LOG GRADING 14

14.0 Log Grading in the Yukon

The component of log scaling that deals with classifying the quality of logs is known as log grading. Grading is done in accordance with the schedule of grades described by the Yukon Timber Regulation.

Logs are graded to make the volume information of the scale more meaningful and useful to sellers and purchasers, 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 revenues for government.

In addition to monetary values, log grades 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. Instead of evaluating finished products, the challenge of the scaler is one of assessing the visible characteristics of each log, and visualizing what can be recovered.

This chapter describes the principles of grading and details how logs are graded for purposes of the Yukon Scaling Manual.

14.1 Background to Log Grading in the Yukon

Before May 3, 2001, there was no grade component to log scaling in the Yukon. The procedures now used for grading are similar to those used in Interior British Columbia. There are many similarities in the established grading rules, as well as the schedule of grades, thus it is useful to look at the history of grading in B.C. and how grading methods in the Yukon were developed from the system used in B.C..

14.1.1 History of Log Grading in B.C.

Official scale rules set the standard for estimating the net yield from logs. Since logs were first measured in B.C. in the mid-1800's five official scale rules have been used:

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

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

14.2 Legal Authority

The legal authority for grading falls under the Yukon Timber Regulation. This chapter details how logs are graded in accordance with the schedule of grades. Grading is also discussed in relation to the different scaling methods described in the previous chapter.

14.3 Preassigned Grades

In some circumstances it is neither practical nor necessary to assess logs individually for the purpose of grading. Under specific conditions, the Forest Management Branch will preassign grades to logs harvested in accordance with specific forest management criteria. The extent to which logs must be assessed for grading purposes is dependant upon:

- The volume and value of the wood being harvested, and
- The homogeneity of the stand in which the wood is being harvested.

Some of the specific scaling methods described in Chapter 13 do not involve assessment of individual logs. Where a permit is authorized to use one of these scaling methods, the Forest Management Branch will determine the most appropriate grade(s) to be assigned to logs harvested under the permit.

The preassigning of grades will take into consideration the condition of the stand from which trees are being harvested, and correspondingly, the dominant grade within the stand. Also taken into consideration will be any data accumulated with respect to log grades of previously harvested trees near the location of an identified permit area. Also to be determined is whether an area identified for a permit has been designated as containing “Category five” timber, by the Director of the Forest Management Branch.

14.3.1 Category Five Timber

In some cases, the Forest Management Branch may issue a permit to harvest in an area dominated by decadent timber. These are areas where trees have been devastated by natural disturbance such as beetle infestation, disease or fire.

The Forest Management Branch may designate timber as category five where:

- 50% or more of the trees in the identified area are dead, or dying due to disease, fire, or beetle infestation, and
- Removal of the timber has been identified as being important for forest management reasons.

Where timber has been designated as category five, the preassigned grade for all logs will be grade 5 (Dry or Dead Lumber Reject), as described later in this chapter.

14.3.2 Preassigning Grades Based on Scaling Method

As stated earlier, some of the scaling methods described in Chapter 13 do not involve the assessment of individual logs. Where one of these scaling methods has been authorized for use, the assignment of grades will be as described in one of the following subsections, corresponding to the scaling method being used.

14.3.2.1 Piece Scaling

Piece scaling requires that each log harvested be individually assessed for volume and value. Grading requirements related to this scaling method are dependant upon the volume of the timber permit. Where the piece scale method is being used for a permit not exceeding 1,000 m^3 per year, the permit holder may choose to have the Forest Management Branch pre-assign the grade of all logs to the Round Wood grade (Grade code 2). Where this is done, firmwood deductions will still be measured and recorded but no grade deductions will be considered. All logs piece scaled for permits exceeding 1,000 m^3 per year must be graded in accordance with sections 14.4 through 14.5 and all subsections contained within.

14.3.2.2 Weigh Scaling

Weigh scaling relies on a sampling process where a portion of the total volume is piece scaled to establish a weight to volume ratio which is used for billing total harvest volumes. Along with this, grades assigned to sample loads are used to establish a grade profile that will determine the grades to be assigned, proportionately, to all loads that were not sampled.

Where weigh scaling is being used with a set conversion as per Section 13.2.3.2, the grade profile will also be set by the Forest Management Branch.

14.3.2.3 Stack Scaling Cut to Length

Because the stack scaling method does not involve the individual assessment of all logs, a single grade must be assigned to the entire volume being scaled. The grade to be assigned is dependant upon the type of permit issued.

- Where logs are being stack scaled under a round wood permit, the grade assigned will default to the Round Wood Grade (Grade 2).
- Where logs are being stack scaled under a fuelwood permit, the grade assigned will default to the Dry or Dead Lumber Reject Grade (Grade 5).

14.3.2.4 Stack Scaling Stem Length

The default grade assigned to all logs scaled using this method will be the Round Wood Grade (Grade 2).

14.3.2.5 Top Scaling

Logs scaled using the top scaling method will default to the Round Wood grade (Grade 2).

14.3.2.6 Piece Count

For logs scaled using the piece count method, grade assignment is as per Section 14.3.2.3. Where logs are being piece scaled under a Class H permit, no grade is required.

14.3.2.7 Standing Tree Measurement

Volumes scaled using the standing tree method will default to the most appropriate grade determined by assessing the quality of the timber in the stand identified for harvest. This assessment will be based on cruise data as well as grade profiles of previously scaled logs from the same area. Other factors to be considered are whether the quality of the timber has been affected by fire, insects, disease, or whether the area is eligible for classification as a priority harvest area or as Category five timber.

14.4 Principles of Log 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:

- Grading: lumber and other value-added products.

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 2) 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.

14.4.1 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 under Section 14.5.1.

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

14.4.1.1 Fractures and Fibre Separation

Wood fibers 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 is 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 Management Branch may order that surface checks be ignored.

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

14.4.1.2 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.

14.4.1.3 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 side hills. 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.

14.4.1.4 Rot, Hole, Char, and Missing Wood

Rot is caused by a variety of fungi that 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 that 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 balsam fir 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, 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 Chapter 2 and Section 14.5.1).

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 14.4.1 details the methods of grading for log characteristics, which reduce product recovery.

14.4.2 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.

14.4.2.1 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.

Twist is the measured deflection that 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., 3/24 x 100% = 12.5%). Many scalers prefer to use centimeters, 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., 9/48 x 100% = 18.75%).

The twist allowances for specific log grades are detailed in Section 14.6.4.5.

14.4.2.2 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.

14.4.2.2.1 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 centimeters 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.

14.4.2.2.2 Types of Knots

Knots are classified as 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 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 forest 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 14.5.3.1.

14.4.2.2.3 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.

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 as they relate to log grades are found in Section 14.6.4.4.

14.5 Applying the Principles of Grading

14.5.1 Grade Reduction

Grade Reduction is the process of determining what portion of a log is not suitable for the manufacture of various products. Section 14.4.1 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 Yukon 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.

% Suitable for Manufacture = <u>Gross Volume B Grade Reduction</u> x 100
Gross Volume

***Where Gross Volume = Defect Free Volume + 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 time consuming 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.

14.5.1.1 Field Methods for Determining Grade Reduction

Instead of using a full metric volume approach using Smalian's formula, shortened field methods may also be used to estimate grade reduction. Field methods such as that outlined in Appendix 14A 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 1, Smalian’s 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.

14.5.2 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 2 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.

14.5.2.1 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. 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. 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) 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-center 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 14.1(1) the off-center star shake has a portion with sufficient collar and a portion without. By averaging, a scaler may not take a grade reduction when one is available, and may take an excessive reduction when a portion of the collar actually does meet the grade requirement.

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

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

Collar thickness principles are provided in Figure 14.1, without showing trim allowance. Trim allowance is added after and collar assessments and is described fully in Section 14.5.2.5.

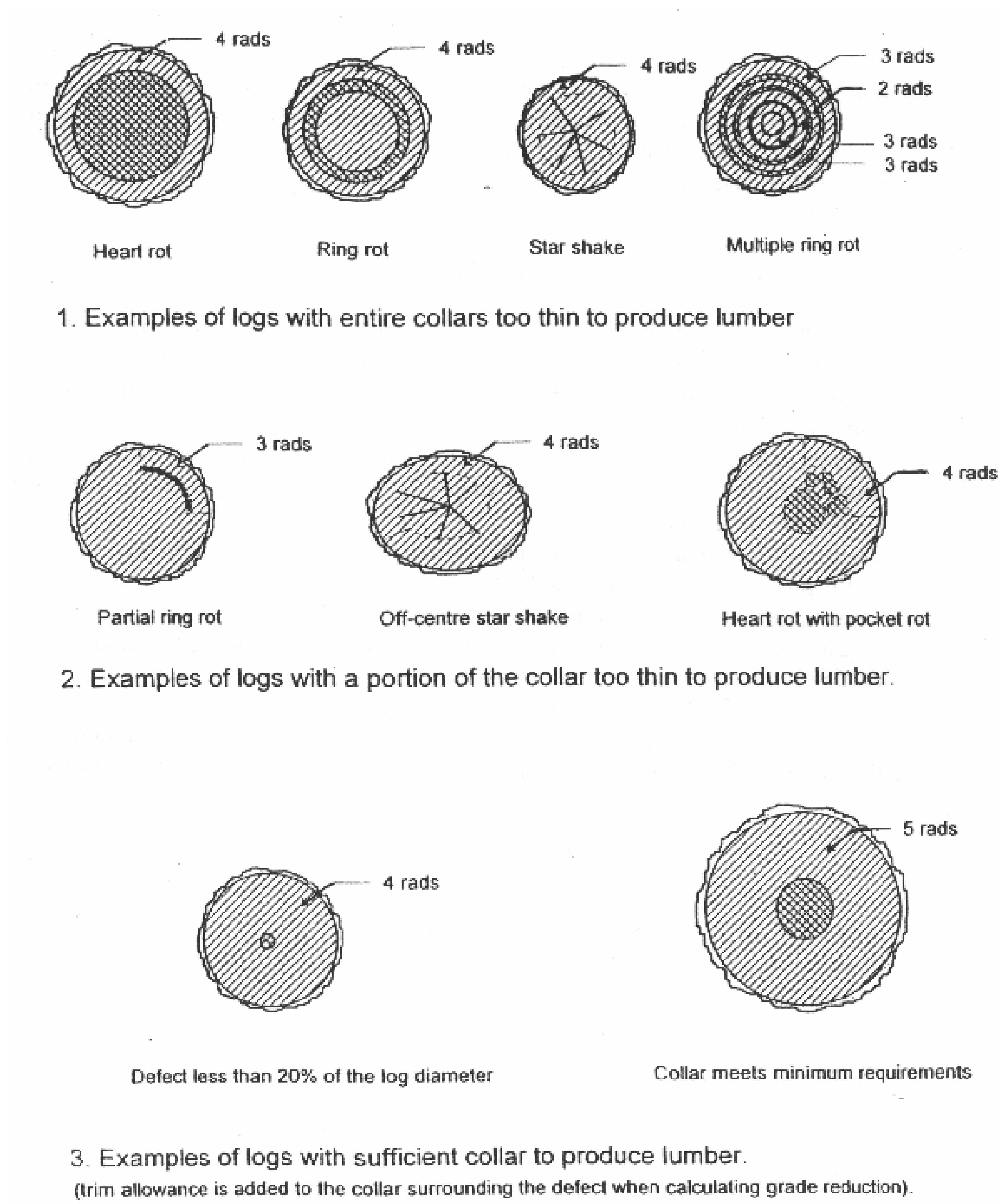


Figure 14.1 Examples of collars around internal defects.

14.5.2.2 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 14.2. Examples of grading residual cores inside ring shake and ring rot are provided in Section 14.5.2.5 (trim allowance section).

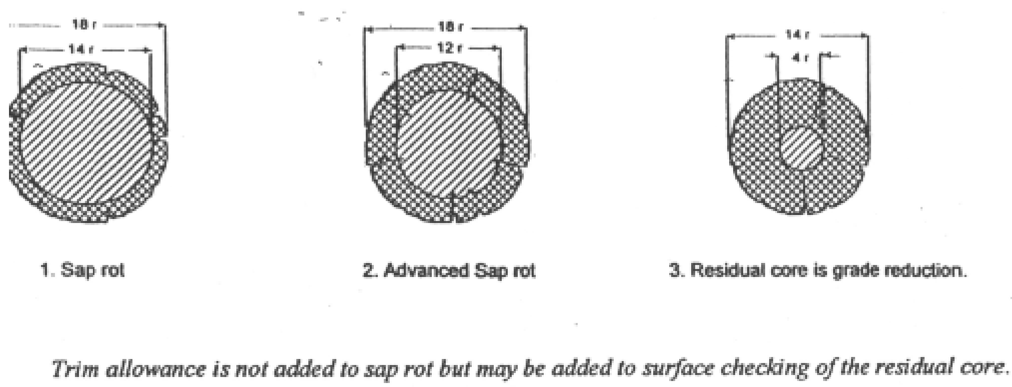


Figure 14.2 Residual cores in sap rot

The first example in *Figure 14.2* 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 dm3

Grade reduction = UV 18 r - UV 14 r = (102 - 62) = 40 dm3

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

The second example in *Figure 14.2* 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 dm3 per metre

Grade reduction = UV 18 r - UV 12 r = (102 – 45) = 57 dm3 per metre

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

The third example in *Figure 14.2* 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 dm3 per metre

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

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

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

Grade reduction = UV 4 r = 5 dm3 per metre

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

% of log which can be manufactured = $\frac{62 - 62}{62} \times 100 = 0.00\%$

14.5.2.3 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 14.5.2.5.

14.5.2.4 Determining Grade Reduction for Slabs

To be considered suitable for manufacture into lumber in the grades, slabs must be at least 7.5 rads (15 cm) thick. The specified minimum thickness 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 thickness can be measured at any point along their length.

The slab in Figure 14.3 was measured for firmwood content according to the method described in Chapter 10, 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 dm3

Slab Unit volume, small end = 05 x 10 x 0.4 = 20 dm3

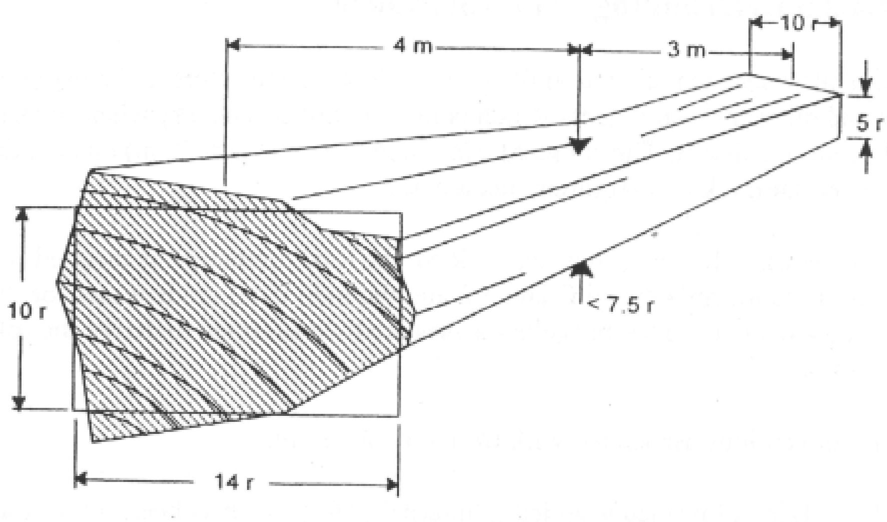
Average unit volume = (56 + 20 / 2) = 38 dm3

Gross volume = (38 by 7 m) = 266 dm3

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 dm3

% of slab which can be manufactured = $\frac{266 - 114}{266}$ x 100 = 57.1 percent



1. 4 m portion of log which is thick enough to cut lumber.

Figure 14.3 Slabs with portions meeting the grade rule

14.5.2.5 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 formula from Chapter 2 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,

   - 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.

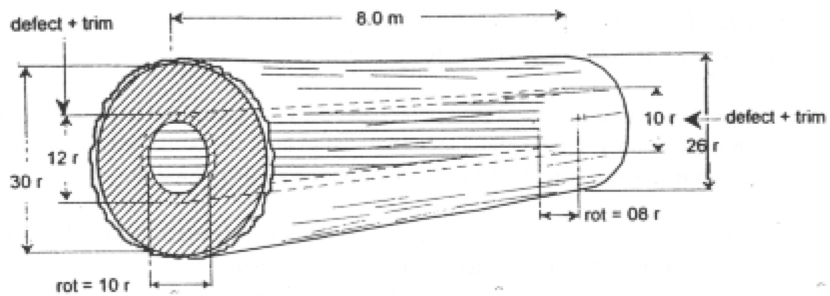
In *Figure 14.4*, the first log has a rot diameter of 8 rads at the top and 10 rads at the butt. The grade reduction will be for a 10 rad top defect and a 12 rad butt defect after the 1 rad trim allowance is added around the defect. From the scale stick:

Gross volume = 8 m/26 r/30 r = (849 + 1131) = 1980 dm3

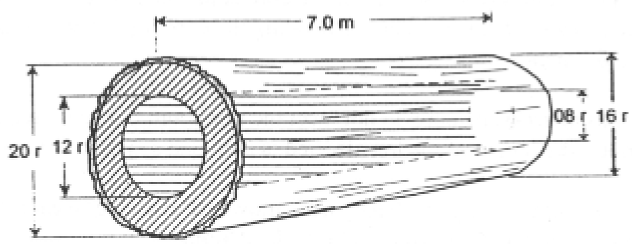
Grade reduction = 8 m/10 r/12 r = (126 + 181) = 307 dm3

% of log which can be manufactured = 84.5 percent

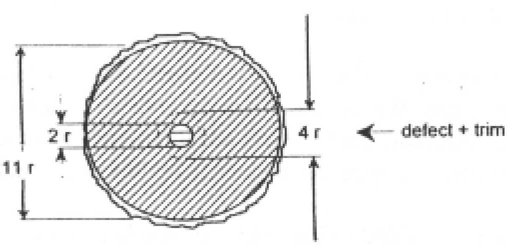
The following figures demonstrate examples of the principles of trim allowance in calculating grade reductions.



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 14.4 Application of trim allowance around heart rot and hole

The second log in Figure 14.4 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 dm3
>
> Grade reduction = 7 m/16 r/20 r = (281 + 440) = 721 dm3
>
> % of log which can be manufactured = $\frac{721 - 721}{721} \times 100 = 0.00$ %

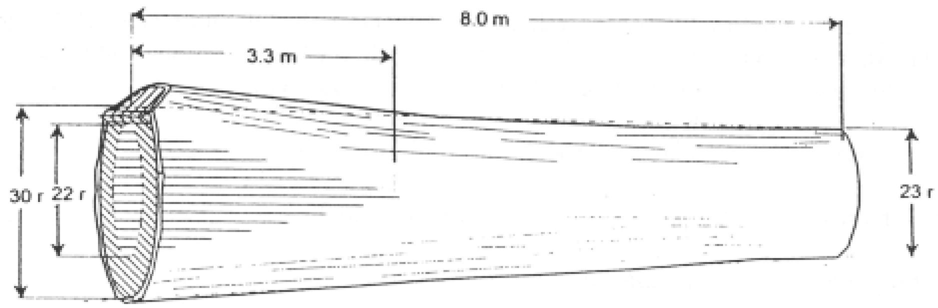
An exception to the grade rule is the third log in Figure 14.4. It has a heart defect diameter less than 20 percent of the log diameter (2 rads divided by 11 rads times 100 = 18 percent) and the residual collar is less than 5 rads thick. If the heart defect is less than 20 percent of the log diameter, 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 dm3

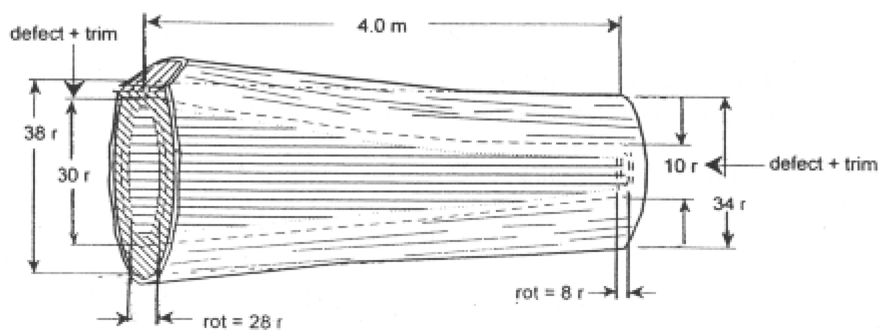
Grade reduction per metre (04 r) = Unit volume: defect = 5 dm3

% of log which can be manufactured = $\frac{38 - 05}{38} \times 100 = 86.8$ %

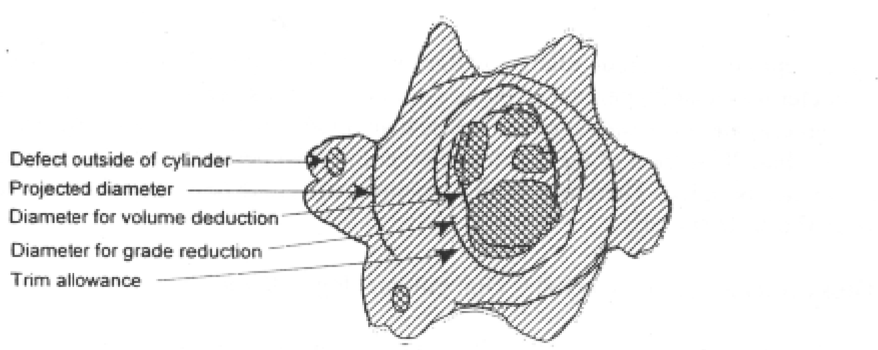
The first example in Figure 14.5 is the exception to the convention of adding trim allowance to a collar of firmwood. Because conical butt rot has a much more variable and complex effect on grade reduction, a number of approaches to a reasonable solution have been tested. Of those methods, doubling the firmwood deduction is a reliable and simple convention, which allows for both trim allowance and minimum collar requirements.



1. A 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 14.5 The application of trim allowance around butt rot

With the scale stick:

Gross volume = 8 m/23 r/30 r = (665 + 1131) = 1796 dm3

Cone volume = 3.3 m/22 r = $\left(\frac{251 + 251}{3}\right)$ = 167 dm3

Grade reduction = 167 x 2 = 334 dm3

% of log which can be manufactured = $\frac{1796 - 334}{1796}$ x 100 = 81.4 %

The second example of butt rot in Figure 14.5 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 4 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 dm3

Average defect diameter = $\frac{10 + 30}{2}$ =20 rads

Grade reduction = 4 m/20 r/20 r = (251 + 251) = 502 dm3

% of log which can be manufactured = $\frac{1633 - 502}{1633}$ x 100 = 69.3 %

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 ½ 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 14.5 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.

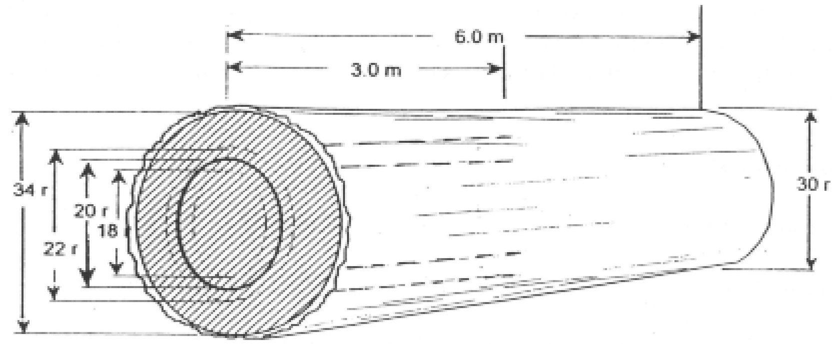
Example 1 in Figure 14.6 shows a log with ring shake, which is estimated to penetrate one-half of the log length. Because the collar meets the minimum collar requirements, add a 1 rad trim allowance on both sides of the shake and deduct the volume of
a 2 rad ring.

From the scale stick:

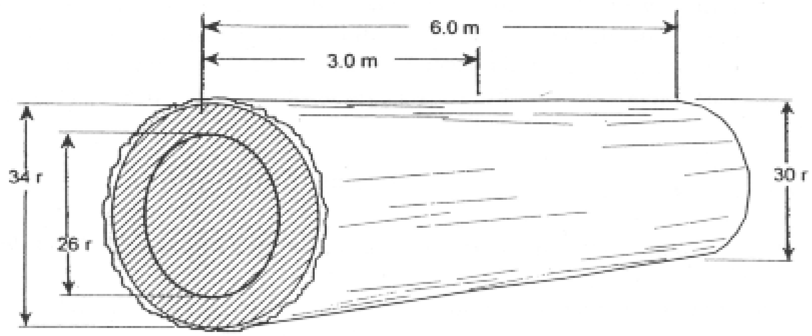
Gross volume = 6 m/30 r/34 r = (848 + 1090) = 1938 dm3

Grade reduction = UV 22 r - UV 18 r for 3 m = (152 - 102) x 3 = 150 dm3

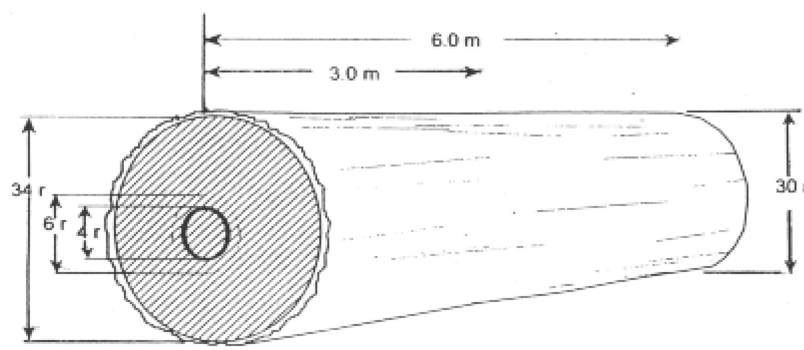
$$\% \text{ of log which can be manufactured} = \frac{1938 - 150}{1938} \times 100 = 92.3\ \%$$



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 14.6 The application of trim allowance around ring shake

Example 2 in Figure 14.6 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 dm3

Grade reduction = UV 34 r - UV 26 r for 3 m =(363 - 212) x 3 = 453 dm3

$$\% \text{ of log which can be manufactured} = \frac{1938 - 453}{1938} \times 100 = 76.6\ \%$$

Example 3 in Figure 14.6 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:

Grade reduction = 3 m/6 r/6 r = (17 + 17) = 34 dm3

$$\% \text{ of log which can be manufactured} = \frac{1938 - 34}{1938} \times 100 = 98.2\ \%$$

The first example in Figure 14.7 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 dm3

Grade reduction = Outside cylinder 5 m/17 r/19 r = (227 +284) = 511 dm3

less = Inside cylinder 5 m/11 r/13 r = (95 + 133) = 228 dm3

= (511 - 228) = 283 dm3

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

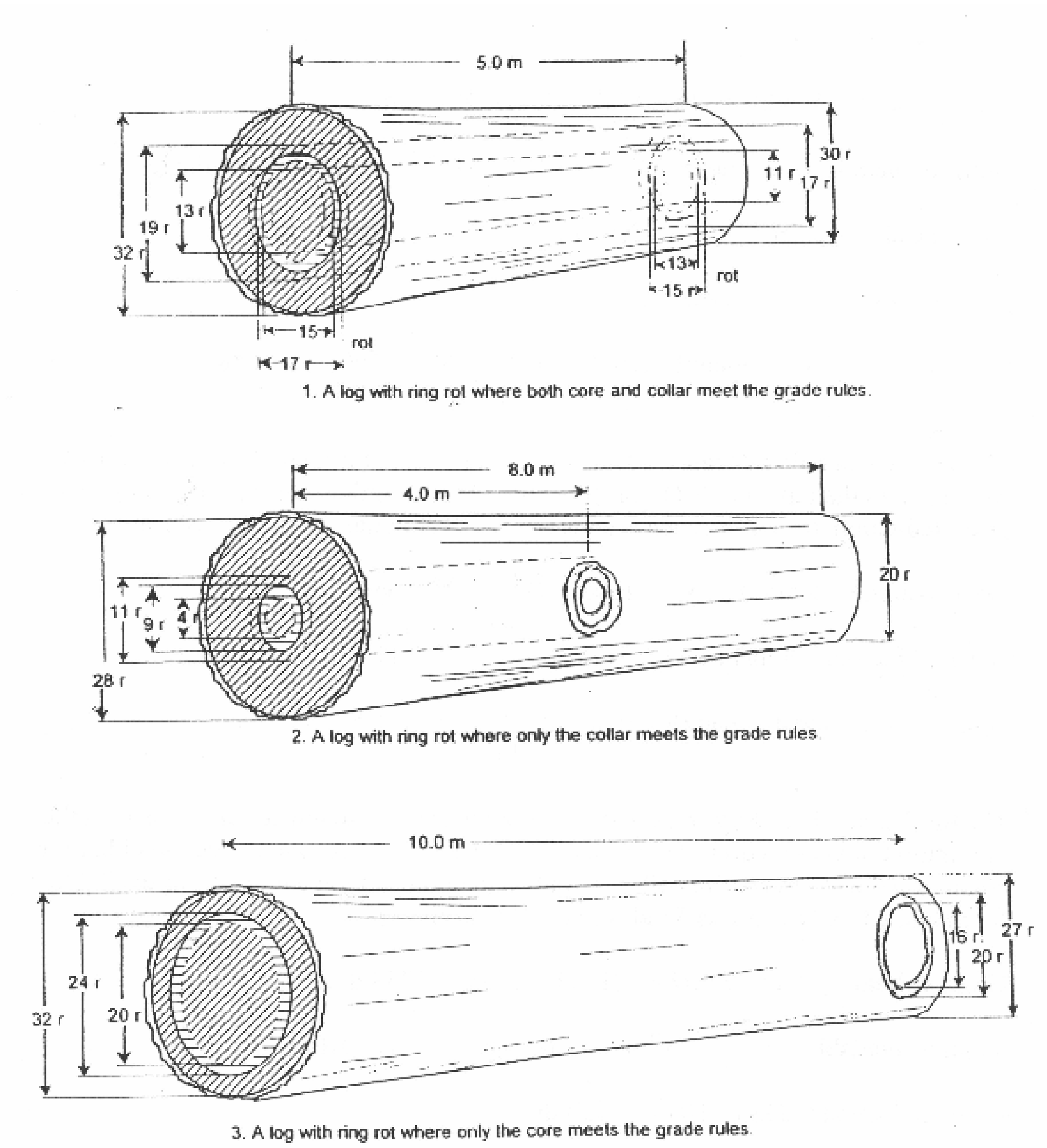


Figure 14.7 Application of trim allowance around ring rot

The second example in Figure 14.7 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 dm3

Grade reduction = 4 m/11 r/11 r = (76 + 76) = 152 dm3

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

The third example in Figure 14.7 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 dm3

Volume available = 10 m/16 r/20 r = (402 + 628) = 1030 dm3

Grade reduction = 2753 - 1030 = 1723 dm3

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

The first example in Figure 14.8 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 dm3

Grade reduction = Outside cylinder 6 m/18 r/20 r = (305 + 377) = 682 dm3

less = Inside cylinder 6 m/08 r/10 r = (60 + 94) = 154 dm3

= (682 - 154) = 528 dm3

% of log which can be manufactured = $\frac{1587 - 528}{1587} \times 100 = 66.7\ \%$

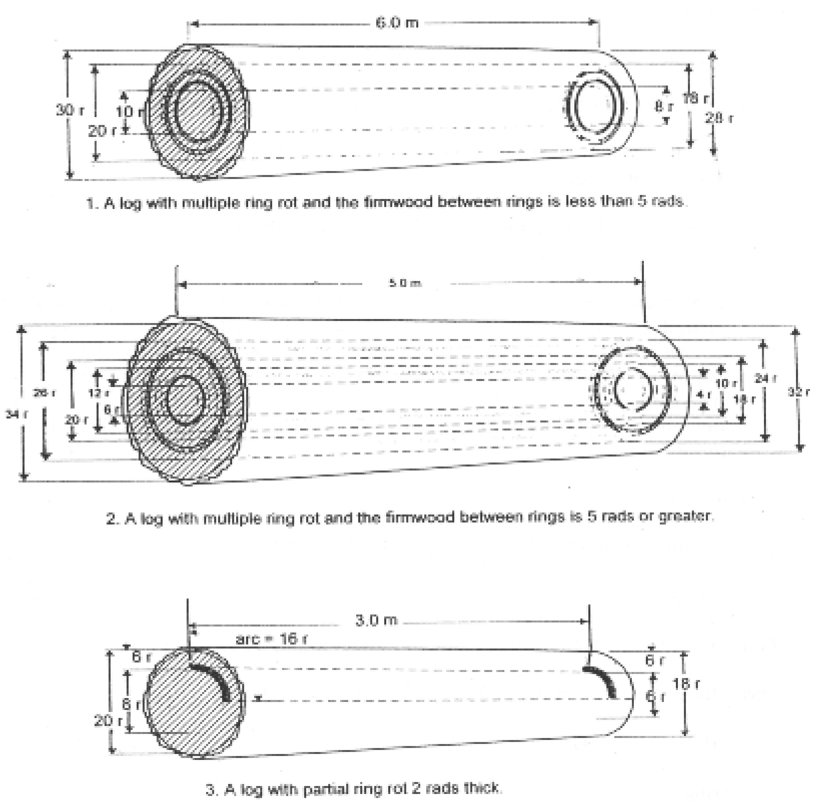


Figure 14.8 The application of trim allowance around multiple and partial rings

The second example in Figure 14.8 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 dm3

Outside ring:

Grade reduction = Outer cylinder 5 m/24 r/26 r = (452 + 531) = 983 dm3

less = Inner cylinder 5 m/18 r/20 r = (254 + 314) = 568 dm3
= (983 - 568) = 415 dm3

Inside ring:

Grade reduction = Outer cylinder 5 m/10 r/12 r = (79 + 113) = 192 dm3

less = Inner cylinder 5 m/04 r/06 r = (13 + 28) = 41 dm3

= (192 - 41) = 151 dm3

Sum of grade reduction = (415 + 151) = 566 dm3

% of log which can be manufactured = $\frac{1712 - 566}{1712}$ x 100 = 66.9 %

The third example in Figure 14.8 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 ½. It can be calculated as a ratio of the circumference by multiplying the diameter by and dividing the result into the arc of the defective sector, but finding the arc is not practical with conventional scaling tools, so an acceptable alternative may be used. 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 = 20 x 3.14159 = 63 r circumference

Defect arc factor = 16 r arc 63 = 1/4 or 0.25 or 25 percent
Factor from a clock face, major divisions in 12ths (secondary divisions in minutes or 60ths, which are equal to 6 degrees/minute):

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

Factor from 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 percent

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

From the scale stick:

Gross volume = 3 m/18 r/20 r = (153 + 188) = 341 dm3

less = Inside cylinder 3 m/06 r/08 r/ = (17 + 30) = 47 dm3

Grade reduction = 341 - 47 = 294 x factor of 0.25 = 73.5 = 74 dm3

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

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 ½ 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 dm3

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 dm3

% of log which can be manufactured = $\frac{341 - 32}{341}$ x 100 = 90.6 %

Example 1 in Figure 14.9 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:

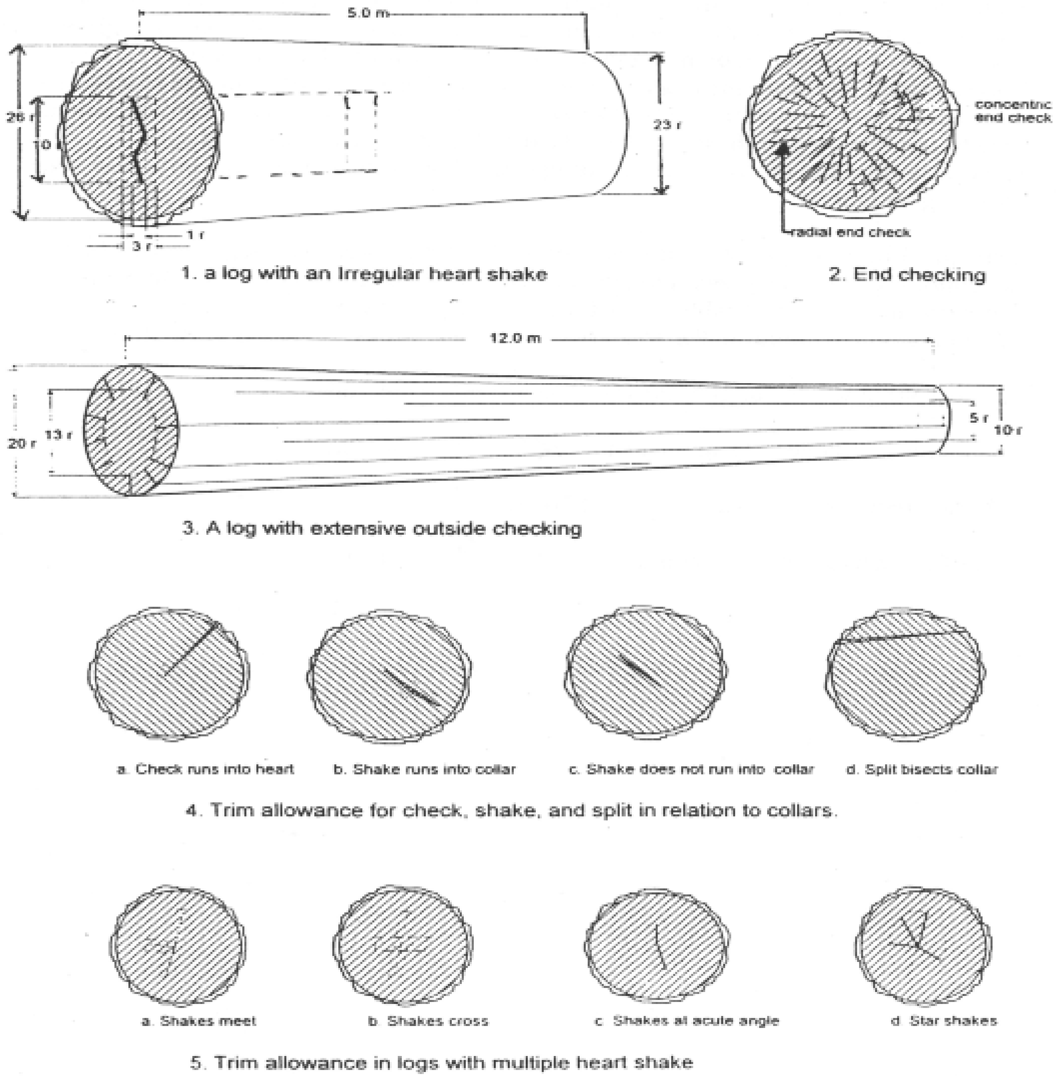


Figure 14.9 The application of trim allowance around checks and shake

From the scale stick:
Gross volume = 5 m/23 r/26 r/ = (415 + 531) = 946 dm3

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 dm3

Another popular method to find the grade reduction for rectangular defects is to use centimeters 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 dm3

Either method will produce the same results:

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

Example 2 in Figure 14.9 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 Management Branch may order that end checking be ignored).

Example 3 in Figure 14.9 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 dm3

Volume available = 12 m/5 r/13 r = (47 + 319) = 366 dm3

Grade reduction = 942 - 366 = 576 dm3

% of log which can be manufactured = $\frac{942 - 576}{942}$ x 100 = 38.8 %

Example 4 in Figure 14.9 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.

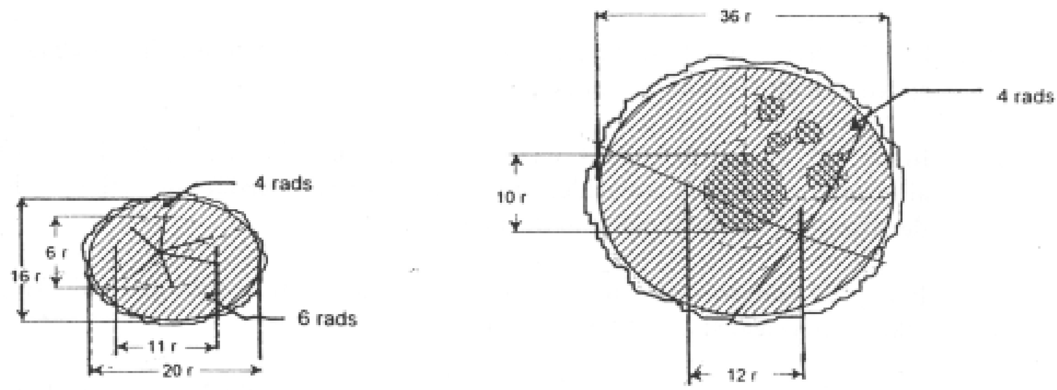
Example 5 in Figure 14.9 shows four log ends with multiple heart shake. It is necessary to apply trim allowance in a manner which best accommodates the forms which the shake takes. Two conventions allow for the full range of heart shakes.

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 Management Branch may order that end checking be ignored.

Although the two examples in Figure 14.10 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

Figure 14.10 The application of trim allowance to off-centre and overlapping defects

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 14.10 shows a log, which has a rotten core and scattered pocket rot, with less than 5 rads separation between the pockets. The entire area enclosing the pockets 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 dm3

Grade reduction = UV 12 r = 45 dm3

Net unit volume = 407 - 45 = 362 dm3

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 dm3

Total reduction = 45 + 90 = 135 dm3

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

14.5.2.6 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.

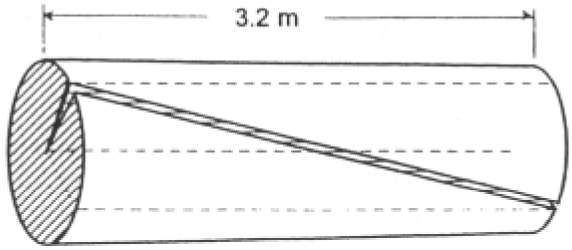
If a spiral surface check does not penetrate all the way into the heart, the grade reduction is of course less than for a full check, and it is important to understand the relationship between the depth of penetration and the effect on volume. For example, a check penetrating half-way to the heart would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

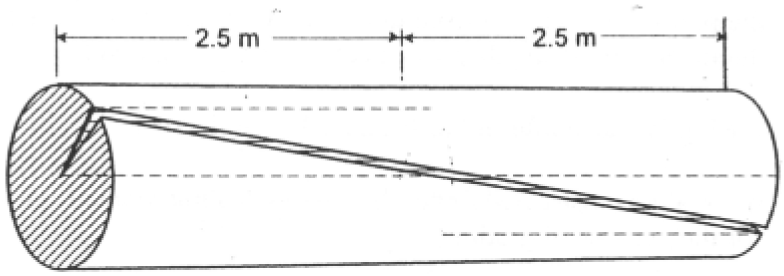
The first log in Figure 14.11 has a uniform spiral check running its full length. Because the log is less than 5 m long, assess the twist on the log length. In field practice, it is only necessary to observe the degree of spiral from one end to the other, and estimating the percentage of the log affected, in this case 25 percent of its circumference. Therefore the grade reduction on the log is also 25 percent.

The second log in Figure 14.11 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.

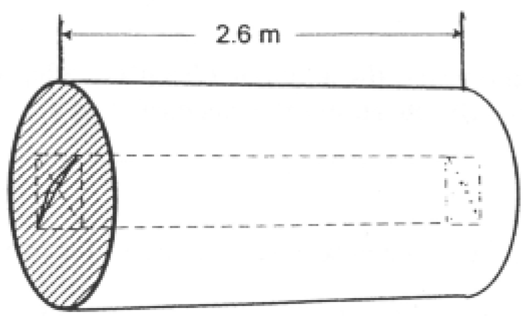
The third log in Figure 14.11 shows a spiral heart shake. It may be treated similarly to acute or irregular heart shake, as shown in the examples in Figure 14.9, except that trim allowance is not added. That is, the grain deflection is projected to the opposite end of the log, the area affected is enclosed 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 14.11 The effect of spiral check and shake on grade

14.5.2.7 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 logs have been cut into lengths less than 2.5 m; for the purpose of grading they may be deemed to be 2.5 m 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 Yukon Scaling Manual 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
- they facilitate more consistent grading decisions.

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

Figure 14.12 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 for the purpose of grading, excluding the firmwood reject portions.

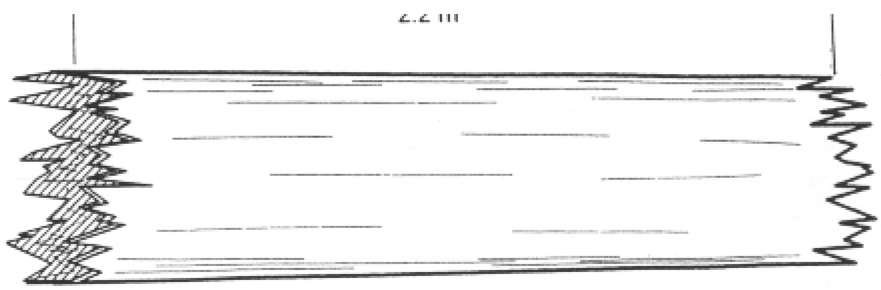
In breakage, log ends may or may not be "cleaned up" when they arrive at a scale site. It is shown in the second example, sharp ends have been bucked off for obvious safety reasons, and is most often apparent to the scaler because some signs of breakage are usually showing, such as splits,

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.

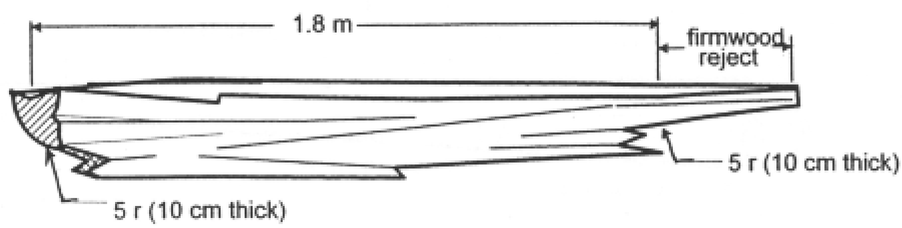
Figure 14.13 shows two similar "rat tail" logs, which were delivered, to a scale site. For both logs, the portion of the log less than 5 rads (10 cm) in diameter is graded as firmwood reject. The portions of the logs 5 rads and larger , however, are treated differently for grading purposes because one 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.

The first log in Figure 14.14 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 14.14 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. Log of any diameter over the utilization standard with broken ends.



2. Slab with sharp ends cleaned up.

Figure 14.12 Short breakage pieces contained in a conventional load

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 14.14 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.

The log in Figure 14.15 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/4.6m	= (209 + 289)	= 498 dm^3
Grade reduction	= 12 r/12 r/2.3m	= (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:

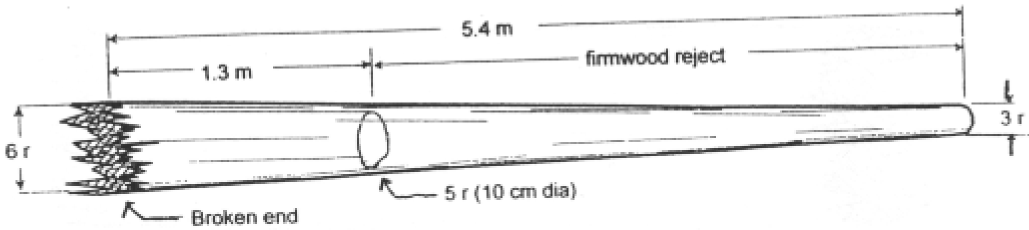
Grade reduction = UV 17 r x 2.3 m = (91 x 2.3) = 209 dm^3

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

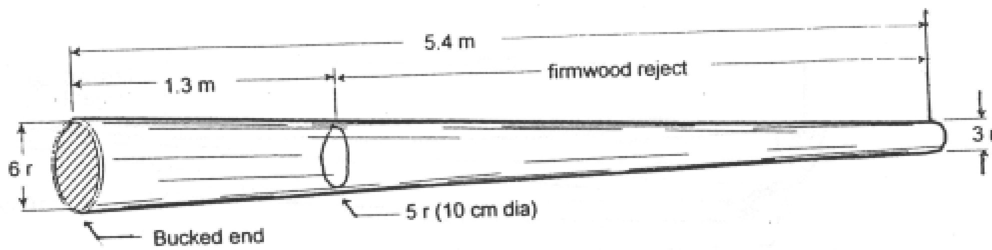
Total grade reduction = 104 + 186 + 209 = 499 dm^3

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

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



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 14.13 Rat tail tops where only a portion of the log is greater than 10 cm

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 14.16 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, even though the recorded measurements are as shown in the examples. That is, they may not be down-graded because they are shorter than the minimum requirements.

Where unscaled logs have been bucked and delivered to a scale site or bucked at the scale site, they must be scaled and graded as individual logs. Figure 14.17 provides examples of different logs which were bucked to specific lengths to suit the specifications of the product. 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.

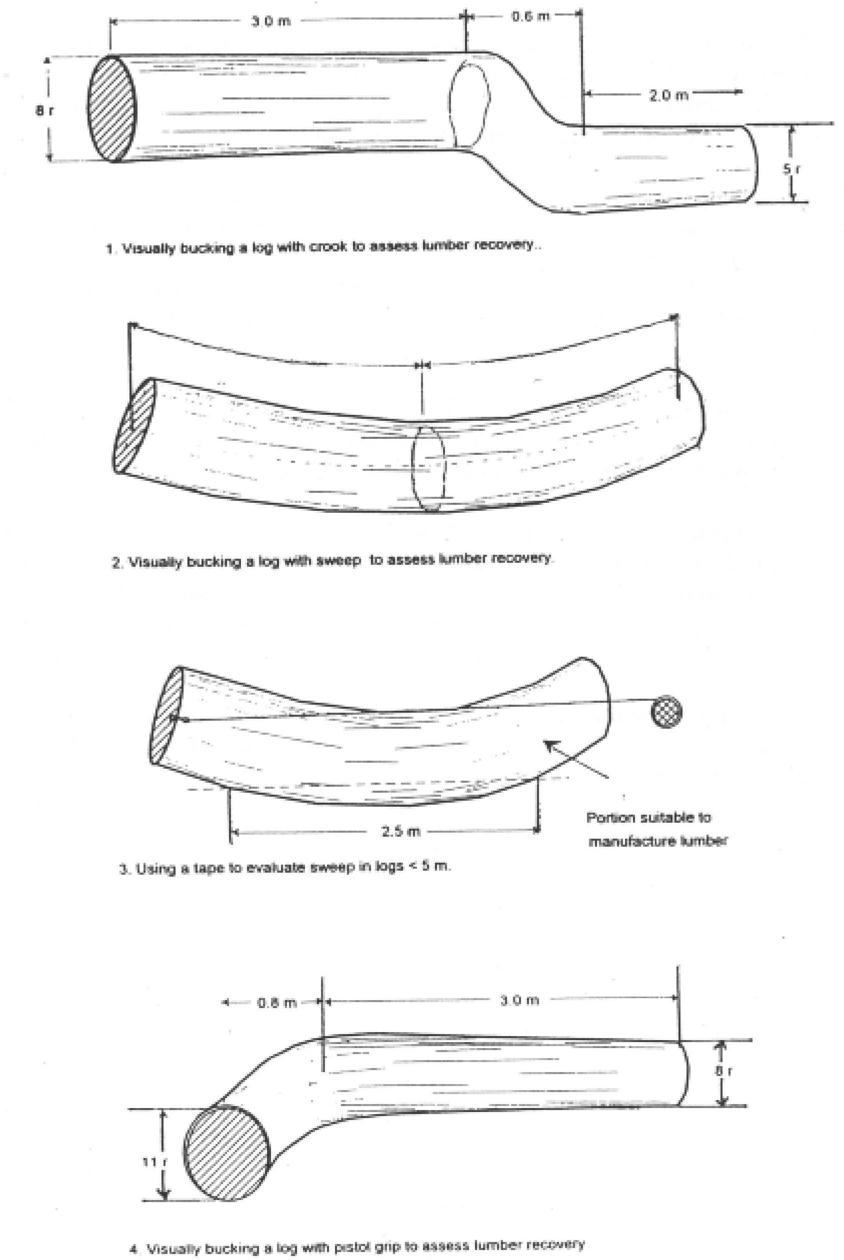


Figure 14.14 Assessing logs with sweep, crook and pistol grip

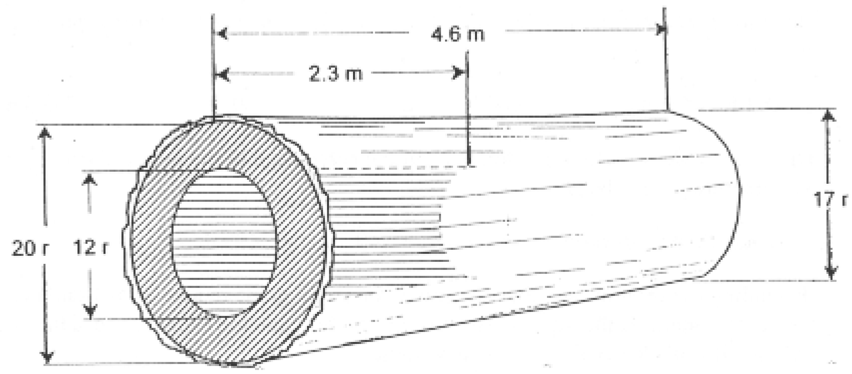


Figure 14.15 Assessing grade in log with heart rot and residual length is too short to cut lumber

14.5.3 Assessing Product Quality

Section 14.4.1 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.

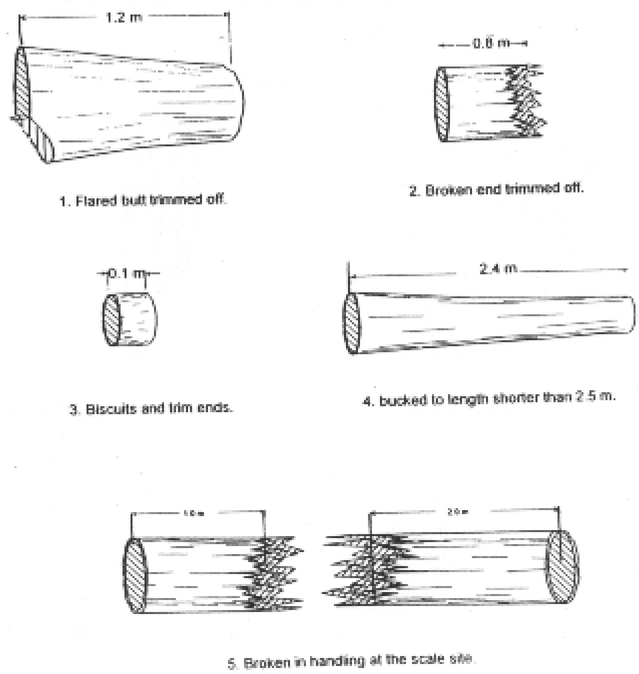


Figure 14.16 Examples of short logs left after bucking at the scale site and deemed to be 2.5m long

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.

14.5.3.1 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.

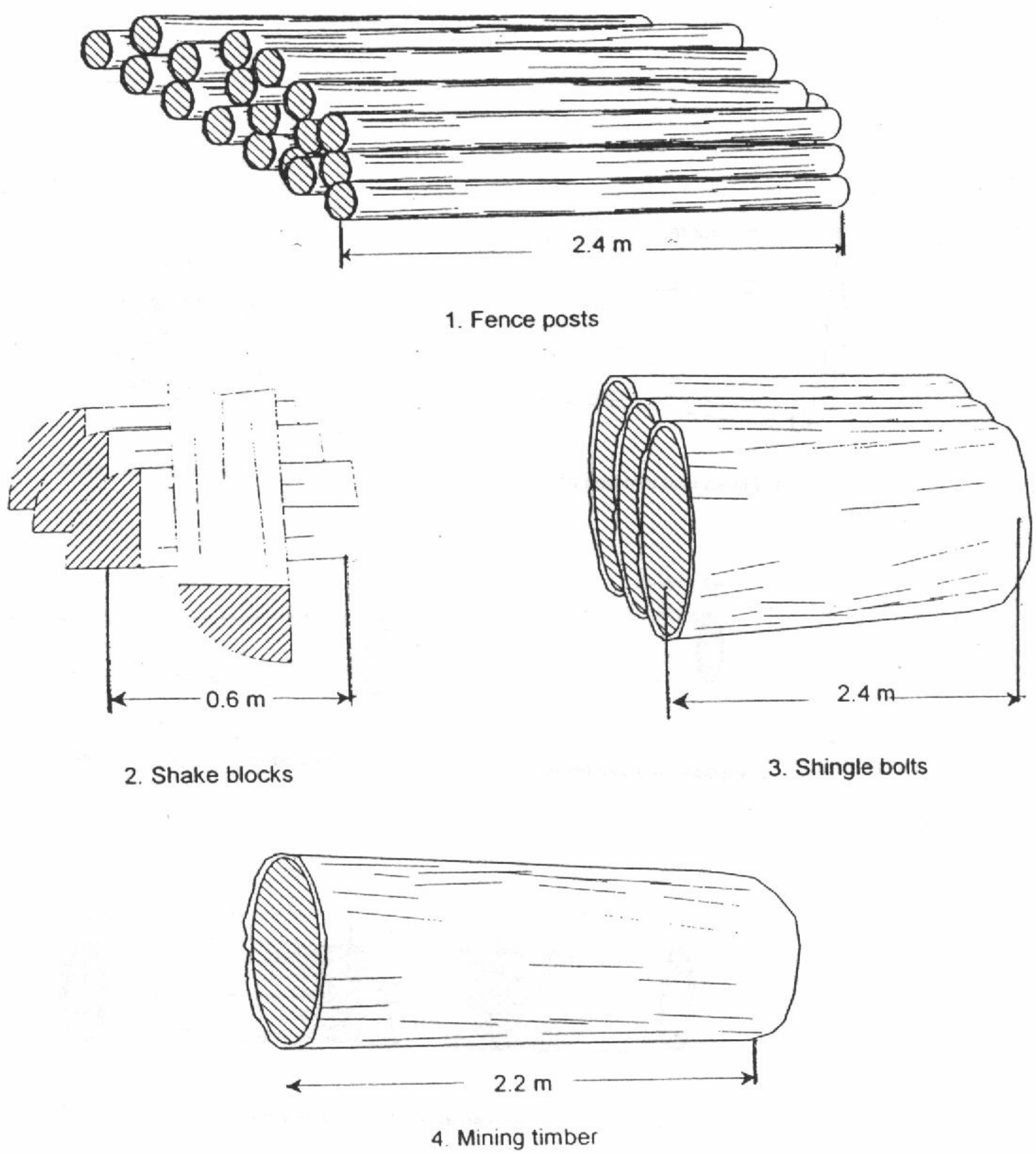


Figure 14.17 Examples of short logs deemed to be 2.5m long

Maximum allowable knot size increases with the diameter of the log, and they are expressed in radius class units (rads) or centimeters of diameter. When taking this measurement, only the actual knot should be measured and not the shoulder surrounding it. Figure 14.18 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.

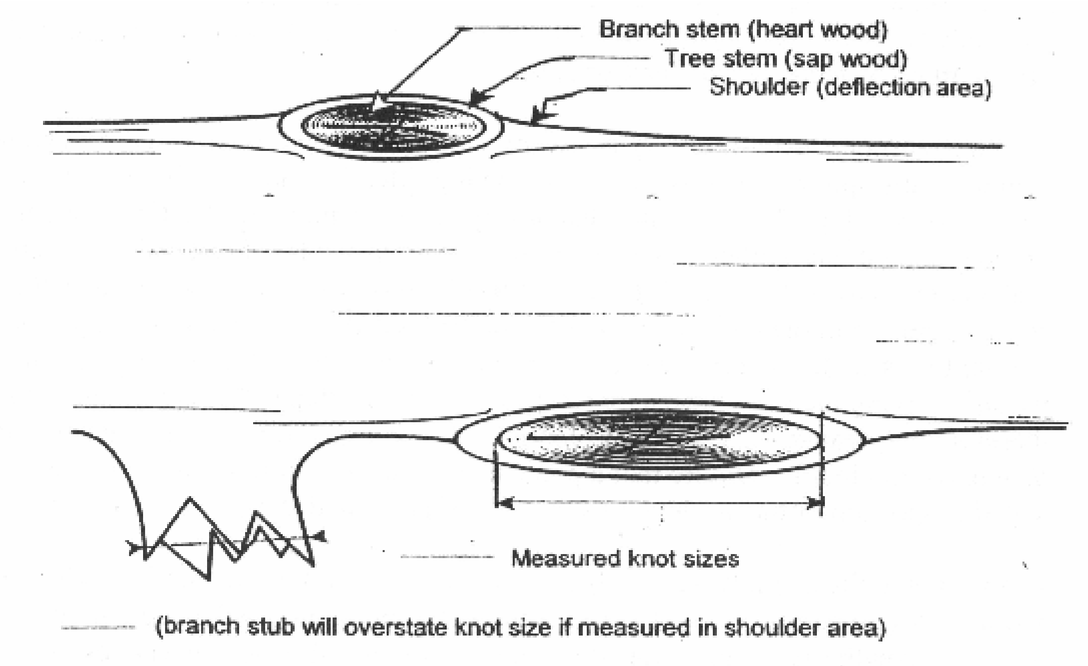


Figure 14.18 Measuring knot diameters

Figure 14.19 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 larch 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 recognize this characteristic and observe some of these logs in the breakdown process.

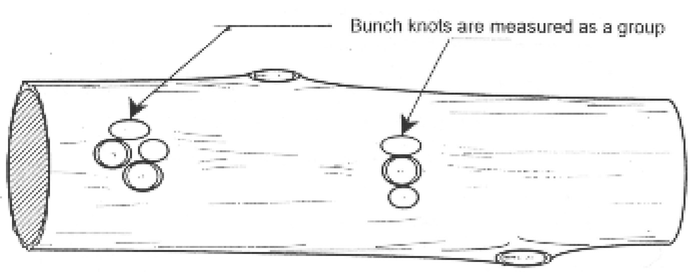


Figure 14.19 Measuring bunch (cluster) knots

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 deduction 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 10,
- for logs up to and including 8 m in length, knots are assessed against the top diameter of the log (Figure 14.20),
- for 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 14.20), and
- slabs are measured across their width for determining knot allowances. Widths for slabs of all shapes are illustrated in Chapter 10. For purposes of knot assessment, if the thickness exceeds the width, the wider measurement is used.

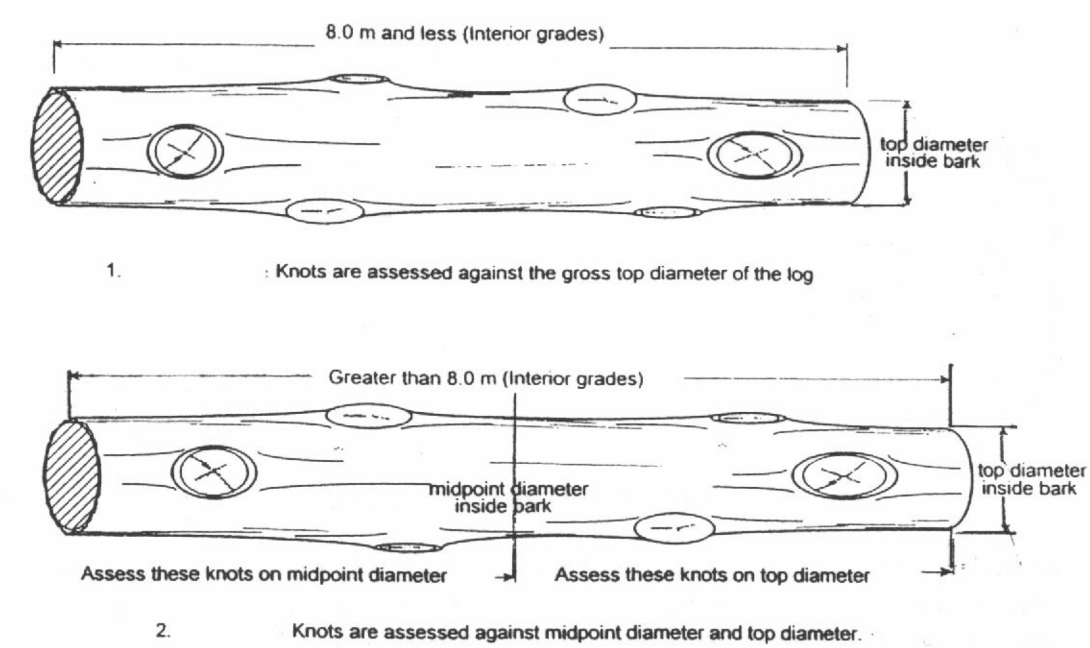


Figure 14.20 The relationship between log diameters and knot diameters

In addition to their size and characteristics, the location and distribution of knots must be carefully considered. For example, if log segments must be 2.5 m long to produce merchantable lumber, occasional oversized knots are permitted if it is possible to cut merchantable lumber from between them. In general, one oversized knot is permitted every 3 m, 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 14.21 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.

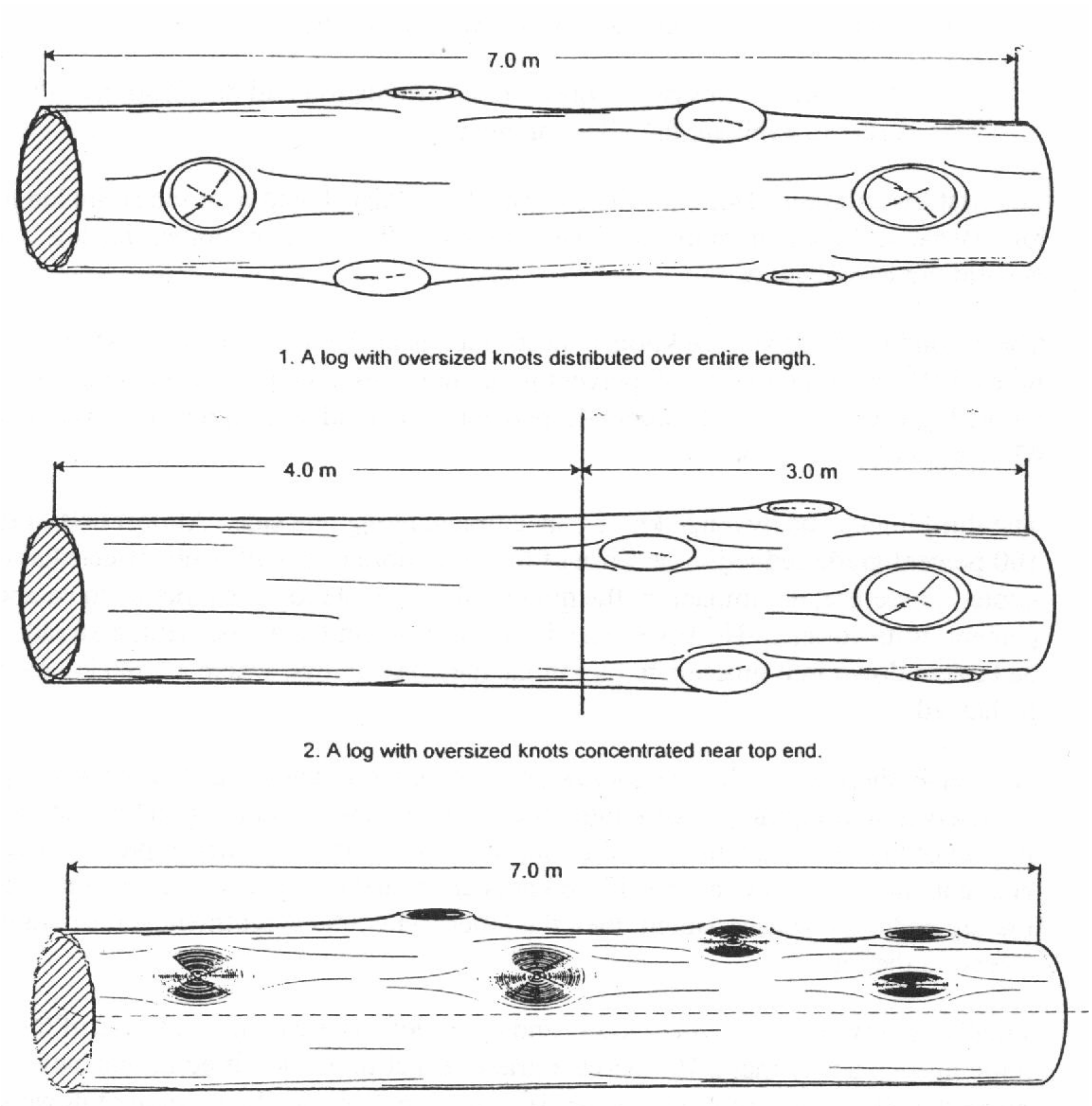


Figure 14.21 Typical knot distributions and their effect on grade

> 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:

1. identified the oversized knots from the top or top and mid-point diameters,

2. determined that their spacing is less than 3 m along the length,

3. decided that a grade reduction is warranted, then

4. it becomes necessary to observe the orientation and distribution of the knots in order to evaluate the effect on grade.

The first log in Figure 14.21 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 its 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 ½ 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.

14.5.3.2 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 14.22).

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

The grades also specify a maximum twist measurement within the prescribed percentage. 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 14.6.4.5.

As shown in *Figure 14.22* and *Figure 14.23*, 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.

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 (see figure 14.23) to simplify measurements.

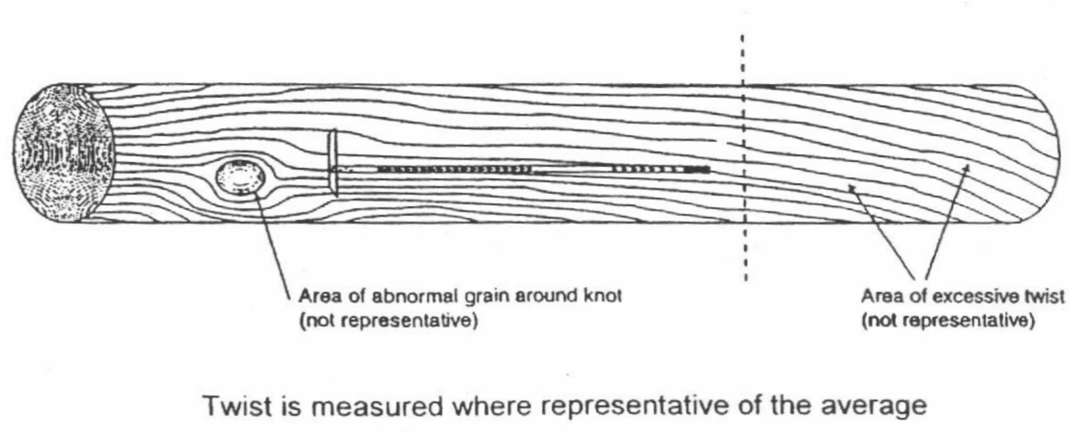


Figure 14.22 Measuring twist – placing the stick

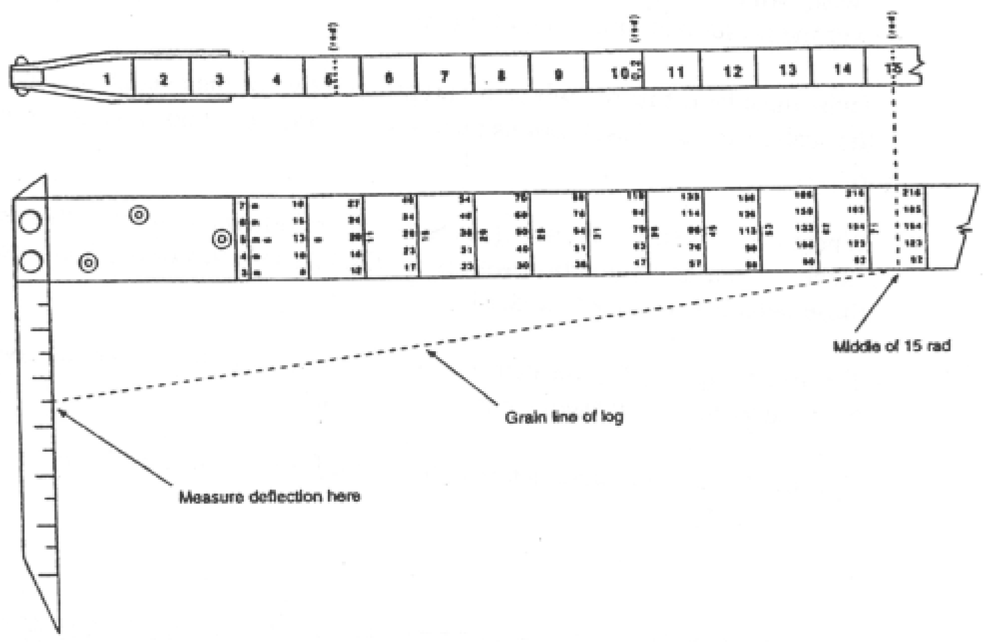


Figure 14.23 Measuring twist – reading the deflection

14.5.4 Factors Unique to Grading

Application of the Schedule of Log 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.

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

14.5.4.1 Dead/Dry Log Status

Administration of the Timber Supply Anaysis harvest levels in the Yukon requires 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.

14.5.4.1.1 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).

14.5.4.1.2 Contra indicators

Contra indicators are log characteristics which indicate a log was cut from a living tree. Logs showing any contra indicators 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 contra indicator 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 contra indicator 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.

Bark beetle larvae feed on fresh, living cambium and are a good indicator that parts of a log are still fresh. If active larvae are observed, the scaler should look carefully for any contra indicators. Larvae are white, legless, stout-bodied grubs with pale, brown heads and range from 1 mm to 7 mm, with few differences in appearance between species.

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

1. Curling bark,
2. Green needles,
3. Fresh cambium (sticky),
4. Mildew or mould on wood surface (except on windthrow),
5. Dark weathered ends (indicative of decked wood),
6. Pitching log ends, or
7. Charred wood (recent fire kill).

> Mortality in trees is often a gradual process and, as such, logs may display both indicators and contra indicators. In all cases, logs displaying both indicators and contra indicators 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,
- Where fire-killed trees are incidentally harvested from undamaged or lightly fire-damaged stands, recent fire-kill will normally be taken to mean any dead standing timber that is felled within one calendar year of the fire being declared out, unless the Director of the Forest Management Branch defines otherwise.
- Where fire-killed trees are harvested from moderate to heavily damaged stands the determination of what is recent fire fill will be based upon a stand-specific decision of the Director.

Specific details of the dead/dry grades (grade codes 3 and 5) can be found in Sections 14.7.4 and 14.7.6.

14.5.4.2 Identifying Undersized Logs

Cutting specifications in the timber permit terms and conditions make reference to the diameter at breast height (DBH). This diameter is important as it determines whether or not the tree has to be utilized.

Scalers must assign an undersized grade to logs which are cut from trees that are smaller than the diameter at breast height specified in the cutting authority.

The *DBH* is measured outside the bark at a point *1.3m* 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 *DBH* is measured outside the bark at a point *1.0 m (50rads)* from the butt end on candidate logs.

To be considered for the undersized grade:

- a log must show sufficient evidence such as an undercut, butt flare, or other butt characteristics to indicate it comprises a tree and not a top cut or long butted log, and
- the outside bark measurement (averaged) at a point *1.0 m* from the butt face must be less than the minimum *DBH* 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 *DBH* is set by the Forest Management Branch at *15.0 cm (outside the bark)* for all species. More stringent utilization requirements may be set under the cutting authority.

> Where timber is cut on an area where cutting specifications are not in place, scalers are to assume a *DBH of 15.0* cm for all species.

14.6 Interpreting the Schedule of Log Grades

14.6.1 Area of Application

The Schedule of Log Grades applies to wood harvested in all areas of the Yukon Territory.

14.6.2 Rationale for Grades

Log grading is in place to meet two general objectives:

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

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

14.6.3 Schedule of Grades

SCHEDULE OF LOG GRADES
ALL SPECIES

1. Round Wood (Premium) Grade Code 1

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

(A)
the diameter at the butt end is 30 cm (15 rads) or greater, or known to have come from a tree of at least 30 cm dbh (inside the bark), and

(B)
for a Balsam Fir log, at least
67% of the gross scale can be manufactured into lumber, and at least
50% will be merchantable, and

(C)
for all other species, at least
50% of the gross scale can be manufactured into lumber, and at least
50% of the lumber will be merchantable.

2. Round Wood, Grade Code 2

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

(A)
for a balsam fir log, at least
67% of the gross scale can be manufactured into lumber, and at least
50% of the lumber will be merchantable

(B)
for all other log of a species, at least
50% of the gross scale can be manufactured into lumber, and at least
50% of the lumber will be merchantable.

3. Dead or Dry Round Wood, 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. Dry or Dead 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 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.

7. 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.

Six grades are prescribed:

Round Wood (Premium)	Grade Code 1
Round Wood	Grade Code 2
Dead or Dry Round Wood	Grade Code 3
Lumber Reject	Grade Code 4
Dry or Dead Lumber Reject	Grade Code 5
Undersized Log	Grade Code 6
Firmwood Reject	Grade Code Z

14.6.4 Principles for Applying the Schedule of Log Grades

Applying the Log Grade 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.

14.6.4.1 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

All Species	**Length**	**Diameter/ Thickness**
a. logs and log segments	2.5 m	5 rads
b. slabs and slab segments	2.5 m	7.5 rads
c. collars of firmwood around: 1. holes, heart rot and star shake if defect is > 20 % of end diameter 2. ring shake, water shake, ring rot and pocket rot.	2.5 m	5rads
d. sound hearts (cores) inside external defects, including sap rot, charred wood, ring rot and ring shake.	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 log 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> 8m.
diameter (outside bark) 1.0 m from the butt end	assessing if logs cut from undersized tree

14.6.4.2 Logs Cut from Dead Trees

Scalers must closely follow the criteria detailed under Section 14.5.4.1 of this manual.

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

14.6.4.3 Logs Cut from Undersized Trees

Scalers must closely follow the criteria outlined under Section 14.5.4.2 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 1.0 m from the butt face, must be less than the minimum diameter at breast 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.

14.6.4.4 Knots

Merchantable lumber can be produced only from logs and log segments having knots not larger than specified maximums. For 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 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. Log 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 14.4.2.2 for a more complete discussion.

14.6.4.5 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 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 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 14.6.4.5 for details on twist measurement.

14.6.5 Definition of Terms in the Schedule of Yukon Log 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 centimeters 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 centimeters of diameter.

14.7 Yukon Grade Rules and Application

The following sections explain the grading rules which pertain to the seven log grades referred to in the Yukon Timber 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.

14.7.1 Firmwood Reject - Grade Code Z (species code R)

14.7.1.1 Grade Rule

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

14.7.1.2 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:	*LO*	*Z*

14.7.2 Round Wood (Premium) - Grade Code 1

14.7.2.1 Grade Rule

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

1. the diameter at the butt end is 30 cm (15 rads) or greater, or known to have come from a tree of at least 30 cm dbh (inside the bark), and
2. for a balsam log, at least 67 percent of the gross scale can be manufactured into lumber, and at least 50 percent of the lumber will be merchantable, and
3. for all logs of species other than balsam, at least 50 percent of the gross scale can be manufactured into lumber, and at least 50 percent of the lumber will be merchantable

14.7.2.2 Application of the Grade Rule

1. For procedures to determine the percentage of the gross scale which can be manufactured into lumber see Section 14.4.2.
2. For procedures and criteria to assess lumber quality see Section 14.5.3.
3. Premium round wood logs are entered on the scale sheet as follows:

	SP	G
Example Tally Entry:	*LO*	*1*

14.7.3 Round Wood - Grade Code 2

14.7.3.1 Grade Rule

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

1. for a balsam log, at least 67 percent of the gross scale can be manufactured into lumber, and at least 50 percent of the lumber will be merchantable, and
2. for all logs of species other than balsam, at least 50 percent of the gross scale can be manufactured into lumber, and at least 50 percent of the lumber will be merchantable.

14.7.3.2 Application of the Grade Rule

1. For procedures to determine the percentage of the gross scale which can be manufactured into lumber see Section 14.4.2.

2. For procedures and criteria to assess lumber quality see Section 14.5.3.

3. Round wood logs are entered on the scale sheet as follows:

	SP	G
Example Tally Entry:	*LO*	*2*

14.7.4 Dead or Dry Round Wood - Grade Code 3

14.7.4.1 Grade Rule

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

14.7.4.2 Application of the Grade Rule

1. The requirements for this grade are identical to those of the round wood grade except Grade 3 logs are logs which were cut from trees which were dead and dry when harvested. Note that dry round wood logs are not graded according to size class, so logs that meet the criteria of grades 1 or 2, but were dead/dry when harvested, are classified as grade 3.

2. The criteria outlined in Section 14.5.4.1 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
Example Tally Entry:	*LO*	*3*

14.7.5 Lumber Reject - Grade Code 4

14.7.5.1 Grade Rule

A log or slab lower in grade then round wood and higher in grade than firmwood reject.

14.7.5.2 Application of the Grade Rule

1. Logs and slabs which do not meet the requirements of the round wood 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
LO	*4*

14.7.6 Dry or Dead Lumber Reject - Grade Code 5

14.7.6.1 Grade Rule

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

14.7.6.2 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 14.5.4.1 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
LO	*5*

14.7.7 Undersized Log - Grade Code 6

14.7.7.1 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 bark, at breast height (dbh).

14.7.7.2 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 breast height (dbh) outside the bark specified in the cutting authority.

2. The criteria outlined in Section 14.5.4.2 must be closely followed in identifying undersized logs.

3. If timber is harvested on an area not having cutting specifications set by the Department, Scalers are to assume a DBH of 15cm (outside the bark) for all 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
LO	*6*

14.8 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 (grade code Z).

3. A log that qualifies as a dry or dead lumber reject (grade code 5) takes precedence over lumber reject (grade code 4).

4. A log which qualifies as a dead or dry round wood (grade code 3) takes precedence over the green round wood grades (grade codes 1 and 2).

5. A log which qualifies as a lumber reject, (grade code 4) takes precedence over the green round wood grades (grade codes 1 and 2).

6. A log which qualifies as a premium round wood (grade code 1) takes precedence over the standard round wood grade (grade code 2).

14.9 Field Methods for Grade Reduction

The following methods for calculating grade reduction may be substituted for the methods described in Section 14.5, in most cases. These methods will closely approximate the prescribed formulas, and many scalers find them easier to apply. Their use can reduce both the time required to calculate grade reductions, and the chance of errors in calculation.

This appendix describes three field methods for three distinct types of defect situations. A description of where each may be used, and comment regarding the accuracy of the method are included.

The field methods express the grade reduction (GR) in terms of log length. The length of the grade reduction is then compared to the gross length of the log to determine the grade reduction percentage.

The three formulae are presented below, and explained in detail in the following sections.

- Formula #1 (non-conical defects):

  UV of lumber loss / Av. UV for the log x length of defect = GR length in metres
  (follow Formula #1 with Formula #3 to convert GR in metres to a percent),

- Formula #2 (cone-shape defects):

  UV of lumber loss / Av. UV for the log x length of defect / 3 x 2 = GR length in m
  (follow Formula #2 with Formula #3 to convert GR in metres to a percent), and

- Formula #3

  Length of GR / log length x 100 = % GR .

14.9.1 Formula #1

This formula is for use where the linear portion of the log affected by defect is partly suitable to cut lumber and part grade reduction.

The formula may not be used for conical defects such as butt rot and water shake (see Formula #2).

The "UV of lumber loss" is the unit volume for the log-end area unsuitable to cut lumber, including rim allowance where applicable.

Where the defect has two ends with different sizes, as with full length defects, the average of the two end unit volumes is used as the "UV lumber loss".

The "average UV of the log" is the average of the unit volumes for the top and butt diameters. For practical purposes, the UV for the average diameter may be used for most logs, but the accuracy of this short cut decreases as taper increases.

This formula expresses the grade reduction in log length. That length is then compared to the gross log length (as described by Formula #3) to obtain the percentage of the gross log that is grade reduction.

Use of this formula will yield identical results to the methods prescribed in Chapter 2. Because it employs unit volumes it is often easier to use, and is more adaptable to quick field calculations.

Examples of types of defects for which this formula may be used are heart rot, ring rot, pocket rot, ring shake, checks, and sap rot.

14.9.2 Formula #2

This formula is for use with butt rot and butt shake, where the defect does not show in the top end of the log.

The "UV of lumber loss" is the unit volume for the base diameter of the defective area, when viewed in terms of suitability to cut lumber. For irregular and scattered defect that diameter will often be significantly larger than what would be used for a firmwood deduction.

The "UV of lumber loss" does not include trim allowance or collars too thin to cut lumber when using this formula.

Once the "UV of lumber loss" is established, the grade reduction is the same as a firmwood deduction would be, except that the result is doubled.

The "average UV of the log" is the average of the unit volumes for the top and butt diameters. The alternative of using the unit volume of the average diameter becomes less accurate as taper increases.

This formula expresses the grade reduction in log length, which is then compared to the gross length (as described by Formula #3) to obtain the percentage of the grade reduction.

Where the defect shows through to the top end, Formula #1 is used. The "UV of lumber loss" is the unit volume for average of the two defect diameters plus trim.

14.9.3 Formula #3

14.9.3.1 For Converting Grade Reduction in Metres to a Percentage

This formula simply converts the length of a log lost to grade reduction to a percent of the gross log length, which is then used as the percent of grade reduction.

When Formula #3 is used to convert length reductions derived from either Formula #1 or Formula #2, it is completely accurate.

14.9.3.2 For Estimating Grade Reduction Percentage from Length Losses

A second application of Formula #3 is where an estimated length of log is completely lost for lumber recovery. In those cases, the length of the grade reduction portion of the log is compared to the gross log length (using this formula) to get an estimate of the grade reduction percentage.

Examples of where the formula may be used in this way are heart rot with a collar too thin to cut lumber, conk, shatter or breakage, pistol grip or crook, and bark seams.

This procedure of using a direct length comparison without applying a factor to account for the taper of the log (as Formulae #1 and #2 do) is sometimes called the lineal method of grade reduction.

Because log taper is not considered, this method is not precise, and the degree of error correlates with the amount of taper in the log. However, the errors tend to compensate over a number of logs, and the "lineal method" is readily adaptable to practical use in scaling.

Consequently, for the defect situations to which it applies, use of the lineal method is standard practice in coastal scaling for logs with up to 50 percent taper (or where the butt diameter is not more than 1.5 times the top diameter).

The method should be used with caution on logs with more than 50 percent taper, where it should not be relied upon for close grade calls. The method should not be used for logs with over 100 percent taper (butt diameter more than two times the top diameter).

The lineal method is more practical than volumetric calculations where large volumes, or highly defective logs are scaled. It is also conducive to more consistent results, particularly on large diameter logs, because differences in diameter measurements will not influence the grade reduction calculation.