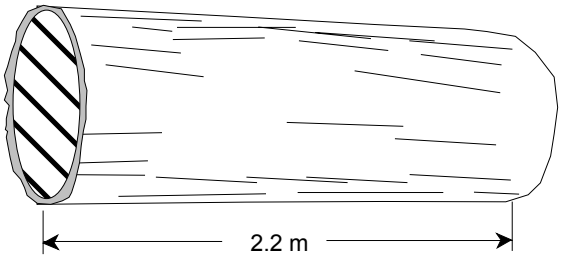
1. Fence posts



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 in the NLGA Lumber Grade Rules 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 2 rads (4 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.

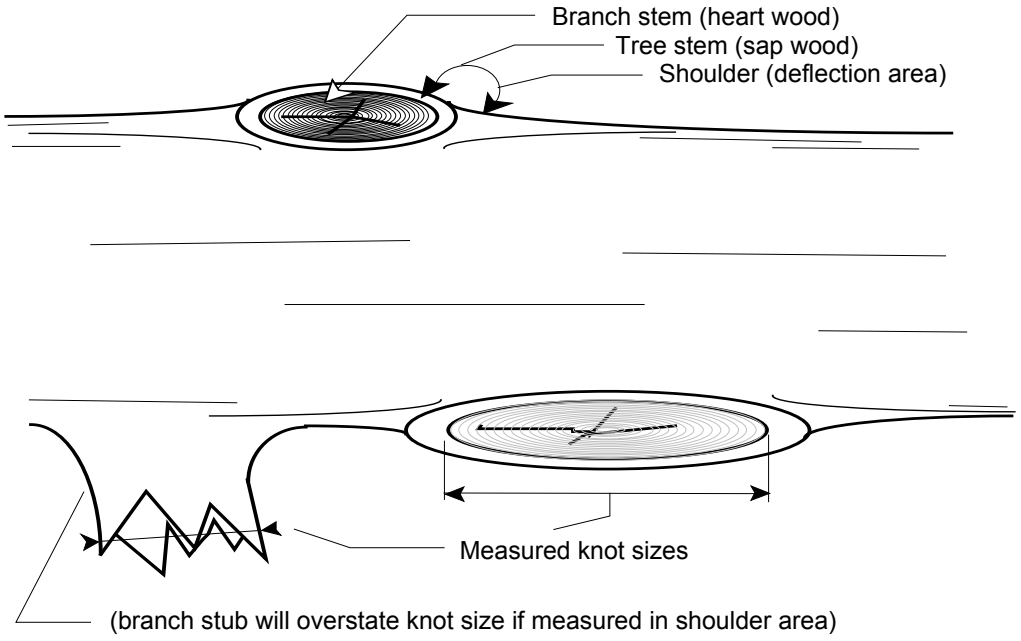


Figure 6.18 Measuring knot diameters.

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.

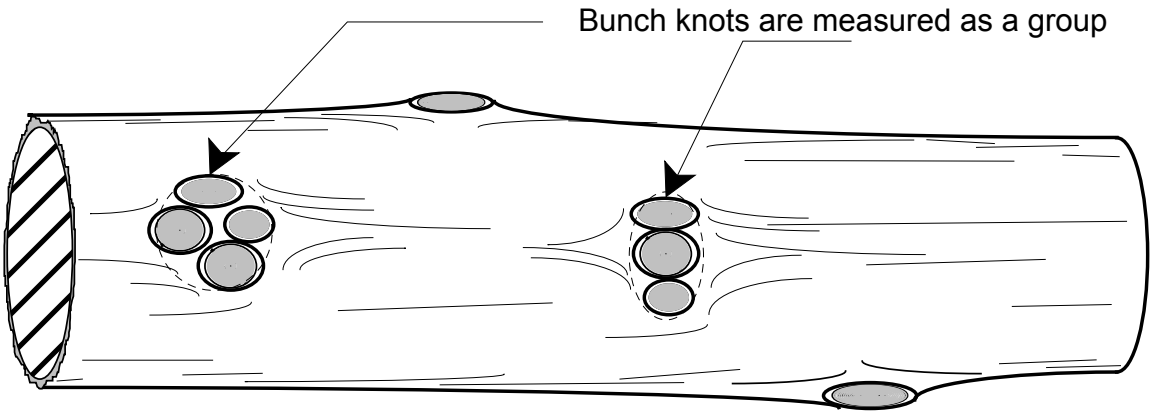
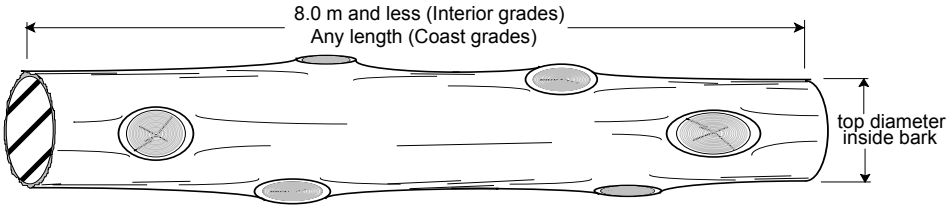


Figure 6.19 Measuring bunch (cluster) knots.

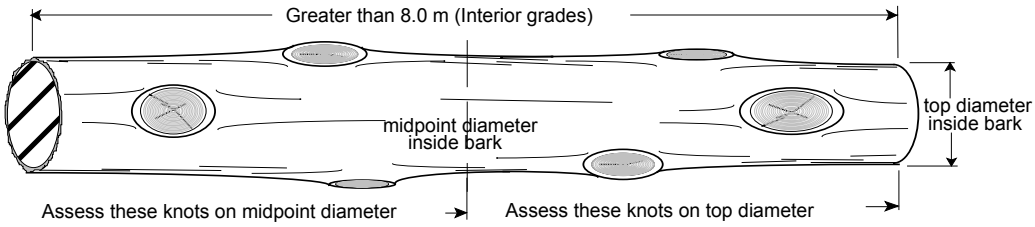
Knots which indicate the presence of conk or other stem rots should also be used in terms of their potential to indicate the extent of heart rot, rather than simply in terms of lowering lumber quality. For example, even though a knot may be under the maximum allowable size but is rotten, there is a good 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 the large majority of 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,
- the same averaging rules are used for measuring knots as for measuring log diameters as described in Chapter 5,
- for interior logs up to and including 8 m in length and for all coastal logs, knots are assessed against the top diameter of the log (Figure 6.20),
- 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 possible to cut merchantable lumber from between them. In general, one oversized knot is permitted every 3 m, 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 metre 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 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.

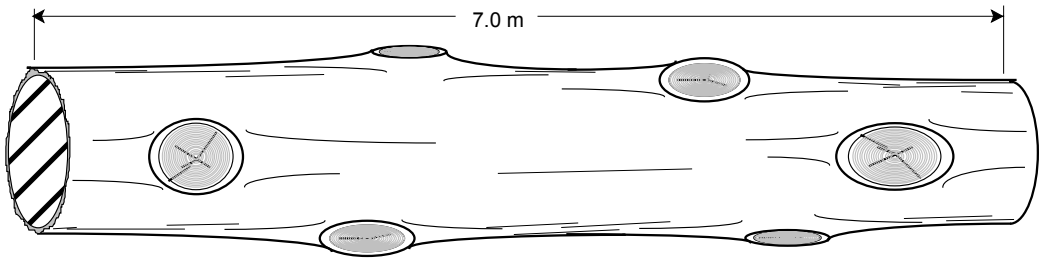
The first log in Figure 6.21 has its oversize knots distributed over the entire length of the log. Because there is no portion of the log which allows 2.5 m lumber, the log is a 100 percent grade reduction.

The second log has oversize knots concentrated near the top of the log. After the scaler notes that 3 m of the log is 100 percent grade reduction, 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.

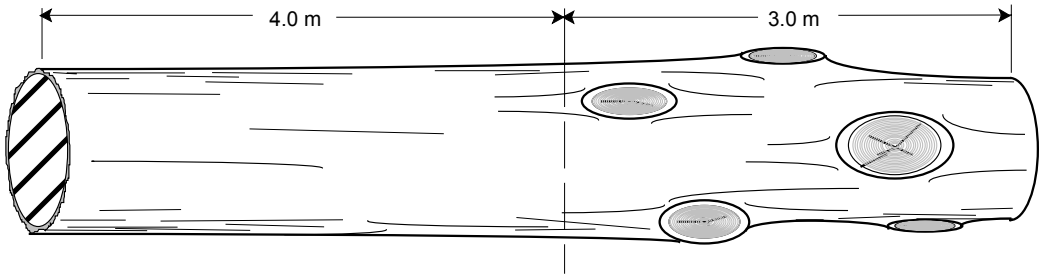
The third log has its oversize knots concentrated along one side. Almost half of the log is 100 percent grade reduction because of this, but more than half is not affected at all by knots. Therefore, the impact on the quality of the whole log is estimated to be about 45 percent of its volume. However, size is also a factor in the assessment; a 30 rad log may be broken down into quarters to maximize merchantability, where a 5 rad log cannot even be halved.

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

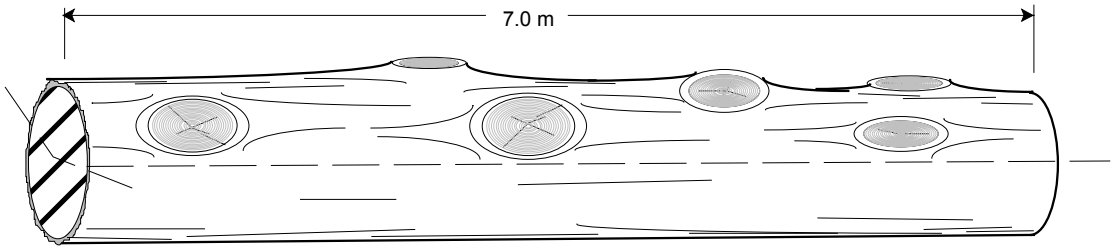
Finally, in any situation where knots and other defects are confined to 1/2 of the length of a log in such a way that a 100 percent grade reduction is identified in that half, it does not mean that 50 percent of the log is grade reduction, because the volume of down graded half must be determined and compared to the volume of the normal half. That is, if the top half of a log is 100 percent grade reduction, then it probably reduces the grade of the log by less than 50 percent. If the butt half of the log is grade reduction, then it probably reduces the grade of the log by more than 50 percent.



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 30 cm (15 rad) section of log length where it is representative of the average for the log. The amount of twist permitted for a particular grade is expressed as a percentage of the diameter of the log according to the rule for a particular grade (see Figure 6.22).

For coastal grading, the diameter of the log is always the top diameter. In addition to a maximum percentage, a maximum twist measurement is also prescribed for each grade which has twist specifications.

For interior grading, the log diameter used is the top diameter for logs up to and including 8 m, and the measured mid-point diameter for logs which are over 8 m in length.

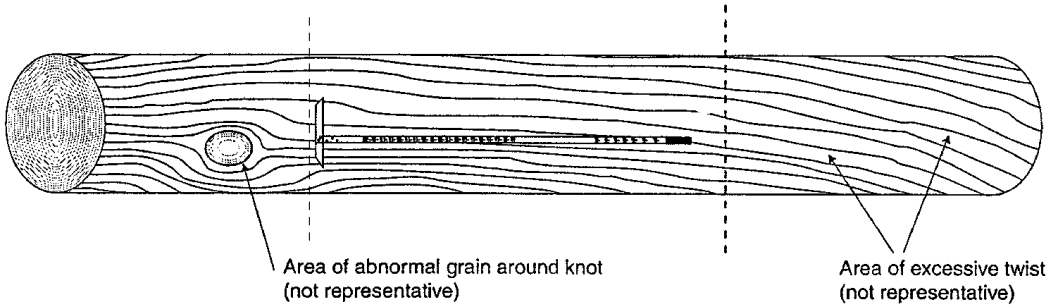
The interior grades also specify a maximum twist measurement within the prescribed percentage and, unlike the coast, a minimum measurement of 4 cm (2 rads). Twist which is over the prescribed percentage does not lower the grade unless it is over the prescribed minimum of 2 rads.

Twist must be measured where it is representative of the average for the log, given what the scaler can see. Assumptions may not be made about portions of the log which are not visible.

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.

The following two figures demonstrate the concept of measuring the average twist, and how the scale stick is used for measuring twist.

Specific twist requirements by grade can be found in Section 6.5 (coast) and Section 6.6 (interior).



Twist is measured where representative of the average

Figure 6.22 Measuring twist - placing the stick.

As shown in Figure 6.22, orient the scale stick parallel with log's central axis on an area where the grain deflection is representative of the log as a whole. In this example the scaler has taken care to place the stick parallel to the log's central axis. The tine, however, used in measuring the twist is too close to the abnormal grain deflection around the knot and is at one end of the log.

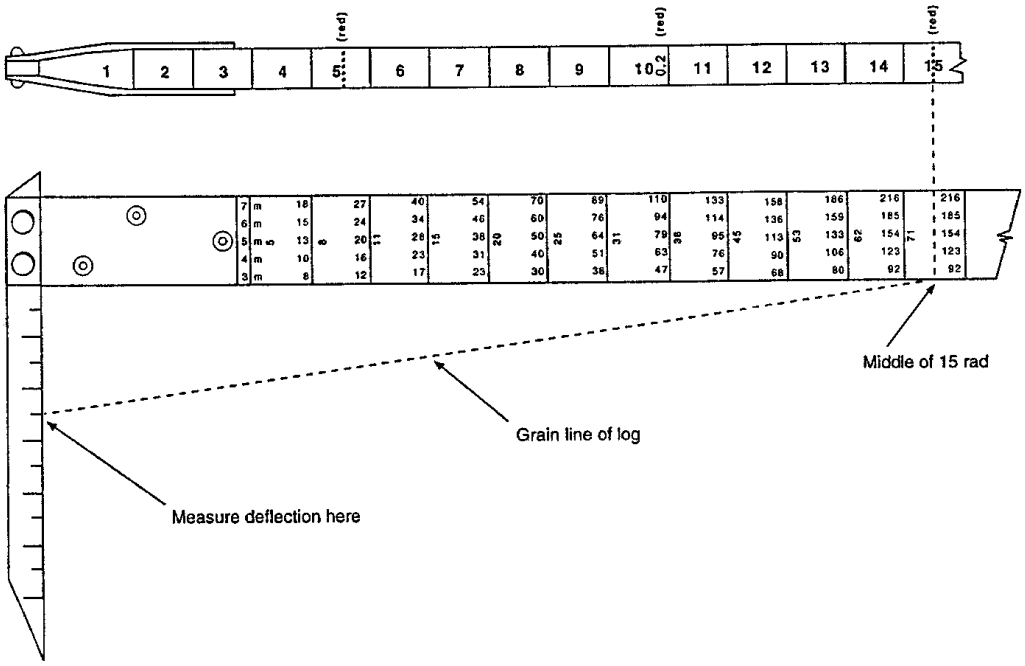


Figure 6.23 Measuring twist - reading the deflection.

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 simplify measurements.

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 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.

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.

6.4.4 Factors Unique to Interior Grading

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

- was the log cut from a tree which was dead when it was harvested, and
- was the log cut from a tree which was undersized for the purposes of utilization.

Interior grading rules must account for these factors for administration of cut control and the utilization policy.

6.4.4.1 Dead/Dry Log Status

Administration of the annual allowable cut (AAC) in the interior requires interior scalers to identify logs cut from trees which were dead and dry when harvested. Unlike the cruiser who identifies dead trees largely by looking at the tree's foliage, the scaler's job is more complex and requires experience and good judgement.

Identifying logs cut from trees which were dead and dry when harvested is not confined to simply looking at one characteristic. Rather, scalers must look for a number of characteristics known as indicators which indicate the tree may have been dead and dry when harvested. Scalers must also look for characteristics known as contraindicators which indicate the tree was green or living when harvested.

6.4.4.1.1 Indicators

To be classified as dead/dry a log must have at least one indicator to indicate it was cut from a tree which was dead when harvested. Indicators include:

- deteriorated cambium,
- loose or shedding bark,
- sap rot (encircling log end),
- wood borers, or
- deep checks (not weather checks).

6.4.4.1.2 Contraindicators

Contraindicators are log characteristics which indicate a log was cut from a living tree. Logs showing any contraindicators are deemed to be cut from a living tree.

Green logs which have not been scaled soon after harvesting, often display bark that has curled away from the wood as a result of rapid drying of the inner layer of bark.

Green logs, when stored in decks for extended periods, often display darkened and weathered ends. Such logs often show evidence of mould and/or mildew on exposed wood surfaces.

Some species, notably pines, are resinous and continue to exude pitch for some time after harvesting. As such, pitchy log ends are a contraindicator and indicate the log was cut from a live, green tree. However, fir and larch will exude pitch long after they are dead; therefore, pitchy log ends are not a reliable contraindicator in these species.

If branches with green foliage are attached to a log, the log must be assumed to have been cut from a tree which was living when harvested.

Logs cannot be classified as dead/dry if they display any of the following characteristics:

- curling bark,
- green needles,
- fresh cambium (sticky),
- mildew or mould on wood surface (except on windthrow),
- dark weathered ends (indicative of decked timber),
- pitching log ends, or
- logs carrying living bark beetles.

> Mortality in trees is often a gradual process and, as such, logs may display both indicators and contraindicators. In all cases, logs displaying both indicators and contraindicators are deemed to be cut from a living tree.

Two other principles apply:

- 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 from living trees, and
- logs displaying fire damage must be graded using indicators and contraindicators, and not automatically considered to be cut from trees which were dead when harvested.

Specific details of the interior dead/dry grades (grade codes 3 and 5) can be found in Sections 6.6.4 and 6.6.6.

6.4.4.2 Identifying Undersized Logs in the Interior

Cutting specifications in interior cutting authorities make reference to the diameter outside bark at stump height (DSH). This diameter is important as it determines whether or not the tree has to be utilized.

> When scaling interior timber, scalers must assign an undersized grade to logs which are cut from trees which are smaller than the diameter at stump height specified in the cutting authority.

The DSH is measured outside the bark at a point 30 cm (15 rads) above the highest ground at the base of the tree. Since scalers do not see the stump, but only the butt log cut from it, the DSH is measured outside the bark at a point 15 cm (7.5 rads) from the butt end on candidate logs.

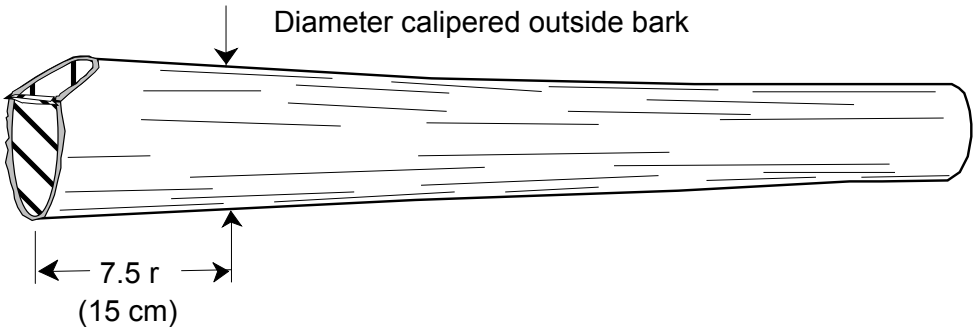
To be considered for the undersized grade:

- a log must show sufficient evidence such as an undercut, butt flare, or other bark characteristics to indicate it comprises a tree and not a top cut or long butt from a larger tree, and
- the outside bark measurement at a point 15 cm from the butt face, must be less than the minimum diameter at stump height specified in the cutting authority.

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

The minimum DSH is set by the *Provincial Utilization Policy* at 15 cm (7.5 rads) for lodgepole pine, and 20 cm (10 rads) for all other species. More stringent utilization requirements may be set under the cutting authority. Utilization standards on the coast do not refer to the DSH. As such, the coast schedule of grades does not have an undersized log grade.

> Where timber is cut on an area where cutting specifications are not in place, scalers are to assume a DSH of 15 cm (7.5 rads) for lodgepole pine and 20 cm (10 rads) for all other species.



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

The Schedule of Coast Timber Grades applies to all timber harvested in the Vancouver Forest Region and the North Coast Forest District, regardless of where it is actually scaled.

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

The radius or diameter of a log affects its potential for the production of manufactured products in several ways. Other factors being equal, larger diameter logs will produce more lumber per cubic meter of log volume, produce a higher percentage of "clear" products and produce larger dimension lumber than smaller diameter logs. Diameter is also one of the factors that dictate the most advantageous end product use of logs, or whether material is classified as commercially useless (firmwood reject).

Consequently, all the coastal log grades have diameter specifications. In the official grade rules these are stated as centimetres of radius, which is the same as radius class or "rads" of diameter.

That dimension is the gross rounded top diameter, before any deductions are made. Therefore, a log with a top diameter which rounds up to the minimum for a grade qualifies for that grade. Diameter deductions may not be made to disqualify a log from meeting a minimum diameter for a grade, or to qualify a log for the maximum diameter for the J grade. This applies to all defects, including sap rot, for all species.

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.

In the sawlog grades, where knots are out of round, knot size is determined by averaging the maximum and minimum measurements. Peeler grades use the maximum measurement for out of round knots. 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 1/3 of the radius (or 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.

6.5.2.3.5 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 of fir, pine and spruce do not allow borings other than those of the ambrosia beetle to penetrate beyond the sap wood.

The ambrosia beetle attacks felled timer, 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 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.

6.5.2.4 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, powder worm and over-size 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 in Section 6.5.1.1 under the Log Requirements to Make the Grade.

6.5.2.5 Slabs

Slabs are not permitted in 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 Definition of Descriptive Terms Used in Section 6.5

6.5.3.1 Clear

Clear means 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.

6.5.3.2 Gross Scale

Gross Scale means the volume of a log inside bark and includes unsound wood and holes in the log.

6.5.3.3 Merchantable

Merchantable with respect to lumber means good, strong, general purpose lumber graded as better than utility or number 3, and not less than 2.5 m long.

6.5.3.4 Shop grade

Shop grade refers to clear lumber at least 2.5 m long, which is cut out from between large knots.

6.5.3.5 Lumber

Lumber must be 2.5 m long and free of rot and fractures.

6.5.3.6 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.

6.5.3.7 Shingles

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..

6.5.3.8 Upper

Upper means closest to the small end , or top end, of a log.

6.5.3.9 List of Permissible Defects

In the following sections, the end of each "Requirements to Make the Grade" are listed permissible defects. The defects indicated 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.

6.5.3.10 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.

6.5.3.11 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.

6.5.3.12 Otherwise Grade

Means a log meets all the requirements of the "otherwise" grade, including being free of non-permissible defects, but has more grade reduction than the "otherwise" grade allows.

6.5.3.13 Ring Shake

Ring shake is a separation of the wood following the circumference, or part of the circumference, of an annular ring.

6.5.3.14 Pitch Ring (or Silt Shake)

Pitch ring is an accumulation of pitch or resin fully or partially around the circumference of an annual ring, where there is no visible wood separation.

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.

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.

6.5.3.15 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.

6.5.3.16 Knot Indication

A knot indication is 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.

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 for smaller diameter logs. 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.

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.

6.5.3.17 Butt Log (or First Cut Log)

This refers to the first log cut from the bottom of the tree.

6.5.3.18 Second Cut Log

This refers to logs cut after the butt log.

6.5.4 Coast Grade Rules and Requirements

6.5.4.1 Firmwood Reject - all species - Grade Code Z (weight scale species 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 are not identified by species, and the letter R is used in place of the species code.

6.5.4.2 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).

6.5.4.3 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.

6.5.4.4 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.

6.5.4.5 No 1 Lumber Balsam and Hemlock, Grade Code D

6.5.4.5.1 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.

6.5.4.5.2 Log Requirements to Make the Grade

1. No conk, or conk 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 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.

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

6.5.4.6.1 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.

6.5.4.6.2 Log Requirements to Make the Grade

1. No conk, or conk 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 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.

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

6.5.4.7.1 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.

6.5.4.7.2 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. Ambrosia, burls, 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.

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

6.5.4.8.1 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.

6.5.4.8.2 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. Burls, 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.

6.5.4.9 No. 4 Sawlog Balsam and Hemlock, Grade Code J

6.5.4.9.1 Grade Rule

A log 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.

6.5.4.9.2 Log Requirements to Make the Grade

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

Log radius	Knot size diameter
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. Burls, 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.

6.5.4.10 No. 5 Utility Balsam and Hemlock, Grade Code U

6.5.4.10.1 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.

6.5.4.10.2 Log Requirements to Make the Grade

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

Log radius	Knot size diameter
5 - 7 cm	4 cm
8 - 13 cm	6 cm
14 - 18 cm	8 cm
19 - 24 cm	10 cm
25 - 37 cm	12 cm
38 + cm	14 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 the other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.4.11 No. 6 Utility Balsam and Hemlock, Grade Code X

6.5.4.11.1 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.

6.5.4.11.2 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 + cm	14 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. Ambrosia, 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.

6.5.4.12 No. 7 Chipper Balsam and Hemlock, Grade Code Y

6.5.4.12.1 Grade Rule

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

6.5.5 Cedar Grades

These grades apply only to red cedar.

6.5.6 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.

6.5.6.1 No. 1 Lumber Cedar, Grade Code D

6.5.6.1.1 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 2/3 percent of the gross scale can be manufactured into merchantable lumber and at least 50 percent of that lumber will be clear.

6.5.6.1.2 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 2/3 percent of the visible surface clear with knots or knot indications permitted on the upper 33 1/3 percent of two sides or the upper 66 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.

6.5.6.2 No. 2 Lumber Cedar, Grade Code F

6.5.6.2.1 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.

6.5.6.2.2 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 2/3 percent of the visible surface clear with knots or knot indications permitted on the upper 33 1/3 percent of two sides or the upper 66 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.

6.5.7 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.

6.5.7.1 No. 2 Sawlog Cedar, Grade Code H

6.5.7.1.1 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.

6.5.7.1.2 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.

6.5.7.2 No. 3 Sawlog Cedar, Grade Code I

6.5.7.2.1 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.

6.5.7.2.2 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. Ambrosia, burls, butt rot, catface, checks, crook, dryside, 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.

6.5.7.3 No. 4 Sawlog Cedar, Grade Code J

6.5.7.3.1 Grade Rule

A log 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.

6.5.7.3.2 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
8 - 13 cm	6 cm
14 - 18 cm	8 cm

2. Maximum twist permitted over 30 cm of length is 10 percent of the diameter.

3. Burls, butt rot, catface, checks, crook, dry side, 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.

6.5.7.4 Shingle Grades

Shingle grade logs will have fewer but possible larger knots than sawlogs, so spaced to permit the production of shingle blocks. Shingle logs are generally not best initialized 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 rads which become K's if they have less than 75 percent suitable for lumber.

6.5.7.5 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 over 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.

6.5.7.6 No. 1 Shingle Cedar, Grade Code K

6.5.7.6.1 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.

6.5.7.6.2 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 2/3 percent of the visible surface clear with knots or knot indications permitted on the upper 33 1/3 percent of two sides or the upper 66 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.

6.5.7.7 No. 2 Shingle Cedar, Grade Code L

6.5.7.7.1 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.

6.5.7.7.2 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.

6.5.7.8 No. 3 Shingle Cedar, Grade Code M

6.5.7.8.1 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.

6.5.7.8.2 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.

6.5.7.9 No. 5 Utility Cedar, Grade Code U

6.5.7.9.1 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.

6.5.7.9.2 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 + cm	14 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, 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.

6.5.7.10 No. 6 Utility Cedar, Grade Code X

6.5.7.10.1 Grade Rule

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

6.5.7.10.2 Log Requirements to Make the Grade

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

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

6.5.7.11 No. 7 Chipper Cedar, Grade Code Y

6.5.7.11.1 Grade Rule

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

6.5.8 Cypress Grades

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

6.5.8.1 No. 1 Lumber Cypress, Grade Code D

6.5.8.1.1 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.

6.5.8.1.2 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 2/3 percent of the visible surface clear with knots or knot indications permitted on the upper 33 1/3 percent of two sides or the upper 66 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.

6.5.8.2 No. 2 Lumber Cypress, Grade Code F

6.5.8.2.1 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.

6.5.8.2.2 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.

6.5.8.3 No. 2 Sawlog Cypress, Grade Code H

6.5.8.3.1 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.

6.5.8.3.2 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. Burls, butt rot, catface, checks, frost checks, heart rot, oversized knots, pocket rot, ring rot, sap rot, shatter, splits, stain, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.4 No. 3 Sawlog Cypress, Grade Code I

6.5.8.4.1 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.

6.5.8.4.2 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. Burls, butt rot, catface, checks, crook, dry side, frost checks, heart rot, insect holes, loose knots, oversized knots, pocket rot, ring rot, rotten knots, 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.

6.5.8.5 No. 4 Sawlog Cypress, Grade Code J

6.5.8.5.1 Grade Rule

A log 4 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.

6.5.8.5.2 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 in length is 10 percent of the diameter.

3. Burls, butt rot, catface, checks, crook, dry side, frost checks, heart rot, insect holes, loose knots, oversized knots, pocket rot, ring rot, rotten knots, 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.

6.5.8.6 No. 5 Utility Cypress, Grade Code U

6.5.8.6.1 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.

6.5.8.6.2 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
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 of length is 13 percent of the diameter up to a maximum deviation of 13 cm.

3. Burls, butt rot, catface, checks, crook, dry side, frost checks, heart rot, insect holes, loose knots, oversized knots, pocket rot, rotten knots, 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.

6.5.8.7 No. 6 Utility Cypress, Grade Code X

6.5.8.7.1 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 the lumber will be merchantable.

6.5.8.7.2 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
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

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. Ambrosia, 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.

6.5.8.8 No. 7 Chipper Cypress, Grade Code Y

6.5.8.8.1 Grade Rule

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

6.5.9 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.

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

6.5.9.1.1 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.

6.5.9.1.2 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 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.

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

6.5.9.2.1 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.

6.5.9.2.2 Log Requirements to Make the Grade

1. No conk or conk stain is permitted.

2. Picket rot is allowed only if it is contained within a circle 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.

6.5.9.3 No. 2 Peeler Fir, Grade Code B

6.5.9.3.1 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.

6.5.9.3.2 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 1/3 percent of the diameter of the log is permitted. An allowable shake in the outer 66 2/3 percent of the diameter is permitted in one end only. An allowable shake in the inner 33 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 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.

6.5.9.4 No. 3 Peeler Fir, Grade Code C

6.5.9.4.1 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.

6.5.9.4.2 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 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 1/3 percent of the diameter of the log is permitted. An allowable shake in the outer 66 2/3 percent of the diameter is permitted in one end only. An allowable shake in the inner 33 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.

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

6.5.9.5.1 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.

6.5.9.5.2 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 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. Burls, 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.

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

6.5.9.6.1 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

    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.

6.5.9.6.2 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 + 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, burls, 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 Fir and Pine, Grade Code J

6.5.9.7.1 Grade Rule

A log 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. Burls, 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 Fir and Pine, 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 + cm	14 cm

2. Maximum twist permitted over 30 cm of length is 26 percent of the radius 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 Fir and Pine, 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 + cm	14 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 Fir and Pine, 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 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.

6.5.10.1 No. 1 Premium Spruce, Grade Code D

6.5.10.1.1 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.

6.5.10.1.2 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 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.

6.5.10.2 No. 2 Premium Spruce, Grade Code E

6.5.10.2.1 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.

6.5.10.2.2 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.

6.5.10.3 No. 1 Lumber Spruce, Grade Code F

6.5.10.3.1 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.

6.5.10.3.2 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 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.

6.5.10.4 No. 2 Lumber Spruce, Grade Code G

6.5.10.4.1 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.

6.5.10.4.2 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 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.

6.5.10.5 No. 2 Sawlog Spruce, Grade Code H

6.5.10.5.1 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.

6.5.10.5.2 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 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. Ambrosia, burls, 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.

6.5.10.6 No. 3 Sawlog Spruce, Grade Code I

6.5.10.6.1 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.

6.5.10.6.2 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, burls, 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.

6.5.10.7 No. 4 Sawlog Spruce, Grade Code J

6.5.10.7.1 Grade Rule

A log 4 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.

6.5.10.7.2 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. Burls, 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.

6.5.10.8 No. 5 Utility Spruce, Grade Code U

6.5.10.8.1 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.

6.5.10.8.2 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.

6.5.10.9 No. 6 Utility Spruce, Grade Code X

6.5.10.9.1 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.

6.5.10.9.2 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.

6.5.10.10 No. 7 Chipper Spruce, Grade Code Y

6.5.10.10.1 Grade Rule

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

6.5.11 Broadleaf Species And Yew

6.5.11.1 Applicability

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

6.5.11.2 Sawlog, Grade Code Blank

6.5.11.2.1 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.

6.5.11.2.2 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.

6.5.11.3 Chipper, Grade Code Y

6.5.11.3.1 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

6.6.1 Area of Application

The Interior Schedule of Timber Grades applies to all timber harvested in all areas of the province except the Vancouver Forest Region and the North Coast Forest District.

> Remember, the area of harvest and not the place of scaling determines which schedule of timber grades must be used.

6.6.2 Rationale for Interior Grades

Interior grading is in place to meet two general objectives:

- differentiate log quality to enable lower stumpage rates to be applied against lower quality logs, and
- support cut control and utilization policies.

To meet these objectives, interior grading focuses on assessing the suitability of logs to manufacture merchantable lumber. In addition to this assessment, interior grading must determine:

- if logs were cut from trees which did not have to be utilized under contractual cutting specifications, and
- if logs were cut from trees which were dead when they were harvested.

6.6.3 Interior Schedule of Grades

SCHEDULE OF INTERIOR TIMBER GRADES

ALL SPECIES

1. Firmwood Reject, Grade Code Z
   - (a) A log where
     - (i) heart rot or hole runs the entire length of the log and the residual collar of the firmwood constitutes less than 50% of the gross scale of the log,
     - (ii) rot is in the log and the scaler estimates the net length of the log to be less than 1.2 m, or
     - (iii) sap rot or charred wood exists and the residual firmwood is less than 10 cm in diameter at the butt end of the log.
   - (b) 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.
2. Sawlog
   A log or slab 2.5 m or more in length and 5 cm or more in radius where
   - (a) for a hemlock log, at least 75% of the gross scale can be manufactured into lumber,
   - (b) for a cedar log
     - (i) up to and including 25 cm in radius at the midpoint, at least 75% of the gross scale can be manufactured into lumber, or
     - (ii) greater than 25 cm in radius at the midpoint, at least 50% of the gross scale can be manufactured into lumber,
   - (c) for a balsam log, at least 67% of the gross scale can be manufactured into lumber, and
   - (d) for a log of a species other than hemlock, cedar or balsam, at least 50% of the gross scale can be manufactured into lumber, and

   at least 50% of the lumber will be merchantable.
3. Dead and Dry Sawlog, Grade Code 3
   A log or slab graded as sawlog cut from trees which were dead and dry when harvested.
4. Lumber Reject, Grade Code 4
   A log or slab lower in grade than sawlog and higher in grade than firmwood reject.
5. Dead and Dry Lumber Reject, Grade Code 5
   A log or slab graded as lumber reject cut from trees which are dead and dry when harvested.
6. Undersized Log Grade, Grade Code 6
   A log or slab higher in grade than firmwood reject and cut from a tree which was below the minimum diameter, including the bark, at stump height.

Figure 6.25 Schedule of Interior Timber Grades, B.C. Reg 446-94.

Six grades are prescribed:

Firmwood Reject	Grade Code Z
Sawlog	Grade Code (Blank)
Dead and Dry Sawlog	Grade Code 3
Lumber Reject	Grade Code 4
Dead and Dry Lumber Reject	Grade Code 5
Undersized Log Grade	Grade Code 6

6.6.4 Principles for Applying the Interior Schedule

Applying the Interior Schedule requires the scaler to:

1. Determine the percentage of the log's gross volume which is suitable for cutting merchantable lumber.

2. Identify logs cut from trees which were dead and dry when harvested.

3. Identify logs cut from undersized trees.

6.6.4.1 Assessing Lumber Recovery

Scalers must apply the principles for calculating grade reduction and assessing product quality as detailed earlier in this chapter.

1. Minimum Dimensions

   To be suitable for the manufacture of lumber, logs, slabs and shells for interior grading must meet or exceed minimum dimensions. These are set as follows:

	Minimum Dimensions	
	Length	**Diameter/ Thickness**
a. logs and log segments *All species*	2.5 m	5 rads
b. slabs and slab segments *All species*	2.5 m	7.5 rads
c. collars of firmwood around: i. holes, heart rot and star check if defect is > 20 percent of end diameter ii. ring shake, water shake, ring to and pocket rot *All species except cedar and hemlock*	 2.5 m 2.5 m	 5 rads 5 rads
d. Collars of firmwood around: i. holes, heart rot and star check if defect is > 20 percent of end diameter ii. ring shake, water shake, ring rot and pocket rot *Interior cedar and hemlock*	 2.5 m 2.5 m	 7.5 rads 5 rads
e. sound hearts (cores) inside external defects, including sap rot, charred wood, ring rot and ring shake. *All species*	2.5 m	5 rads

All length, diameter, and thickness measurements in the schedule of grades are the actual gross measurement (e.g., a length of 2.46 m is not rounded to 2.5 m, etc.).

2. Diameter References

This table summarizes the type and use of diameter measurements in interior grading.

Diameter	**Referenced For**
top diameter (inside bark)	assessing twist, lengths ≤ 8 m. assessing knots, lengths ≤ 8 m and, knots on the upper 1/2, lengths > 8 m. minimum top diameter.
midpoint diameter (inside bark)	assessing twist on logs > 8 m. assessing knots on lower half of logs > 8 m. assessing lumber recovery in red cedar > 25 r at midpoint.
diameter (outside bark) 15 cm from the butt end	assessing if logs cut from undersized tree

6.6.4.2 Logs Cut from Dead Trees

Scalers must closely follow the criteria detailed under Section 6.4.4.1 of this manual.

> Logs showing both indicators and contraindicators must be assumed to be cut from living trees.

6.6.4.3 Logs Cut from Undersized Trees

Scalers must closely follow the criteria outlined under Section 6.4.4.2 of this manual.

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

- the log must show sufficient evidence such as an undercut, butt flare, or other bark characteristics to indicate that it comprises a tree and not a top cut or second cut from a larger tree, and
- the outside bark measurement at a point 15 cm from the butt face, must be less than the minimum diameter at stump height specified in the cutting authority.

Logs must not be graded as Grade 6 if there is no evidence the log was cut from an undersized tree.

6.6.4.4 Knots

Merchantable lumber can be produced only from logs and log segments having knots not larger than specified maximums. For interior grading, both the midpoint and top diameters may be referenced in assessing knots. Knot specifications are as follows:

Log Diameter	**Maximum Knot Diameter**	
	RADS	**CM**
5 - 7	2	4
8 - 13	3	6
14 - 18	4	8
19 - 24	5	10
25 - 37	6	12
38+	7	14

To apply:

1. For logs $\leq$ 8 m in length assess knots against the top (inside) diameter.
2. For logs > 8 m in length, measure the midpoint diameter and:
   a. assess knots on the top log segment against the top diameter, and
   b. assess knots on the bottom log segment against the midpoint (inside) diameter.

Logs or log segments with excessive oversize knots are deemed to be unsuitable for the manufacture of merchantable lumber.

Knots which exceed the maximum are considered as oversize. Interior grading allows one oversize knot for every 3 m of log length. As the minimum log length for lumber recovery is 2.5, this assumes a 2.5 m sawlog segment could be cut between knots which are 3 m apart.

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

Refer to Section 6.4.3 for a more complete discussion.

6.6.4.5 Twist (Spiral Grain)

Measure twist over a representative 15 rad (30 cm) log section. To manufacture merchantable lumber, the grain deflection over the 15 rad (30 cm) section cannot exceed 15 percent of the reference diameter:

- for logs $\leq$ 8 m in length the reference diameter is the logs top diameter, and
- for logs > 8 m in length the reference diameter is the log's midpoint (inside bark) diameter.

Application of the interior twist criteria is subject to:

- twist must be at least 2 rads (4 cm) before it can be considered for grading purposes, and
- regardless of diameter, the maximum allowable twist for any log is 4.5 rads (9 cm).

> Logs or portions of logs displaying excessive twist are deemed to be unsuitable for the manufacture of merchantable lumber.

See Section 6.4.3 for details on twist measurement.

6.6.5 Definition of Terms in the Schedule of Interior Timber Grades

Gross Scale

Gross scale means the volume of a log inside the bark and includes unsound wood and holes in the log.

Lumber

Lumber must be 2.5 m long and free of rot and fractures.

Merchantable Lumber

Merchantable lumber means good, strong, general purpose lumber graded as better than utility or number 3 (this is assessed on the basis of knots and twist).

Radius and Diameter

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

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

6.6.6 Interior Grade Rules and Application

The following sections state each of the six 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.

6.6.7 Firmwood Reject - Grade Code Z (weight scale species code R)

6.6.7.1 Grade Rule

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

6.6.7.2 Application of the Grade Rule

1. Firmwood reject takes precedence over all other grades.

2. Part 2 of the grade rule requires that any parts of logs less than 10 cm (5 rads) in diameter must be recorded as separate logs and graded as firmwood reject.

3. Similarly, portions of logs and slabs less than 10 cm (5 rads) must be recorded as separate logs and graded as firmwood reject.

4. When scaling weight scale sample loads for recording firmwood reject logs the species is not recorded. Instead, the letter R followed by a blank is recorded in the species field.

	SP	G
Example Weight Scale Entry:	R	Z

5. For piece scales and scaling examinations, the correct species is always entered against all grades.

	SP	G
Example Piece Scale and Scaling Exam Entry:	CE	Z

6.6.8 Sawlog Grade Code ( ) Blank

6.6.8.1 Grade Rule

A log or slab 2.5 m or more in length and 5 cm or more in radius 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.

6.6.8.2 Application of the Grade Rule

1. Summary of Recovery Criteria

The sawlog grade lumber recovery rules by species are:

Species	**Lumber Quantity** **% of the Gross Scale which can be manufactured into lumber**	**Lumber Quality** **% of lumber manufactured that must be merchantable**
Hemlock	75	50
Red cedar Midpoint diameter inside bark: - 25R and less .- Greater than 25R	 75 50	 50 50
Balsam	67	50
All other species	50	50

2. For procedures to determine the percentage of the gross scale which can be manufactured into lumber see Section 6.4.2.

3. For procedures and criteria to assess lumber quality see Section 6.4.3.

4. Sawlogs are entered on the scale sheet as a blank (no other entries are permitted).

	SP	G
Tally Entry:	CE	

6.6.9 Dead and Dry Sawlog - Grade Code 3

6.6.9.1 Grade Rule

A log or slab graded as sawlog cut from a tree which was dead and dry when harvested.

6.6.9.2 Application of the Grade Rule

1. The requirements for this grade are identical to those of the sawlog grade except Grade 3 logs are logs which were cut from trees which were dead and dry when harvested.

2. The criteria outlined in Section 6.4.4.1 must be strictly followed in determining whether logs are cut from living or dead trees.

3. The grade is recorded on the tally sheet as follows:

SP	G
CE	3

6.6.10 Lumber Reject - Grade Code 4

6.6.10.1 Grade Rule

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

6.6.10.2 Application of the Grade Rule

1. Logs and slabs which do not meet the requirements of the sawlog grade fall into this grade unless:

    - they meet the firmwood reject definition,
    - they are cut from trees which were dead/dry when harvested, or
    - they are cut from trees which did not have to be utilized under the cutting authority.

2. The grade is recorded on the tally sheet as follows:

SP	G
CE	4

6.6.11 Dead and Dry Lumber Reject - Grade Code 5

6.6.11.1 Grade Rule

> A log or slab graded as lumber reject cut from a tree which was dead and dry when harvested.

6.6.11.2 Application of the Grade Rule

1. Grade 5 logs are lumber rejects (Grade 4) cut from logs which were dead and dry when harvested.

2. The criteria outlined in Section 6.4.4.1 must be strictly followed in determining whether logs are cut from living or dead trees.

3. Logs cut from dead and dry trees measuring 15 cm (7.5 rads) or less at the midpoint may be considered for grade reduction if they contain two or more surface checks at least 4 cm (2 rads) in depth. The length affected by the checking is 100 percent grade reduction, and if sufficient volume of the log is so affected, it shall be coded as grade 5.

4. The grade is recorded or the tally sheet as follows:

SP	G
CE	5

6.6.12 Undersized Log Grade - Grade Code 6

6.6.12.1 Grade Rule

> A log or slab higher in grade than firmwood reject and cut from a tree which was below the minimum diameter, including the back, at stump height.

6.6.12.2 Application of the Grade Rule

1. Logs qualify for Grade 6 only where they can be clearly identified as being cut from a tree which was below the minimum diameter at stump height (DSH) specified in the cutting authority.

2. The criteria outlined in Section 6.4.4.2 must be closely followed in identifying undersized logs.

3. If timber is harvested on an area not having cutting specifications set by the Ministry, Scalers are to assume a DSH of 15 cm for pine and 20 cm for all other species.

4. If logs do not show evidence they are cut from undersized trees they must not be graded as Grade 6.

5. The grade is recorded on the tally sheet as follows:

SP	G
CE	6

6.6.13 Grade Precedence

Where a log meets the criteria of more than one grade, the following grade precedence applies:

1. A log or portion of a log that qualifies as firmwood reject (grade code Z) takes precedence over other grades.

2. A log that qualifies as undersize (grade code 6) takes precedence over all other grades except firmwood reject.

3. A log that qualifies as a Dead/Dry lumber reject (grade code 5) takes precedence over lumber reject (grade code 4).

4. A log which qualifies as a Dead/Dry sawlog (grade code 3) takes precedence over a green sawlog (grade code blank).

5. A log which qualifies as a Lumber Reject, (grade code 4) takes precedence over a green sawlog (grade code blank).