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Introduction

Under British Columbia's *Forest Act*, all timber harvested from both Crown and private land must be scaled. Timber is scaled to determine its volume and quality.

This manual documents how timber is scaled for purposes of the *Forest Act* and the *Scaling Regulation*.

Scale data is the basis for many transactions for both government and industry. To ensure scale results are reliable and mean the same thing to all users, scaling is dependent upon compliance with the standards, conventions, and procedures prescribed in this manual.

Need More Information?

This manual was written as a reference and a working tool for government, industry, students and anyone else with an interest in scaling. With such a broad target audience, it may not provide sufficient detail to meet all your needs.

If you need clarification on any topic, we encourage you to contact your local Forest Service office.

We Need Your Comments and Suggestions

To ensure this manual is useful for you, it is important that you provide us with your comments and suggestions.

Please send them to:

Scaling Policy Forester Ministry of Forests Revenue Branch 2nd Floor, 1450 Government Street Victoria, B.C. V8W 3E7
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Some of the Elements of Scaling



*Hammer indenting a log
with a timber mark.*



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



A loaded truck on a weight scale.



A defective log on a scale site.



A coastal dryland sort.

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Scaling Overview

1

Scaling plays a very important and significant role in meeting the needs of both government and industry. This chapter provides an overview discussion on:

- the role and importance of scaling,
- the evolution of B.C.'s scaling practices, and
- an overview of the legal and administrative framework for scaling.

The chapters following describe B.C.'s scaling practices in detail.

1.1 The Role of Scaling and its Importance

Scaling plays a very important role for government, the forest industry and other users of scale data. For government, scale data are used to invoice the forest industry for stumpage and royalty (in 1994/95 almost \$2 billion in stumpage and royalty was billed) and to administer the cut. For the forest industry, scale data are the basis for many transactions, including buying and selling forest products, and, contractor payment. In short, many parties are dependent upon an accurate and meaningful scale. The scaler is the most significant player in providing this assurance.

As discussed in the following sections, scaling practices in British Columbia have adapted and evolved to meet the needs of the consuming wood industry, government and other parties with an interest in the scale.

1.2 The Evolution of B.C.'s Scaling Practices

Scaling in British Columbia is rich in history. An understanding of this history provides an insight into today's scaling practices and their roles and relationships in forest administration.

1.2.1 British Columbia's Official Scales

The earliest scaling in British Columbia comprised the licensee or lessee keeping a written account of the number of trees felled on a tract of land. Each month, the operator submitted a sworn statement of trees felled and accepted responsibility to pay dues based on this count. The term "stumpage" arose from this crude procedure. While the approach enabled a fast and accurate check on the statement of trees felled and dues payable by simply counting stumps, it failed in providing meaningful information for buyers and sellers about value, volumes and quality. The need for a more accurate and versatile scale was soon identified.

In 1895, the British Columbia Board Foot Log Scale was established as the official scale. It was used to determine scale in foot board measure (BCFBM). The Scribner Decimal C and Doyle Log rules were used along side the B.C. Log Rule until 1915 at which time they were no longer accepted for government measurement purposes. The B.C. Log Rule was derived mathematically and was tempered with certain arbitrary assumptions (Figure 1.1).

$V_{\text{FBM}} = .0476(D - 1.5)^2 L$			
where:	V_{FBM}	=	volume in foot board measure (board feet),
	D	=	small end diameter in inches, and
	L	=	length in feet.

Figure 1.1 The B.C. Log Rule.

The resulting formula yielded the number of board feet of lumber (rough, green) that could be cut from logs of a given length and small end diameter. The formula was later modified to better account for longer logs.

While the B.C. Log Scale provided satisfactory results of the timber profile harvested when the rule was first introduced, later forest exploration in the 1930s saw the harvest of smaller timber and production of longer logs. Scale results quickly came under criticism from buyers and sellers, and scaler's were accused of manipulating scale results to the benefit of their employer. This problem is inherent of scale rules just as much today as it was then. Consistent and accurate results can only be expected when the timber profile and processing practices are within the often narrow confines of that assumed in the log rule. By the 1940s, over 50% of the provincial cut was converted into products other than lumber, and as such, users of scale data often had little interest in a scale premised on lumber recovery.

In 1946, an amendment to the *Forest Act* introduced the British Columbia Cubic Scale. The amendment followed the 1945 Sloan Royal Commission Report, which set out a blueprint for the introduction of sustained yield forestry to the province. The cubic scale was introduced as a means of developing information that would be more useful for the Forest Service in reconciling forest depletion with its inventory.

In contrast to the British Columbia Log Scale, which attempted to estimate the amount of lumber that could be produced from a log, the cubic scale made no allowance for wood wasted in slabs and kerfs, and only attempted to estimate the volume of the log suitable for the manufacture of lumber. The Cubic Scale was not expressed in foot board measure (FBM), but rather cubic feet (or 'cunits', representing 100 cubic feet).

Initially, the cubic scale was known as the B.C. Lumber Cubic Scale because the scale made allowances for log defects such as twist, crook, knots, shake, and split. It also allowed for collars of sound wood around holes and rot to recognize that defects must be 'squared out' in the manufacture of lumber.

During the mid-1960s, with the introduction of Close Utilization Standards, the references to lumber manufacture were dropped from scaling and the scale only represented the net firmwood content of each log. The only permissible deductions for scaling purposes were rot, missing and charred wood, and catface. This scale became known as the B.C. Firmwood Cubic Scale.

When first introduced in 1946, the use of the cubic scale was optional and licensees could use either an FBM or cubic scale. In 1952, all new sales made provision for cubic scale, and in 1972, both FBM and lumber cubic scales were no longer authorized for use. Metrication in 1978 saw the B.C. Metric Cubic Scale proclaimed as the only official scale for British Columbia, and it remains so today.

From the inception of cubic scaling, the Smalian formula (Figure 2), which calculates logs on the basis of a parabolic frustrum, was adopted as the cubic scale rule. This scale requires measurement of the two inside bark diameters and the length.

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

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

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

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

L is the length of the log in m.

Figure 1.2 The Smalian formula.

The elimination of the FBM log scale was met with much resistance from the forest industry, and was an eddy of controversy from within government as well as within industry. Although cubic scaling represented a stronger and more consistent basis for forest depletion and revenue collection for government, the industry was very reluctant to base commercial transactions on a scale that was unrelated to product output. Dual scales in cubic and FBM became commonplace and are common to this day, as are the use of conversion factors to better relate scale data to a given product.

The Scribner Decimal C Scale is still the basis for most forest commerce in the western United States and Alaska, as well as in the Asian markets. Similarly, there is still a demand for scaler's with experience using the B.C. Log Scale (FBM), even though it was removed from official use years ago.

The use of dual scales clearly reflects the observation that one scale often does not satisfy all needs.

Figure 1.3 itemizes principal scaling events in greater detail.

1884	Scribner's Lumber and Logbook, Doyle Rule (F. B. M.) used as basis for scaling.
1894	Provision for Appointment of Official Scaler's under the Official Scaler's Act.
1895	B. C. Board-foot Log Scale (FBM) established as the official scale.
1902	Log grades first established made official by Timber Measurement Act, 1902.
1912	Provision for Re-scales to be made, also the issuance of licences (proclaimed under the first B. C. <i>Forest Act</i> , which also established the B. C. Forest Service).
1915	Doyle rule no longer accepted, new log grades for cedar, fir, spruce, pine and cottonwood.
1920	Scaling fund established, official scaler's were given the opportunity to apply for civil service status.
1944	Cubic measure first authorized for use - B. C. Cubic Scale (Lumber Cubic).
1948	Hemlock log grades introduced.
1952	New timber sales and T. F. L. permits to be scaled by B. C. cubic scale - Dual scale performed (i.e., Cubic Scale and BCFBM).
1963	Weight scaling introduced in B. C. Interior.
1965	Firmwood cubic scale introduced (FBM and cubic).
1972	B. C. Log Scale (FBM) and lumber cubic discontinued.
1979	Metric Scale replaced Imperial firmwood cubic (B. C. metric cubic scale proclaimed the official scale for B. C.).
1979	Alleged scaling incident at Shoal Island.
1980-81	Portable data recorders for scaling developed by the Ministry and Epic Data Limited.
1981	Coastal letter grades adopted (change from numeric to letter grades).
1985	Revenue scaling was privatized.
1988	Log grading was introduced to the Interior (Sawlog, Lumber Reject, Firmwood Reject grades).
1988	Provision made for industry to transmit scale data electronically.
1989	Auditor General Review cites shortcomings in scaling and scale controls.
1990	Zero Waste Policy Introduced - Waste Measurement Procedures introduced for entire province.

Figure 1.3 Scaling in B. C. - Principle Events.

1.2.2 Log Grading

Log grading dates back to 1902 on the B.C. coast. Timber is graded to provide information about potential end use and log quality and, as such, makes scale data more meaningful for various transactions and administering the cut. Grading is regulated by schedules of timber grades specific to the coast and the interior under the *Scaling Regulation*.

While the early very basic schedule of timber grades evolved and expanded greatly in response to changing demands and needs to make scale data more relevant for its many users, the principles of grading have changed very little over the years.

Grading played a much lesser role in the interior until 1988, at which time a formal schedule of grades was introduced to better differentiate timber quality and to accommodate revisions to the utilization and timber pricing policies.

1.2.3 The Roles and Responsibility for Scaling

The appointment and licensing of scaler's has remained a responsibility of government since 1894 with the proclamation of the Official Scaler's Act. While the Pacific Northwest States moved towards the concept of a third party scale under log scaling bureaus jointly funded by buyers and sellers, the provincial government policy until 1985 saw provincial employees conducting almost all scaling for revenue purposes. Non-government licenced scaler's were authorized for scaling only where government scaler's were not available, or where timber values were considered low.

Government scaler's were not commonplace in the interior until the early 1960s because the less significant interior harvest was largely processed through many small bush mills. Rapid expansion of the interior forest industry occurred during the 1960s with the introduction of pulp mills and the consolidation and centralization of the industry.

British Columbia's policy on scaling is rooted in the province owning over 90% of the forest land base. During the 1960s and 1970s, this arrangement saw some 450 to 500 government scaler's trained and supervised by the province. While various funding arrangements were in place, the industry traditionally absorbed the costs of scaling.

In 1985, the responsibility for all revenue scaling was transferred to the private sector. Several factors contributed to this policy change:

- it reduced the direct costs of government,
- it removed any potential union interface problems between government scaler's and industry workers, and
- it reduced government interference with industrial operations and allowed industry more flexibility in staffing and operating scaling stations.

Government's role in scaling is now comprised of the following activities:

- Examining and licencing scaler's,
- Authorizing and appointing scaler's and setting all revenue scaling policies and procedures,
- Authorizing scale sites and setting scale site conditions,
- Designating where timber must be scaled,
- Setting scale data computation and data control procedures and standards, and
- Assessing compliance with scaling requirements and standards.

1.2.4 Scaling Methods

Scaling accounts for some 86% of the provincial harvest. About 14% of the harvest is accounted for through a cruise-based measurement procedure. The cruise-based procedure is confined to the interior's uniform stands and has a minimal presence on the coast. In B. C., two principal scaling methods are in place:

- Piece Scaling, and
- Weight Scaling.

1.2.4.1 Piece Scaling

Piece scaling or stick scaling accounts for some 85% of coastal production and about 3% of interior production. This procedure involves measuring and grading each log, usually while they are spread out in a log yard or in a log boom floating in the water.

Before the introduction of weight scaling in the early 1960s and dryland sorts in the 1970s, almost all coastal production was piece-scaled in the water in the form of booms. Today, piece scaling through dryland sorts accounts for about 95% of the coastal piece scale production. Less than 5% is still scaled on the water. Dryland sorts are flat areas, usually paved, where loads are lifted out of the water or offloaded from logging trucks and spread onto the ground for scaling, grading and subsequent sorting. For scaling, the identity of each load is retained for control purposes. A listing of scale details is also maintained for all logs scaled. Accurate scaling is greatly facilitated through dryland sorts as the scaler can view almost the entire log with boom scaling, only a small surface was available for inspection.

After scaling and grading, the logs are picked up by stackers and put into log bunks according to their log grade or company sort code. From there, the logs are bundled and transported to a processing facility, or other destination. Interior piece scale production is predominantly in the form of small operator scaling, often in the millyard.

1.2.4.2 Weight Scaling

Instead of scaling each piece, weight scaling is a sampling method where only a portion of the total production is measured or sampled. Based on the sample results, estimates are made about the production.

The 1960s and 1970s saw the rapid growth of B.C.'s interior forest industry fueled by the construction of pulp mills and the resultant demand for sawmill residues. Over the same period, government policy provided incentives for licensees to adopt close utilization standards in the bush. This coupled with improvements in sawmilling technology resulted in truckloads arriving at the scale site with dramatically smaller average log size and increased number of pieces on the truck. Weight scaling represented an opportunity to estimate harvested volumes with an acceptable level of accuracy and it costs lower than scaling each piece.

When first introduced in the early 1960s, weight scaling was restricted to homogeneous small diameter spruce and lodgepole pine stands. Its use was subsequently expanded as confidence was gained using the approach. Today, over 95% of interior production is weight scaled.

On the coast, less homogeneous forest types, more complex sorting and marketing needs, and more complex transportation and log handling opportunities have impaired the acceptance of weight scaling. While weight scaling offered the same cost savings, it also represented an opportunity to account for logging production before it was put into the water and transported to processing plants. During the 1960s, almost all the coastal logging production was stick scaled while it was boomed in the water. Sinkage often accounted for very significant losses before the logs were scaled. If logs were weighed before they were watered, depletion could be correctly stated and Crown revenues could be controlled. Needless to say, the Forest Service encouraged weight scaling for coastal operations.

Weight scaling grew in prominence on the coast during the 1970s and early 1980s (up to 30% of coastal harvest) but lost in prominence with the growth of dryland sorts and the inability of the weight scale system to provide reliable species and grade volumes to coastal users. In 1994, weight scaling on the coast accounts for less than 15% of the total harvest.

1.2.4.3 Special Forest Products

Instead of raw logs, sometimes partially or fully manufactured products are scaled. These are known as special forest products.

Special forest products comprise about 3% of forest production in B.C. and includes Christmas trees, cribbing, poles and posts, stakes, piling, shakes and shingles, bolts and blocks, and other products as outlined in Chapter 8. To be classified as a special forest product, the product must conform to the product description, be contemplated in the cutting authority (i.e., for Crown timber), and be manufactured on the area of harvest.

For scaling, the scaler does a piece count or uses a variety of approaches to estimate the volume. All special forest products are reported in cubic metres for cut administration and reporting purposes.

1.3 The Legal and Administrative Framework for Scaling

1.3.1 General

The legal and administrative framework for scaling in British Columbia is set by Part 6 of the *Forest Act* and the *Scaling Regulation*. This legislation contains the authority for scaling and sets out the requirements for scaling. It is applicable to all timber cut from both publicly and privately owned land within provincial jurisdiction. This legislation does not apply to timber cut on lands falling under federal jurisdiction. Such timber includes timber cut on Indian or military reserves.

This manual and B.C. Forest Service Scaling Policy fall within the same legislative framework and further define how scaling will be practiced and administered.

All roundwood scaling procedures must conform to the minimum criteria for scaling roundwood in metric units and minimum specifications for scaling instruments established in the Canadian Standards Association (CSA) Standard CAN3-0302.1-M86, Scaling Roundwood. The CSA Standard is the National Standard for Canada and was prepared by the CSA Technical Committee on Scaling of Primary Forest Products. British Columbia is represented on this committee.

The appendix to this chapter provides a brief discussion of each section of Parts 5 and 6 of the *Forest Act* and the *Scaling Regulation*.

Appendix 1A Synopsis of Parts 5 and 6 of the *Forest Act* and the *Scaling Regulation*

The objective of the following discussion is to acquaint users of this manual with a basic understanding of the various provisions of the *Forest Act* and the *Scaling Regulation*. It is not intended to provide a comprehensive discussion.

1A.1 The Forest Act - Part 5 - Timber Marking

While timber marking does not generally fall under their responsibilities, scalers are required to record timber marks as a part of recording scale results. As such, scalers must have a working knowledge of timber marks, scaled timber brands, and marine log brands as well as the requirements for timber marking and branding.

Timber marks are a one to six character code that are either painted or stamped on the ends of logs to identify the authority under which the timber was harvested as well as other information about the timber.

1A.1.1 Section 64

Under Section 64 all timber marks for the agreements listed in Section 10 of the *Forest Act* have expiry dates and the maximum duration of any given mark is five years.

Ensure you have a current copy of the *Forest Act* and the *Scaling Regulation*. If in doubt contact Crown Publications to purchase new copies.

1A.1.2 Section 65 - Timber Mark and Marking Requirements

Under Section 65 the holders of a timber mark and the person(s) working with their consent must ensure timber is conspicuously marked in the prescribed manner and prior to transport off the area of harvesting. The prescribed manner is set under the *Timber Marking Regulation* as hammer indentation on each end of each piece. Subsection 65 (5) enables exemptions from the marking requirements and authorizes conditions to be part of the exemption.

The format of exemptions is defined under the Scaling Policy. Exemptions from the marking requirements under Section 65 will not be issued if timber will be waterborne or subject to export. Timber transported out of a jurisdiction (region or district) will not be exempted from full marking unless a different level of marking is approved by the receiving jurisdiction. In all cases, the minimum level of marking is set by the regional manager.

In addition, under policy, harvesting agreements and cutting authorities may include a standard clause requiring the licensee to erect signs at the exit point of each cut block clearly showing the timber mark applicable to that cut block.

1A.1.3 Section 66 - Timber Mark Applications

This section requires that timber marks must be applied for. In addition, this section authorizes timber marks to be cancelled if the mark holder contravenes a provision of Part 5 or 6 of the *Forest Act* or for other sufficient cause. When this action is contemplated, the timber mark holder must be given an opportunity to be heard before the mark is cancelled.

1A.1.4 Log Brands

Log Brands are applied to logs to indicate that timber has been scaled. Section 66.1 and 67 (i) authorize two types of brands.

1A.1.4.1 Section 66.1 - Scaled Timber Brands

Under Section 66.1 timber that has been scaled must be marked with a scaled timber brand before being removed from the scale site. The method of marking is prescribed by regulation and exemptions may be issued with conditions attached.

1A.1.4.2 Section 66.2 - Applications for Scaled Timber Brands

This section provides that a certificate describing a scaled timber brand and the scale site to which it applies be issued upon application. Scaled timber brands may be cancelled under subsection 66.2 (2).

1A.1.4.3 Section 67 (1) - Marine Log Brands

Section 67 (1) provides for issuance upon application of a marine log brand by the Registrar of Timber Marks. Where approved, a certificate containing a facsimile of the marine log brand is issued. Under this section, marine log brands must be unique and not resemble any other marine log brand.

1A.1.4.4 Section 68 - Marking with a Marine Log Brand

This section requires timber to be marked with a brand only after it has been marked with a timber mark and it has been scaled. Under the *Timber Marking Regulation* the prescribed method of marking is hammer indentation on each end of each piece and under Section 68 the brand must be readily discernible when the timber is in water.

1A.1.5 Section 69 - Transfers

Under this section timber marks, scaled timber brands, or marine log brands must not be used without the consent of the holder. Use of marine log brands may not be transferred from the holder to another person without the consent of the regional manager or the district manager and without prior written notice to the Registrar of Timber Marks.

Timber marks and scaled timber brands are not transferable and, as such, changes in ownership result in timber marks and scaled timber brands being cancelled and re-issued.

1A.1.6 Section 70 - Evidence

This section provides that the certificate describing the timber mark and its holder is a legal document and can be used as evidence in court.

1A.1.7 Section 71 - Registers Must be Kept

This section simply requires the Registrar of Timber Marks to maintain a register for timber marks and marine log brands and the register must include details as outlined.

To Summarize

Timber carrying a timber mark tells you:

- The timber mark identifies the cutting authority under which the timber is harvested. This information can then be used to identify the area of origin, the identity of the markholder, and the exportability of the timber.

Timber carrying a marine log brand tells you:

- The timber has been scaled, and
- The timber is owned by the holder of the brand.

A marine log brand does not tell you where the timber was scaled and its use is optional.

Timber carrying a scaled timber brand tells you:

- The timber has been scaled, and
- Where it was scaled.

It does not designate ownership and its use is mandatory unless exempted.

1A.2 The *Forest Act* - Part 6 - Timber Scaling

1A.2.1 Section 72 - Interpretation

The term "to Scale" under the *Forest Act* means:

- To determine the volume or quantity of timber, and
- To classify the quality or grade of that timber.

Timber under the *Forest Act* (Section 1) is defined to include trees, whether standing, fallen, living, dead, limned, bucked, or peeled and for purposes of the *Scaling Regulation* includes special forest products.

1A.2.2 Section 73 - Timber to be Scaled

Section 73 sets the requirement that all timber harvested under jurisdiction of the province (both private and Crown land) must be scaled prior to manufacture or sale, or transported to a place, other than where it is required to be sent for scaling. It is ministry policy that the place of scaling for all timber marks must be designated to one or more authorized scale sites prior to transport off the area of harvesting.

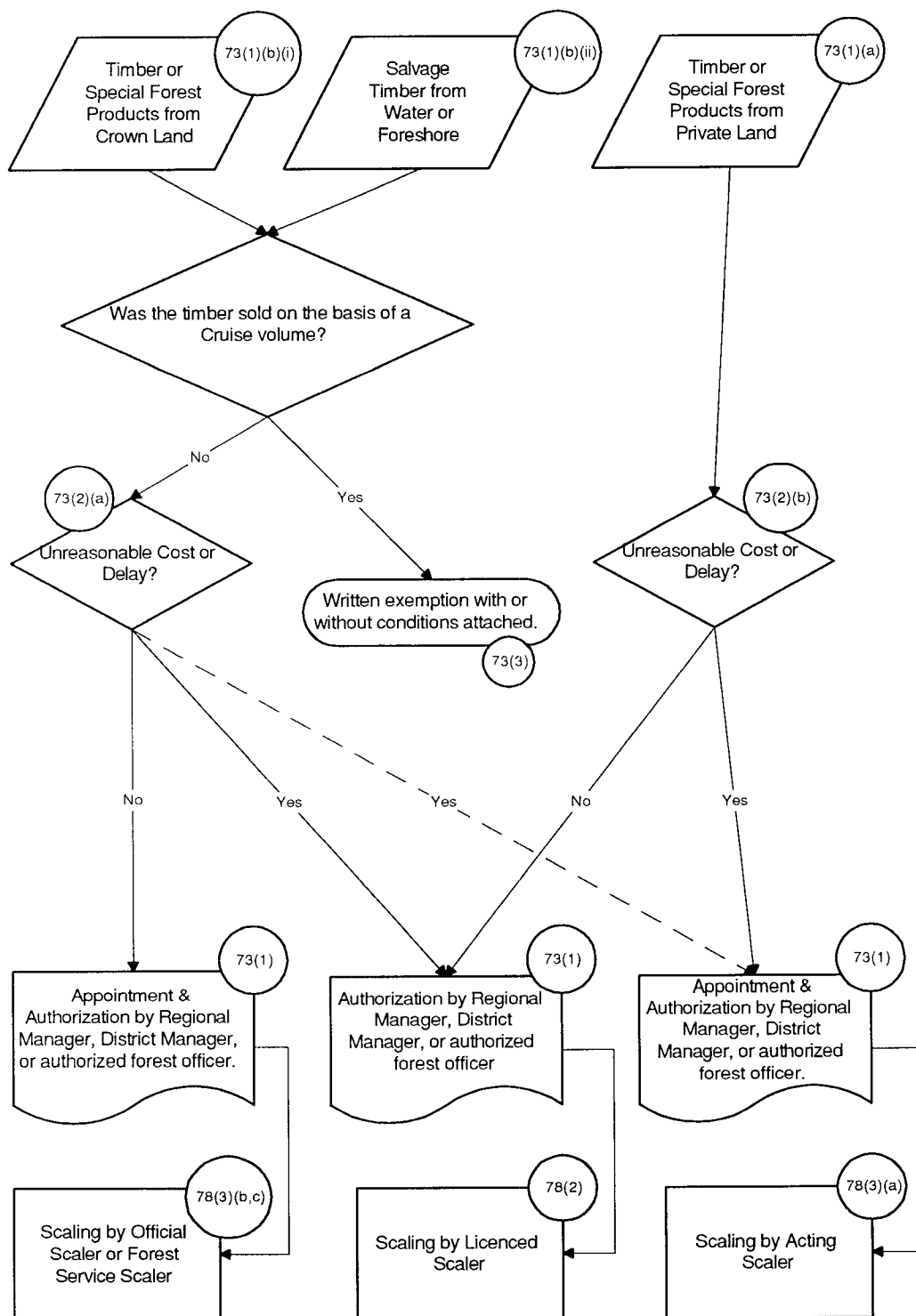


Figure 1A.1 Flow diagram outlining scaling requirements under Sections 73 and 78 of the Forest Act.

This further defines who may be authorized to scale under various circumstances. Figures A and B are schematics summarizing subsections 73. (1), 73. (2) and 73. (3) as they relate to timber harvested on private and Crown lands.

The intent underlying Section 73 is to ensure that Crown timber is scaled by the most competent and qualified scaler's available. Less demanding requirements are in place for timber cut on private lands as private timber is not subject to stumpage and royalty, and is not generally regulated for cut control purposes.

1A.2.3 Subsection 73. (2.1) - Scaling Special Forest Products

This subsection provides the authority to scale special forest products in product form instead of in timber form where the special forest products are manufactured on the same site where the timber was felled. Chapter 8 of this manual details special forest product descriptions and defines when special forest products may be scaled instead of timber in log form.

1A.2.4 Subsection 73. (2.2) - Set Aside Requirements for Check Scaling

Provided under this subsection is the requirement that the most recently scaled parcel or load of logs for each scaler at the scale site be set aside or retained at the scale site and be accessible for check scaling. The responsibility for this requirement applies to the owner of the scale site, the scale site operation, or the owner of the timber.

1A.2.5 Section 73 - Exemptions from Requirements

Sections 73. (2) and 73. (3) provide the authority to the designated persons to exempt the requirements of Section 73 and attach conditions to the exemptions.

Criteria for scaling exemptions are defined under ministry scaling policy. Exemptions from the other requirements of Section 73 may be considered where ministry objectives are not compromised by the exemption.

1A.2.6 Subsection 73.1 - Scale Site Authorization

This subsection requires that timber be scaled only at scale sites that have been authorized by the named persons. Scale site authorizations must be applied for and applications may be denied as outlined in subsection 73.1. (3). Scale site authorizations may include conditions to ensure a complete and accurate scale. Provision is included to add, modify, or remove conditions. Where there is contravention of sections (i), (ii) or (iii) listed under Section 73. (1) (6) a scale site authorization may be suspended or cancelled after the holder has been given an opportunity for a hearing.

The responsibility for complying with the scale site authorization rests with the owner of the scale site, the operator of the scale site, and the holder of the scale site authorization.

The intent of Scale Site Authorization is to ensure all timber is scaled in controlled conditions that support a complete and accurate scale.

1A.2.7 Section 74 - The Metric Scale

Under the *Forest Act* all scaling must be carried out in accordance with the procedures prescribed under the *Scaling Regulation*. These procedures are set out in several sections of this regulation.

1A.2.7.1 Time of Scaling

Section 2 of the *Scaling Regulation* requires that timber be scaled as soon as possible after it is cut. Specific standards are not prescribed so that the factors such as the method of harvesting, log handling and transportation practices which impact the timing between harvesting and scaling can be recognized.

1A.2.7.2 Late Scale Invoice

Where it is determined that timber has not been scaled as soon as possible after it is cut, Section 3. (1) of the *Scaling Regulation* enables an invoice to be issued to the owner for any stumpage or royalty and any other charges that may apply. This invoice may be based on an estimate. When a scale is undertaken, Section 3. (2) requires the invoice to be adjusted to reflect the scale. If however, it is concluded the delay in scaling caused the volume to change or the quality to deteriorate, Section 3. (3) provides that the initial invoice based on the estimate may stand as issued.

1A.2.7.3 Bucking at the Scale Site

Section 4 of the *Scaling Regulation* provides the necessary authority to control the bucking of logs prior to scaling. The intent of this section is not to forbid the bucking of logs prior to scaling, but rather to ensure logs are cut to improve the resultant scale. Under the section, timber must not be bucked at the scale site unless bucking has been permitted or ordered. This is often covered under conditions included in the scale site authorization.

Where timber has been bucked at the scale site prior to scaling into lengths of less than the prescribed minimums, subsection 9. (2) deems the log lengths for the purposes of grading to be 5.2 m for the Coast Schedule of Grades and 2.5 m for the Interior Schedule of Grades.

1A.2.7.4 Type of Scale

Section 5 sets out the different types of scale:

- a. by scaling each piece (piece scaling),
- b. by scaling samples under the weight scaling system, or
- c. other methods approved by the persons named under Section 5.

Where timber is scaled under weight scaling, subsection 5. (b) of the *Scaling Regulation* sets out the legislative requirements that must be satisfied. Weight scaling is covered under Chapters 9 and 10 of this manual.

This section requires that special forest products other than poles, pilings, building logs, and Christmas trees must be scaled by a method approved by the regional manager, district manager, or a forest officer authorized by either. Poles, pilings, and building logs must be scaled either by piece or weight scaling. Christmas trees must be scaled by classifying each tree according to species and length class, and counting the number of trees in each classification. Chapter 8 of this manual documents scaling of special forest products in detail.

1A.2.7.5 Scaling Procedures

Section 6 of the *Scaling Regulation* prescribes how a scaler is to scale timber and record scale data. This manual details these requirements.

1A.2.7.6 Timber Grading

Sections 7, 8, and 9 of the *Scaling Regulation* set out the requirements for classifying the grade of timber as required under subsection 6. (k).

Section 7 prescribes that cut from an area in which timber is appraised using a log based appraisal must be graded in accordance with the Schedule of Coast Grades. Timber cut from all other areas must be graded using the Schedule of Interior Grades.

Section 8 outlines the placement of grades in the schedule where the grade criteria matches more than one grade.

Section 9. (1) defines what rounding conventions are to be applied in using the schedules of timber grades.

Section 9. (2) prescribes the disposition of grades where timber has been bucked at the scale site into lengths less than prescribed minimums (see Bucking at the Scale Site, Section 7.3).

Timber Grading is discussed in detail under Chapter 7.

1A.2.7.7 Calculation of Log Volumes

Section 10 of the *Scaling Regulation* prescribes the method and standards for calculating scaled log volumes under the British Columbia metric scale.

The basis for the B.C. Metric Scale is detailed in Chapter 5 of this manual and the standard for calculating volumes is contained in appendix to Chapter 7.

1A.2.8 Scale Return

Subsection 75. (1) of the *Forest Act* requires the owner of the scale site, the operator of the scale site, the person whose timber is being scaled, and the person who performed the scale to complete a scale return in a form approved by the minister. The section further requires a copy of the scale return to be delivered within a prescribed time to the person whose timber is scaled and to the regional or district manager and also retain a copy at the scale site.

Subsection 11. (1) of the *Scaling Regulation* prescribes the required timing for submission of the scale return to be seven days after the end of the period stated under the scale site authorization. Subsection 11. (2) further prescribes penalties where these timing requirements are not met.

Section 12 of the *Scaling Regulation* further authorizes the regional manager to order the electronic submission of scale returns where the annual volume from the scale site exceeds 50 000 m³.

1A.2.9 Check Scales

Subsection 75. (4) of the *Forest Act* provides that where a check scale conducted under Section 73. (2.2) of the *Forest Act* varies from the original scale by a prescribed percentage in terms of volume or value, the check scale governs for purposes of the *Forest Act*. Section 14 of the *Scaling Regulation* sets the prescribed percentage at 3%.

Subsection 75. (5) of the *Forest Act* authorizes the named persons to exempt replacement of the original scale by the check scale where it is considered the original scale was performed in accordance with good scaling practices and the differences in the original scale and the check scale are attributable to the condition of the timber.

Subsection 75. (6) of the *Forest Act* makes various persons responsible for ensuring the original scale details are replaced by the check scale details where a replacement is required.

In addition, Section 13 of the *Scaling Regulation* enables the costs in attempting to conduct a check scale to be assessed against the scale site owner or operator where a check scale cannot be performed because the set aside requirement under Section 73. (2.2) of the *Forest Act* has not been complied with.

Section 15 of the *Scaling Regulation* authorizes a second check scale to be conducted at the request of a scaler whose scale has been replaced as the result of a check scale.

This section provides a recourse for scaler's to have a second binding opinion if they do not agree with a check scale that replaced their original scale.

Where a second check scale is conducted, it becomes the basis of comparison with the original scale. Unlike a check scale where value is included in the replacement criteria, replacement of an original scale by a second check scale is dependent only upon the volume difference. If the second check scale varies from the original scale by more than the prescribed 3%, the second check scale must replace the original scale and the scaler who requested the second check scale must pay the costs and expenses incurred by the ministry in conducting the second check scale. Where the second check scale is between 0 and 3% of the original scale, the original scale is confirmed and the scaler who requested the second check scale is free of any expenses incurred by the ministry in conducting the second check scale.

1A.2.10 Scaling Costs

Various fees, costs, and expenses are prescribed under Section 76 of the *Forest Act*. The only charges levied by the Crown under this section are where the Crown incurs expenses and costs in doing the scaling and preparing and submitting the scale return. These charges are contained in a schedule as specified by the Chief Forester.

1A.2.11 Second Scale

Section 77 of the *Forest Act* sets out the conditions under which timber may be scaled a second time to check on the accuracy of the original scale.

This section provides a recourse for any person with an interest in the original scale to contest the accuracy of the scale. Where conducted, the results of the second scale are binding. Where the second scale varies from the original scale by more than a prescribed percentage in terms of volume, the second scale volume governs for all purposes of the *Forest Act*.

Where the second scale does not vary from the original scale by more than the prescribed percentage, the original scale stands and the person who objected to the original scale and requested a second scale must pay for the costs and expenses incurred by the ministry in performing the second scale.

The prescribed percentage is set under Section 16 of the *Scaling Regulation* at 3% of the volume.

1A.2.12 Examination of Licenced Scaler's

Section 78. (1) of the *Forest Act* requires that a person who applies for a scaling licence to be examined by one or more scaling examiners appointed by the chief forester. Section 78. (2) requires that the scaling examination be approved by the chief forester and persons who pass the examination may be issued a scaling licence.

Section 78. (3) authorizes the appointment of acting scaler's, forest service scaler's, and official scaler's.

Under the *Scaling Regulation*, Section 18 sets the fee for a scaling licence examination at \$50 and Section 19 sets the fee for appointment as an acting scaler at \$100 per year. Under the scaling policy the scaling licence examination does not apply to an applicant under the following conditions:

- Is a Forest Service employee, or
- Holds an acting scaler appointment and has paid the \$100 appointment fee, or
- Holds a scaling licence and is taking an upgrading exam or is being re-examined under Section 79 of the *Forest Act*.

Similarly, the acting scaler appointment fee may be waived if the volume scaled under the appointment will not exceed 300 m³ in a 12-month period.

Chapter 11 of this manual documents licencing standards, procedures, and related administration.

1A.2.13 Re-examination

Section 79 of the *Forest Act* provides the chief forester with the authority to require a licenced scaler to be re-examined within a specified time. Failure to pass the examination within the specified time will render the scaling licence cancelled.

1A.2.14 Suspension of a Scaling Licence

Section 80. (1)(a) of the *Forest Act* provides the regional manager, or the district manager with the authority to suspend, for a period of time, the licences of scaler's who fail to properly perform their duties.

1A.2.15 Cancellation of a Scaling Licence

Section 80. (1)(b) of the *Forest Act* provides the chief forester with the authority to cancel the licences of scaler's who fails to properly perform their duties. Section 80. (2) requires the chief forester to give the licenced scaler an opportunity to be heard before the scaling licence is cancelled.

1A.2.16 Timber Transport Requirements

Sections 19 and 20 of the *Scaling Regulation* set out the reporting and documentation requirements for timber that has been scaled or has had stumpage assessed based on a timber cruise.

1A.2.17 Offences and Penalties

Offences under the *Forest Act* are set out in Section 159. Offences applicable to Parts 5 and 6 of the *Forest Act* include and may be subject to summary conviction under the *Offences Act*:

65 (1)	73 (2.2)
65 (2)	73.1 (1)
65 (3)	73.1 (7)
65 (4)	74 (1)
66.1 (1)	75 (1)
66.1 (2)	75 (6)
66.1 (4)	
69 (1)	
73 (1)	

In addition, under Section 159 of the *Forest Act*, it is an offence to:

- 159. (b) to mark timber with a marine log brand or scaled timber brand unless it is first marked with a timber mark under Part 5 and scaled under Part 6,
- 159. (c) for persons to represent that they are authorized to perform a scale under Part 6 when they are not so authorized, and
- 159. (f) to hinder, obstruct, or impede a regional manager, district manager, or forest officer or a person acting under the direction of any of them in the discharge or performance of a duty or the exercise of a power or authority under the *Forest Act*.

Contravention of several sections of the *Scaling Regulation* also constitute an offence under the *Forest Act*. These include:

- Section 2,
- Section 4 (1) and 4 (4),
- Section 19, and
- Section 20.

Most offences under the *Forest Act* and *Scaling Regulation* are subject to violation tickets being issued by the ministry. These offences and applicable fines are set out in the *Violation Ticket Fines Regulation* (B.C. Regulation 434/90) under the *Offence Act*. These offences may also be subject to summary conviction under the *Offence Act*.

Penalties are also prescribed in the *Scaling Regulation* under Section 11 for late submission of scale data and Section 13 for not retaining timber for check scaling purposes.

Timber Marking and Branding

2

Under the *Forest Act*, no timber may be removed from either Crown or private land unless the timber is marked with a timber mark. Timber marks are issued by the Forest Service and consist of unique sets of letters, numbers, and sometimes other characters which are stamped or written on the ends of logs. Timber marks are used to identify the specific cutting authority or geographic location where the timber was harvested as well as other specific information about the timber.

Timber Brands are also issued by the Forest Service and identify timber which has already been scaled.

Each year, the provincial timber harvest comes from harvesting conducted on some 10 000 active timber marks. Transport of this harvest to the place of scaling or a transport point for other transport sees the movement of almost two million truckloads of logs.

Timber marks and brands play an important role in ensuring timber is transported and scaled in a controlled manner, and ensuring harvested timber is correctly accounted for.

This chapter discusses:

- requirements which must be met before timber can be transported off the area of harvesting,
- the different types and categories of timber marks and brands as well as their purpose,
- requirements for applying timber marks and brands,
- log salvage identification marks and their use, and
- the scaler's responsibilities.

2.1 Registered Timber Marks

To harvest and transport timber off either private or Crown land, you must:

1. a. For private timber, obtain a timber mark certificate,
b. for Crown timber, hold an agreement under Section 10 of the *Forest Act* as well as a cutting authority or other authorizations as required under the agreement.
2. Obtain a scale site designation (see Section 11.2).
3. Mark the timber in accordance with the requirements set by the ministry and with the timber mark described in the timber mark certificate or cutting authority.

All timber marks issued by the ministry are entered on the Timber Mark Registry. Details on the registry include:

- the timber mark,
- the registered owner(s) of the mark,
- the land parcel(s) cover which the mark is valid,
- the issue date and expiry date of mark certificates (maximum five years), and
- the harvesting licence type (for Crown land), issue date and expiry date.

2.1.1 Purpose of Timber Marks

Timber marks identify the authority under which timber is harvested and are used to identify other information about the timber after it has been removed from the harvesting site. This information includes:

- the royalty rate, or whether the timber is royalty free, or subject to stumpage and royalty,
- whether or not the timber may be exported from the province without first being manufactured,
- the identity of the mark holder, and
- area of origin.

Timber marks are issued to the owner of the timber (or a person with Power of Attorney) or the holder of the harvesting licence. This identity is essential for assigning financial and other obligations. It is an offence for any person to use a timber mark without express consent of the markholder.

Timber marks are also viewed as evidence of ownership just like brands on cattle. Under the Criminal Code of Canada, timber marked with a registered timber mark is the property of the mark holder, unless there is evidence to the contrary. The same is true of marine log brands discussed under Section 2.2.2.

Under the Forest Service policy, only one registered mark may be issued for a given land area. Log ends may carry other information as long as the registered timber mark is not obscured.

Terms for timber marks are set as follows:

1. For Crown Timber - (i.e., timber marks held under an agreement listed under Section 10 of the *Forest Act*) the timber mark expires upon the expiry of the agreement. If the agreement is suspended or cancelled, the timber mark is also suspended or cancelled at the same time.
2. For Private Timber - timber marks held under a timber mark certificate have a maximum duration of five years. The certificate may be renewed upon expiry or with the consent of the applicant may set a duration of less than five years. It is sometimes expedient to issue a temporary mark or "Letter of Marking Authority". Letters of Marking Authority are limited to six month terms.

Prior to 1993, timber mark certificates had no expiry. To achieve more control in administering timber marks, the *Forest Act* was amended to call for five years terms and automatic expiry of timber mark certificates as follows:

- expiry on June 30, 1993 if the holder of the certificate was not the land owner, and
- expiry on the anniversary date in 1997 if the holder of the certificate is the owner of the land and the certificate has not been renewed before that date.

2.1.2 Timber Marking Requirements

Under the *Forest Act* and ministry policy, all timber must be conspicuously marked on the area of harvest as soon as possible after it is cut, and prior to any transportation off the area and any manufacture. Unless exempted, timber must be marked in the prescribed manner.

The prescribed manner is set by regulation and requires the mark to be hammer indented on each end of each piece.

The prescribed manner or 100% marking is mandatory unless exempted by the ministry. Exemptions are not usually granted where:

- timber will be waterborne,
- timber is to be exported from B. C., or
- timber will be transported to a scale site or region or district where exemptions are not entertained.

In determining specific timber marking requirements, the ministry considers the risk of revenue loss and the loss of scale data control. Specific requirements must consider:

- the volume, nature, frequency, and complexity of the proposed modes of log handling and transportation,
- the adequacy of data controls in place, and
- the place and method of scaling.

In many situations, timber is transported and scaled with little risk of mixing timber marks and compromising load integrity. Under these circumstances, it is common practice to exempt markholders from the prescribed method of marking.

Where exemptions are employed, they must be in writing and provide the required method of marking. The method may include marking with a hammer and/or use of crayon or paint. Exemptions may be specific to:

- a designated scale site,
- geographic area,
- form of timber transport,
- licence or group of licensees or marks,
- type of forest product, or
- a combination of the above.

In all cases, a minimum standard of marking for each region is set by the Regional Manager.

To ensure use of the correct timber mark for each harvesting area the Forest Service may, under harvesting agreements and cutting authorities, require licensees to post signs at the exit point of each cut block, clearly showing the timber mark applicable to that cut block.

Under the *Forest Act*, it is an offence to remove, obliterate or alter a mark that has been applied to timber before the timber has been used in manufacturing.

2.1.3 Requirements of the Scaler

The scaler's principle responsibility is to ensure the timber marks found on the timber are accurately recorded. Where a scaler believes that timber has been incorrectly marked, he or she should contact the local forest district as soon as possible.

The scaler must:

- legibly record the mark appearing on the timber (any changes must be referred to the district scaling supervisor for approval),
- know what marks are approved for scaling at that scale site (i.e., scale site designation letter), and
- know what to do if timber arrives at the scale site bearing marks which are illegible, inadequate, invalid or not approved for scaling at that site. (Procedures are usually specified in the scale site authorization. If not, the scaler should contact the local forest district as soon as possible)

The scaler must be familiar with the scale site authorization as well as the scaler's authorization to scale.

2.1.4 Timber Mark Formats

Over the history of registering timber marks, the format of the marks has been used to serve many needs. Until recently, timber mark certificates over private land had no expiry. As such, many mark formats are still in place.

Timber marks are generally comprised of numbers and letters, and may include other distinguishing features, such as crescents and bars. There are some twenty two classes of timber marks in use and within these classes, there are numerous mark styles.

Please refer to Section 7.1.2.1 - Recording of Commonly Misinterpreted Characters.

Many different timber mark configurations may be encountered. Contact the local Forest Service office if there is any confusion concerning the validity of a mark or to receive instructions on how to record it.

There are two major groups of marks:

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

2.1.4.1 Crown Land Tenure Marks

For mark and brand formats, see Table 2.1.

2.1.4.1.1 Forest Licences and Timber Sale Harvesting Licences

Where more than 26 cutting permits will be issued, a "mark designate" is assigned, otherwise the mark follows the format of timber sale licences. These designates consist of two letters and a number followed by five numbers. For example for forest licence A15429, the mark designate is always EK1 followed by three numbers denoting the applicable cutting permit, and is recorded as EK1123, EK1321, and so on. Similarly, Forest Licence A18665 would have marks like UG7123 or UG7321.

2.1.4.1.2 Tree Farm Licence

Tree farm licence marks will appear in a broken circle or broken triangle where the top numeral designates the licence number and the bottom number designates the cutting permit.

2.1.4.1.3 Timber Sale Licences

Timber sale licences are all issued in the "X" or "A" series, which is the letter X or A followed by five numbers, often with a letter following denoting the cutting permit if no CP designate is assigned. If no cutting permit is required, the mark for licence A12345 would be recorded as: 12345, and the mark for licence X12345 would be recorded as: <12345.

Where cutting permits are required, the mark for licence A12345 Cutting Permit B would be recorded as: 12345B.

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

2.1.4.1.4 Timber Licences

Timber licences most often appear as a T and four numbers, for example, T1234. If a timber licence agreement includes a cutting permit, it will have the cutting permit in the form of a letter that is to be recorded at the end, for example T1234B for CP "B".

2.1.4.1.5 Woodlot Licence

Farm Woodlot licences issued under the old *Forest Act* use "FW" on the mark with the number of the woodlot appearing below. Woodlot licences under the present *Forest Act* use a licence number in the "WL" series, and are phasing into the "W0" (i.e., [W] [Zero]) series. Generally, marks relating to woodlots are recorded as they appear on the log (e.g., woodlot licence W0123 cutting permit "A" is recorded as W0123A.); however, because several changes have been made over the past few years, the mark may appear with the cut permit indicator in the middle (e.g., WLA123), but it is to be recorded as WL123A (i.e., with the cut permit at the end.)

2.1.4.1.6 Licence to Cut

Newer licences to cut begin with an "L" followed by five numbers as in L12345. Older licences have two letters followed by three numbers. The first letter is always "Y" and the next letter indicates the region of origin as follows: YC & YW are Williams Lake, YV is Vancouver, YK is Kamloops, YR is Prince Rupert, YN is Nelson, and YG, YH, YE, YD, and YF are all Prince George Forest Region. This series appears on a hammer mark with the two letters over top of the numbers. They would be recorded as YC123.

2.1.4.1.7 Oil and Gas Licence to Cut

The only oil and gas licences to cut are in the Dawson Creek Ft./St. John area and follow the format of normal licences to cut.

2.1.4.1.8 Cash Sale Licences

Cash sale licences are always a "D" followed by five numbers, for example, D12345. Cash sale timber is "prepaid" and further scaling is not required for government revenue purposes. Nonetheless, cash sale wood is often scaled for operational needs. Returns are not usually required to be submitted. The scaler should confirm the local requirement with the forest district.

2.1.4.1.9 Indian Reserves

Timber from Indian Reserves carries a mark with Z, ID, IN, or IR followed by one, two, or three numbers. The most common style is IR123. Less common examples are ID12, IN12, or Z12.

2.1.4.1.10 Road Permits and Rights of Way

Road permits are designated with an R followed by five numbers (the first of which is very commonly zero which must not be recorded as the letter [O]) They are recorded in the as found on the timber (e.g., R01234.)

2.1.4.1.11 Christmas Tree Permit

Christmas trees are not normally marked individually with a registered mark because of their small size, rather those in possession of Christmas trees will always carry a copy of their permit, and prominently display the permit number on bundles of trees in transport. The Christmas tree permit begins with the letter C followed by five numbers, for example, C01234.

2.1.4.1.12 Watershed Agreements

Watershed agreement marks all begin with WS and a number, followed by the number of the cutting permit attached to the agreement. For example, the agreement number "1" with a cutting permit number 6 attached would appear as WS1006.

2.1.4.1.13 Free Use Permits

Free use permits, though uncommon, are issued for a number of purposes. Administratively, they are like a cash sale, where the Forest Service determines the volume of timber to be harvested prior to the harvest taking place, and the applicant pays for it at the time of making the application. As with Cash Sales, the scaler should check with the local district staff to determine the scale submission requirements. These marks appear as FUP12345.

2.1.4.2 Marks for Privately Owned Land

2.1.4.2.1 Crown Grant - Exportable

Timber harvested from lands alienated from the Crown prior to March 12, 1906 is not subject to Provincial export restrictions. Timber marks issued over such lands are distinguishable from those over lands granted after March 12, 1906.

Some older exportable marks incorporating combinations of numbers, letters, and special characters are still in use. The most common is two letters followed by three numbers. Recently issued exportable marks issued begin with an E followed by four letters. For older marks, the scaler would expect to see such combinations as AA123, A12 (with crescent or bar) and 1A1 (with crescent), and for newer marks, EABCD. (See Ch. 7.1.2.1 for additional information on recording these special characters.)

2.1.4.2.2 Crown Grant - Non-Exportable

As with exportable Crown grants, some older marks using numbers, letters, and special characters are still in use for private lands. Older marks would appear with number and letter combinations such as AZ009, A1, A99, 99A (with crescent beneath) and 99AA. A "H", followed with the letter H, M, N, P, Q, S, T, or Z and three numbers, such as HH123 or HM123 are quite common. All newer marks issued begin with an N followed by four letters and appear as NABCD.

2.1.4.2.3 Letter of Marking Authority - Exportable

Letters of marking authority are issued to identify minor quantities of logs removed from private lands alienated prior to March 12, 1906. This mark is a series of six letters; the first letter is "L", indicating that is a letter of marking authority, and the second letter is "E", indicating that it is exportable. The following four letters refer to a specific authority. These marks are written as LEABCD for example.

2.1.4.2.4 Letter of Marking Authority - Non-Exportable

Non exportable letters of marking authority are the same as the exportable marks except the second letter is an [N], indicating that it is non-exportable. The marks would appear on logs as LNA over BCD and be written as LNABCD.

Table 2.1 outlines timber mark and log brand formats as well as how they are to be recorded on the scale tally sheet.

Table 2.1 Current Timber Mark and Log Brand Formats

File type	Tenure type	Licence or certificate	Timber marking	Recording on tally
A01	Timber sale harvest licences	A04092 CP 1	E15 001	E15001
A01	Forest licences	A15429 CP 123	EK1 1 2 3	EK1123
A02	Tree farm licence	TFL39 CP130	$\frac{39}{130}$	39/130
A03	Timber sale licence, major	A25690 CP 1	WM5 001	WM5001
B20 B21 B22 A23 B23	Other timber sale licences -TSL S16 Competitive -TSL S18 Direct sale -TSL S56.1 Resale -TSL S16.1 Multi marks -TSL S16.1 Single mark	A12345 without CP X12345 or A12345 CP "B" with CP	123 45 1B2 345 or 123 45B	12345 <12345 12345B 12345B
A06	Timber licence with CP	T0196, CP "B"	T01 96B	T0196B
A06	Timber licence within a TFL	T07 567	T07 567	T07567
B07	Timber licence without CP and not within a TFL	T 0 255	T 0 255	T0255
	Third band sale, CP 4	A10363 CP4	V22 004	V22004
A04	Woodlot licence	WL123 CP "A"	W01 23A	W0123A
B03	Oil & gas licence to cut	L01234	L01 234	L01234
B05	Licence to cut	L12345	L12 345	L12345
B21	Cash sale licence -TSL S18 Direct Sale	D12345	D12 345	D12345
B09	Crown grant - non exportable	N E RTG	NE RTG	NERTG
B08	Crown grant - exportable	E A CGU	EA CGU	EACGU
B14	Indian reserves	IR123	I R 123	IR123

B15	Letter of marking authority - exportable	LEA UXM	LEA UXM	LEAUXM
B16	Letter of marking authority - non exportable	LNB ACP	LNB ACP	LNBACP
A10	Watershed agreement	WS1, CP6	WS1 006	WS1006
B01	Road permits	R01234	R01 234	R01234
B02	Christmas tree permit	C00155	C00 155	C00155
S01	Free use permit	FUP1234	FUP 1234	FUP1234
B11	Scaled timber brands	DCR 102	DCR 102	not recorded
B11	Marine log brands	RC	<i>RC</i>	RC
B11	Log salvage marks	20135		not recorded

2.2 Log Brands

2.2.1 Scaled Timber Brands

2.2.1.1 Authority

Part 5 of the *Forest Act* provides that:

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

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

Figure 2.1 is an example of a Certificate describing a Scaling Timber Brand.

	Province of British Columbia	Ministry of Forests	
CERTIFICATE OF SCALED TIMBER BRAND			
SCALED TIMBER BRAND:			
<div style="border: 1px solid black; padding: 10px; display: inline-block;">DSA 399</div>			
IS HEREBY ISSUED TO:			
Somekinda Logging Ltd. 123, ABC Street Anytown, BC			
SUBJECT TO THE ATTACHED CONDITIONS.			
REGIONAL MANAGER ANY FOREST REGION			

Figure 2.1 Scaled Timber Brand Certificate.

2.2.1.2 Purpose

Scaled timber brands are used to indicate:

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

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

2.2.1.3 Marking Requirements

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

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

The responsibility for physical application of the brand falls jointly upon the holder of the certificate and any person using the brand with the consent of the holder (i.e., employees, truckers, etc.).

The brand *cannot* be applied to any timber that has not been scaled or has not had revenue assessed on the basis of a cruise under section 85 of the *Forest Act*. Application of a brand to unscaled timber may result in charges under the Criminal Code of Canada.

Each time scaled timber leaves a site it must be marked with the brand for that site. As such, it is possible for a well travelled log to bear more than one scaled timber brand.

2.2.1.4 Requirements of Scaler's and Weigh Persons

Scaler's may not assume that timber delivered to a scale site has been previously scaled unless it meets the branding requirements and is accompanied with other supporting documentation as may be required such as the FS 649 Load Description Slip (see Appendix 7A). Where doubt exists as to the scaled status of delivered timber, the scaler or weigh person should place the timber in a secure storage area and contact the local Forest Service office as soon as possible. At most sites, incoming scaled timber is recorded under the scaled timber brand instead of a timber mark to prevent the possibility of a double scale.

2.2.1.5 Format of Scaled Timber Brands

A separate scaled timber brand certificate may be issued for each authorized scale site. The format of the brand is a three character alpha code representing the forest district in which the timber is scaled, and a three character alpha-numeric code identifying the scale site where the timber was scaled.

i.e.,

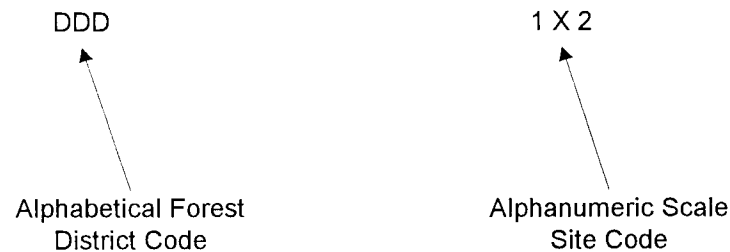


Table 2.2 details the district codes for all forest districts in the province.

For example, DCR 102 represents the Campbell River Forest District, Scale Site No. 102, and DPG 4HC represents the Prince George Forest District, Scale Site No. 4HC.

Table 2.2 Forest District Codes

Code	Forest District	Code	Forest District
DAR	Arrow (Castlegar)	DLI	Lillooet
DBO	Boundary (Grand Forks)	DMC	Mid-Coast (Hagensborg)
DBU	Bulkley (Smithers)	DME	Merritt
DCA	Cassiar	DMH	100 Mile House
DCB	Cranbrook	DMK	MacKenzie
DCH	Chilcotin (Alexis Creek)	DMO	Morice (Houston)
DCK	Chilliwack	DNC	North Coast (Prince Rupert)
DCL	Clearwater	DPA	Port Alberni
DCR	Campbell River	DPE	Penticton
DDC	Dawson Creek	DPG	Prince George
DDU	Duncan	DPM	Port McNeill
DFN	Fort Nelson	DQC	Queen Charlotte
DGO	Golden	DQU	Quesnel
DHO	Horsefly	DRE	Revelstoke
DIN	Invermere	DRV	Robson Valley (McBride)
DJA	Fort St. James	DSA	Salmon Arm
DJO	Fort St. John	DSC	Sunshine Coast (Powell River)
DKA	Kamloops	DSQ	Squamish
DKI	Kispiox (Hazelton)	DVA	Vanderhoof
DKL	Kootenay Lake (Nelson)	DVE	Vernon
DKM	Kalum (Terrace)	DWL	Williams Lake
DLA	Lakes (Burns Lake)		

2.2.1.6 Applying for a Scale Timber Brand

To acquire a scaled timber brand, the scale site operator must submit a written application to the Forest Service district or regional office.

Figure 2.2 is an example of an application for a scaled timber brand. This application may vary by region and may be part of a more comprehensive application concerning scaling at a specific scale site. Contact your district or regional office to ensure you have the correct application form.

MINISTRY OF FORESTS

SCALE SITE OWNER APPLICATION FOR SCALED TIMBER BRAND

(Applicants must first have an authorized scale site.)

I hereby apply for a Scaled Timber Brand under Section 66.1 of the *Forest Act*, for transport of scaled timber from the following site:

APPLICANT INFORMATION

NAME: _____

MAILING ADDRESS: _____

Tel: _____ Fax: _____

REGISTERED COMPANY? YES/NO _____
IF YES CORPORATE REGISTRATION NUMBER: _____

MINISTRY SCALE SITE CODE: _____

SCALE SITE NAME: _____

SCALE SITE LOCATION: _____

DATED: _____, 19__ AT _____, B.C.

SIGNATURE: _____

MINISTRY USE: CLIENT NO.: _____ LOCN. CODE: _____

Figure 2.2 Application for Scaled Timber Brand.

2.2.2 Marine Log Brands

2.2.2.1 Authority

Part 5 of the *Forest Act* provides for issuing marine log brands upon application. The Forest Service issues a certificate which describes the marine log brand. Marine log brands are registered by the Registrar of Timber Marks and any given marine log brand will not resemble any other registered log brand.

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

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

2.2.2.2 Purpose

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

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

2.2.2.3 Marking Requirements

Marine log brands may be applied to timber only after it has been marked with a registered timber mark and scaled. The brand must be hammer indented on the ends of every log so that the brand is readily discernible when the timber is in the water.

2.2.2.4 Requirements of Scaler's

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

2.2.2.5 Format of Marine Log Brands

Marine log brands are from one to four letters, often stylized, such as A, AB, ABC, or ABCD. See Table 2.1 for an example of a marine log brand.

2.2.2.6 Applying for a Marine Log Brand

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

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

For the approved application form, see the local Forest Service district or regional office.

2.2.3 Boom Chain Brands

Under the Boom Chain Act, there is provision for a boom chain brand.

Boom chains are chains with toggles attached for use in the booming of logs. A brand is made up of characters or marks that are impressed on a boom chain for purposes of identification. The Forest Service keeps a register of these brands in the timber mark register, but they are not used for marking timber.

2.3 Log Salvage Identification Mark

2.3.1 Authority

Part 11 of the *Forest Act* provides for establishing log salvage districts. Within the log salvage district, a licence may be granted to operate a receiving station. Permits may also be granted to persons wishing to salvage logs (i.e., log salvors).

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

2.3.2 Purpose

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

2.3.3 Marking Requirements

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

2.3.4 Requirements of Scaler's

Log salvage identification marks are only used to identify the parcel and are not recorded in lieu of a timber mark.

2.3.5 Format of Log Salvage Identification Marks

Log salvage marks are always one to four numbers enclosed in a diamond.



Figure 2.3 Log salvor's permit number within a diamond.

Species Identification

3

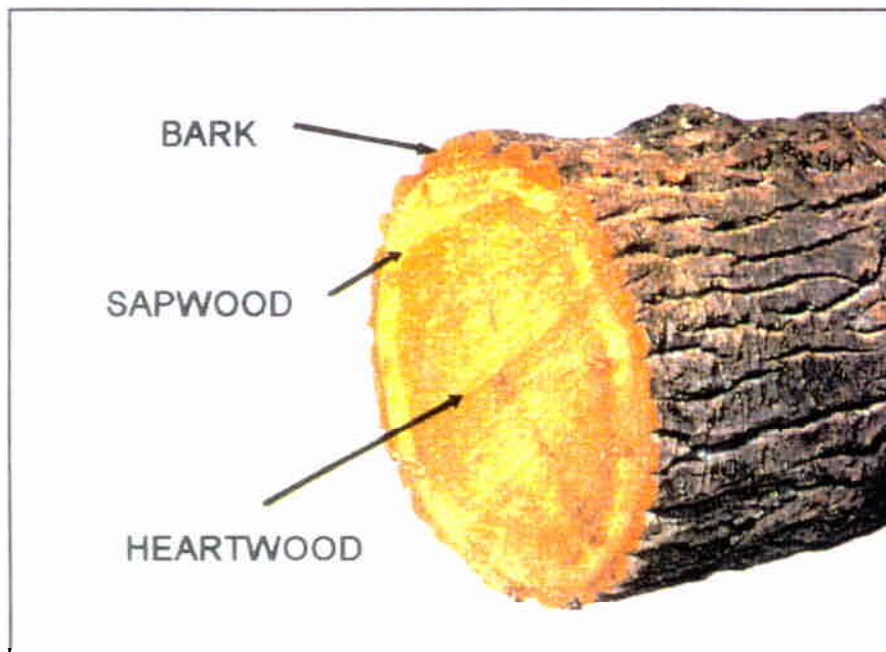
3.1 Purpose of Classification by Species

The wood of each species has unique properties that affect its value and in many cases, the grade applied to it. Each species' commercial value is tied to its suitability for the manufacture of specific products.

As part of the scaling process, a scaler must be able to identify species so that volumes may be calculated by category, for species as well as grade. This section of the manual deals not only with identifying the various species found in British Columbia, but to some degree, the defects commonly associated with each one. To assist in species identification, a set of quick reference tables follows immediately after this introduction. The purpose of the tables is to help scaler's identify species through such indicators as bark form, heartwood colour, and hardness of wood.

Species are discussed in detail on the following pages. Illustrations are also provided, as well as references to the most common defects for each species. Note that the species symbols used in this manual are unique to the function of scaling. Other disciplines, such as cruising and silviculture, use different codes to designate the various species.

At the end of this chapter there is a summary table alphabetically listing the conifer and broadleaf species by their common names, their scaling species codes, and their Latin names.

Table 3.1 Species Identification Quick Reference

Species with:

Scaly or plated bark on mature trees	Spruce White pine Yellow pine	Lodgepole pine Whitebark pine Larch
Deeply furrowed bark on mature trees	Douglas-fir Hemlock	Balsam Cottonwood
Stringy, fibrous bark on mature trees	Red cedar	Cypress
Dark-coloured, distinct heartwood	Red cedar Larch	Douglas-fir Yew
Light-coloured heartwood and little contrast between heartwood and sapwood	Hemlock Spruce White pine Lodgepole pine Maple Aspen Arbutus	Balsam Cypress Yellow pine Alder Cottonwood Birch
Pitchy sapwood	White pine Yellow pine Douglas-fir Balsam	Lodgepole pine Whitebark pine Spruce

Table 3.2 Relative Hardness Table of Heartwoods

<u>Soft</u>	<u>Medium</u>	<u>Hard</u>
Cottonwood	Lodgepole pine	Larch
Red cedar	Yellow pine	Douglas-fir
Aspen	Whitebark pine	Hemlock
White pine	Spruce	Birch
	Cypress	Maple
	Balsam	Arbutus
		Yew

Many species have bark that is somewhat similar in appearance. Conversely, bark may look markedly different on the same tree. For example, the bark at the base of a mature Douglas-fir may be thick and furrowed into plates that resemble that of hemlock or even western larch, while the top logs of the same Douglas-fir may have smooth and blistered bark, closely resembling that of young balsam. If in doubt, be sure to check *all* indicators before classifying any log by species (i.e., appearance of bark, colour and hardness of wood, sapwood/heartwood contrast (if any), form and shape of logs and type of needles).

3.2 Coniferous Species

3.2.1 Balsam

Balsam includes three species of true firs: subalpine fir (*Abies lasiocarpa*), amabilis fir, or Pacific silver fir (*Abies amabilis*), and grand fir (*Abies grandis*).

These species are recorded as BA.

Logs	Normally cylindrical in form, with branches in whorls.
Inner bark	<p>Soft and mushy and thicker than the outer bark. The outer bark takes three main forms:</p> <ul style="list-style-type: none">• on young trees and the top logs of older trees, it is a light-to-dark ash grey with greyish white flecks. The bark is smooth and shows pitch blisters, or scars of pitch blisters.• the bark of the lower stem on older trees is also light-to-dark ash grey with greyish flecks. However, as the tree ages, the smooth bark of the lower stem begins to break into longitudinal and some transverse cracks. The cracks are dark, even black in colour. Bark at the edges of the cracks tends to peel. Scars of pitch blisters may be visible.• the bark of still older trees breaks into dark grey flat ridges and develops a scaly appearance.
Wood	Light, soft, and of relatively low strength. It has little odour and is white to a pale, yellowish brown colour. There is no contrast between heartwood and sapwood. Cut ends usually pitch, especially in the interior ranges.

Needles	<p>Vary between species</p> <ul style="list-style-type: none">• subalpine fir (balsam)—greyish green to pale bluish green on both upper and lower needle surfaces. Both surfaces show numerous markings. Needles are 2.5 to 4.5 cm long and rounded or notched at the tip.• amabilis fir (balsam)—needles are a shiny dark green on upper surface and white banded underneath. There are no markings. Needles grow 2 to 3 cm long.• grand fir (balsam)—needles are very similar to amabilis ones, but may show a few scattered markings. Length is 2.5 to 5 cm.
Common defects and identifiers	Butt rot, pocket rot, ring rot, heart rot, pin rot, sap rot, ambrosia, butt (water) shake, frost checks, checks.
Common uses	For the manufacture of veneer, structural and fine quality export lumber. Poor quality balsam is usually used for pulp.

3.2.2 Red cedar (Western)

This species is frequently referred to as redder, or western red cedar (*Thuja plicata*), to distinguish it from cypress, which is commonly called yellow-cedar (*Chamaecyparis nootkatensis*).

The species is recorded as CE.

Logs	Range in size from quite small to very large. They have irregular branching, and butt logs usually show significant flare and often, ingrowing bark. The larger ones are frequently defective.
Bark	<p>A reddish cinnamon brown to greyish brown, ranging from thin (e.g., 1 cm) on younger trees to as much as 5 cm thick on older ones. It grows in fibrous ridges and can be stripped off in large strands. It is similar to fibre-like muscle tissue in appearance.</p> <p>The inner bark is whitish yellow and fibrous in texture.</p>
Wood	Light in weight, brittle and soft. It has relatively low strength, and is very straight-grained. The sapwood ring is very thin and nearly white in colour. The heartwood is a usually a reddish brown, though it may be pinkish to deep brown. The contrast between heart and sap wood is distinct. The wood has a distinctive pungent odour and is quite resistant to decay.
Needles	Yellowish green and shiny, 0.5 to 1 cm long, on vigorously growing twigs. Usually there are no markings.
Common defects and identifiers	Butt rot, pocket rot, red ring rot, deadside/catface, checks, shatter, bark seams, weather/sun checks, rotten knots, powder worm (western red cedar cedar borer), burls, and shatter.
Common uses	Finishing and side lumber, fencing material, pre-fabricated homes, building logs, shakes and shingles, split red cedar posts and rails.

3.2.3 Cypress

This species (*Chamaecyparis nootkatensis*), is often referred to as yellow-cedar, Alaska cedar, or yellow cypress.

The species is recorded as CY.

Logs	Not large and seldom exceed 1 m in diameter. Trees are slow growing, rarely may reach 1.5 m in diameter at the stump and have irregular branching.
Bark	Thin and similar in appearance to that of red cedar, except that it is more ash grey to ash brown in colour. The bark is also somewhat harder and shows a grey streak that is missing in red cedar. On younger trees the bark may be scaly, while mature trees display narrow, intersecting ridges.
Wood	Light, moderately hard, strong, even textured, and close-grained. It is non-resinous and has a characteristic odour. Unless badly weathered, the wood is a sulphur yellow colour with thin, whitish yellow sapwood, not clearly distinguishable from the heartwood.
Needles	Dark bluish green, 0.5 to 1 cm long. They are pointed and scale-like and the twigs appear to be four-sided rather than flat.
Common defects and identifiers	Butt rot, pocket rot, ring rot, catface, spiral grain, bark seams, weather/sun checks, rotten knots, frost checks, burls, and stain.
Common uses	For the manufacture of high quality lumber for the Asian market, and general finishing lumber.

3.2.4 Douglas-fir

Douglas-fir (*Psuedotsuga menziesii*) grows in two forms: coast and interior. The coast form is large, reaching heights of 90 metres. Diameters have been known to reach five metres. The interior form rarely reaches half that size.

The species is recorded as FI.

Logs	Often very large, particularly on the coast. Branches grow in whorls and the butt end of the logs—especially on trees from drier interior sites—have some flare.
Bark	On young trees it is thin, smooth and grey, with resin blisters. It resembles the bark of young balsam. As the tree matures, bark darkens to reddish brown with a light grey overcast. Bark becomes corky and very thick (up to 30 cm on the largest trees), with deep, longitudinal furrows. A cross section of the bark shows distinct, light, cream-coloured flecks.
Wood	Hard, moderately heavy, and strong. Annual rings are fairly distinct, with the summer wood being markedly darker and harder than the spring wood. Immature trees have yellow white sapwood, which is clearly distinguishable from the reddish brown heartwood. On mature trees, the sapwood develops into yellowish brown heartwood without a distinct boundary line. Sapwood usually shows oozing pitch.
Needles	1.5 cm to 3 cm long, often sharply-pointed, soft and bright yellowish green, paler on the lower surface. They stand out from three sides of the twig and appear two-ranked.
Common defects and identifiers	Butt rot, red ring rot, pocket rot, conk, sap rot, ambrosia, borers, ring shake, checks, pitch pockets, sweep, pistol grip, spiral grain, and bunch knots.
Common uses	For the manufacture of veneer, structural lumber, and high quality flooring.

3.2.5 Hemlock

Western hemlock (*Tsuga heterophylla*) and mountain hemlock (*Tsuga mertensiana*) are the two varieties that grow in British Columbia.

These species are recorded as HE.

Logs	Tend to be flared, even fluted, at the butt, frequently with ingrown bark. Branching is irregular. Bark-free surfaces have a lumpy appearance, particularly on butt ends of logs.
Bark	Scaly on young trees and russet brown in colour. It becomes darker with age and deeply furrowed into flat topped ridges. The ridges tend to be scaly on western hemlock. Mountain hemlock bark takes on an appearance similar to mature Douglas-fir. The inner bark is a distinctive solid red, streaked with purple.
Wood	Medium to heavy in weight. It is strong, somewhat brittle and close-grained. The sapwood is quite thin, showing little or no contrast with the heartwood. Colour is whitish to pale brown and may have a slight purplish tinge. Butt ends of logs may show a yellowish brown stain.
Needles	<p>Vary somewhat between species:</p> <ul style="list-style-type: none">• western hemlock - needles are flat and blunt-tipped or indented. They narrow abruptly at the base to a threadlike stalk. Lengths vary from 1 to 2 cm on the same twig. Needles grow in two ranks along the twig.• mountain hemlock - needles are about 2 cm long and blunt-tipped. Similar in form to western hemlock, but grow all around the twig, tending to the upper side.
Common defects and identifiers	Conk, Indian paint fungus, pocket rot, butt rot, heart rot, ring rot, butt (water) shake, ambrosia, frost cracks, and goitre.
Common uses	For the manufacture of veneer (limited use), structural lumber, and pulp.

3.2.6 Larch

There are three species of larch that grow in British Columbia, though only two are of any commercial importance. The least commercial one is commonly called tamarack (*Larix laricina*); the others are western larch (*Larix occidentalis*) and alpine larch (*Larix lyalli*).

These species are recorded as LA.

Logs	Gently tapered, round in form. Branches grow in whorls.
Bark	Tamarack is thin, smooth, and grey on younger trees, becoming reddish brown and scaly on mature ones. Western larch is reddish brown on young trees, scaly and becoming deeply furrowed with flat, flaky ridges on mature stems. Bark may be up to 20 cm thick and may be picked off in characteristic, thin flakes.
Wood	Tamarack is moderately hard and heavy and may have a somewhat oily appearance. Western larch is noted for being heavy, strong, and hard, though rather brittle. Both varieties are somewhat decay-resistant. Sapwood is white to yellowish white, with reddish-brown heartwood.
Needles	<p>Tamarack needles are slim, pointed, and about 2.5 cm long. They are soft and light green in colour, turning to yellow in the fall, when they are shed.</p> <p>Needles of western larch are up to 3.5 cm long and similar in appearance to tamarack, also soft to the touch and a pale yellowish green in colour. They too, turn yellow and are shed in autumn.</p>
Common defects and identifiers	Butt rot, heart rot, pocket rot, bunch knots, and conk knots.
Common uses	For the manufacture of structural lumber, shingles, shakes, and some limited use as veneer.

3.2.7 Lodgepole Pine

Lodgepole (*Pinus contorta*) is one of four species of pine recognized for scaling purposes, in British Columbia. Along the coast, the species grows in the form of shore pine, a short, scrubby and usually crooked variety. In its Interior range, it grows up to 30 metres in height.

The species is recorded as LO.

Logs	Small, rarely exceeding 60 cm in diameter. They have little taper and butt ends of logs frequently show catface. Branches grow in whorls, with recessed and usually small knots.
Bark	Lodgepole in the coastal area becomes deeply furrowed into flat, coarse and flaky, dark reddish-brown plates. Bark can be up to three centimetres thick. Interior lodgepole pine has thin bark, finely scaled, blackish to dark brown to orange grey in colour, with orange brown under-bark between the scales. Bark usually is only about 1 cm thick.
Wood	Relatively light and soft, sometimes spiral-grained. Where free of bark, its surface is often prominently dimpled. Heartwood is light yellow to yellowish brown. Sapwood is almost white. Cut ends tend to pitch.
Needles	Grow in twos, are 2.5 to 7.5 cm long and are stiff and spirally twisted. They are very sharply pointed and dark green to yellowish green, with sharply toothed edges.
Common defects and identifiers	Butt rot, catface at butt, red heart rot, spiral and straight checks in dry stems, blue stain in sapwood, and galleries under the bark in beetle attacked stems.
Common uses	For the manufacture of structural lumber, veneer, special forest products such as fence posts and fence rails, and some limited use for shakes and shingles.

3.2.8 Ponderosa (Yellow) Pine

Yellow pine (*Pinus ponderosa*) is sometimes referred to as ponderosa pine.

The species is recorded as YE.

Logs	Can be fairly large, up to 1 m in diameter. They have branches that grow in whorls and may have large knots in the upper stem logs.
Bark	On younger trees is blackish, rough, and scaly, and may resemble the bark of lodgepole pine. On mature trees, the bark may range in colour from dark brown to yellow brown or pinkish on the oldest stems. It is deeply fissured into broad, elongated, flat, flaky, and ridge-like plates. Bark can be up to 10 cm in thickness.
Wood	Relatively heavy and soft, with a wide sapwood ring and yellowish to reddish brown heartwood. The sapwood ranges from nearly white to pale yellow. Cut ends tend to pitch profusely.
Needles	Usually grow in threes, though occasionally in twos on the same tree. They may range from 12.5 cm up to 28 cm long. They are straight, slender, flexible, and very sharp, with a dark, yellowish-green colour and sharp-toothed edges.
Common defects and identifiers	Butt rot, red heart rot, large knots, and naturally forked top logs.
Common uses	For the manufacture of veneer, structural lumber, decorative panelling, and door and window framing.

3.2.9 White Pine

Western white pine (*Pinus monticola*) is sometimes referred to as silver pine.

The species is recorded as WH.

Logs	Usually straight and cylindrical, with little taper. Branches grow in whorls and knots are often a deep purple.
Bark	Thin, smooth, and greyish green on young trees, darkening with age. Mature trees may be purplish grey to almost black and the bark is broken into squarish, thick, and scaly plates. Bark may be up to 5 cm thick on older trees.
Wood	Light in weight and moderately low in strength, soft, straight-grained, and slightly pitchy, with a resinous odour, creamy white to yellowish, with white sapwood. The sapwood is relatively deep and pitches profusely when cut. The sap soon oxidizes to a whitish colour and the sapwood ring darkens to a bluish tinge. Heartwood is creamy white to yellowish and stains to dirty grey or black.
Needles	Grow in five's and are 5 to 8 cm long. They are bluish green with a whitish bloom and the edges are finely-toothed.
Common defects and identifiers	Butt rot, red heart rot, blue stained sapwood, sap rot, pocket rot, conk, borers and left hand spiral grain.
Common uses	For the manufacture of furniture and in some cases, white pine is sold mixed in with other pines such as lodgepole, for structural lumber.

3.2.10 Whitebark Pine

Whitebark pine (*Pinus albicaulus*) is an alpine tree, found in mountainous regions of the province. Another species, called limber pine (*Pinus flexilis*), may occasionally be encountered. Record it as whitebark pine.

These species are recorded as WB.

Logs	Tend to be small and usually taper fairly quickly, though occasionally trees will grow to heights of 25 m and diameters close to 1 m, providing logs with considerably less taper. Branches grow in whorls and knots tend to be abundant.
Bark	On young stems is thin, smooth, and chalky white. Bark on old trees rarely is more than 1 cm thick and grows in narrow, brown, scaly plates.
Wood	Whitebark pine is moderately soft and close-grained. The heartwood is pale brown, the sapwood narrow, and almost white. Cut ends tend to pitch profusely.
Needles	White bark pine grow in five's and are 3.5 to 8 cm long. They are stout, stiff and slightly curved, with a bluish-green colour. Needles of limber pine are virtually the same.
Common defects and identifiers	Butt rot and red heart rot.
Common uses	For the manufacture of structural lumber. It is usually mixed with other pines such as lodgepole.

3.2.11 Spruce

Spruce includes four species: Sitka spruce (*Picea sitchensis*), Englemann spruce (*Picea Englemannii*), white spruce (*Picea glauca*) and black spruce (*Picea mariana*).

These species are recorded as SP.

Logs

Tend to be quite cylindrical and straight, with a pronounced flare, even fluting in some cases, on butt ends of logs. Branches grow in whorls and when dead are very brittle. Live Sitka spruce branch stubs may have a distinctly brushy or broom-like appearance. Sitka logs are often quite large.

Bark

Thin and scaly.

- Sitka spruce scales are large, loose and circular or oval in shape. The outer bark colour ranges from greyish brown through dull red brown to brown and even to brownish black in some cases. Where a scale is recently removed, the bark underneath is a brighter reddish or purplish brown. The inner bark is silvery white to silvery grey in colour. Englemann spruce scales are large, coarse, loose and reddish brown, with a silvery-white inner bark;
- white spruce scales are light greyish brown, with silvery-white inner bark;
- black spruce dark greyish brown, with deep olive green inner bark.

Wood

Soft, light in weight, resilient, relatively strong, and straight-grained. The wood is white in colour with little contrast between heartwood and sapwood. Sitka however, has light, pinkish-brown heartwood, fading to a creamy white sapwood. Cut ends usually exude pitch, though Sitka does this to a lesser extent than other spruce species.

Needles

Vary somewhat between species:

- Sitka spruce broad, about 2.5 cm long, stiff and sharply-pointed. Form is flat and needles will not roll between thumb and forefinger. Colour is yellow-green on top, whitish underneath. Needles radiate at right angles to the twig.
- Englemann spruce broad, about 2 cm long, stiff and sharply-pointed. Will roll between thumb and forefinger. Blue-green in colour with a whitish bloom. Needles grow pointing to upper side and end of twig.
- white spruce similar in size and shape to Englemann needles, but blunt on the ends. Colour is also similar.
- black spruce broad, about 1.5 cm long, stiff and blunt. Colour is dark bluish green without lustre.

Common defects and identifiers

Butt rot, pocket rot, conk, checks, frost cracks, spiral grain, oversize knots, wavy grain or horse mane, burls.

Common uses

For the manufacture of veneer, structural lumber, fine quality finishing material, and pulp (poor quality spruce).

3.2.12 Yew

Yew (*Taxus brevifolia*) is also known as western yew, or Pacific yew.

The species is recorded as UU.

Logs	Normally quite small and often twisted and fluted.
Bark	Very thin, scaly, and dark reddish to purplish in colour. Newly exposed bark tends to be a rosy or purplish-red colour.
Wood	Heavy, hard, fine-grained, and non-resinous. The sapwood is thin and light yellowish in colour. The heartwood is orange to reddish when freshly cut, becoming reddish brown upon exposure to light.
Needles	Flat, about 2.5 cm long and spirally arranged. They are a dark, yellowish green above and paler green below. Needles are sharply-pointed and tapered at the base to a short, slender stalk.
Common defects and identifiers	Spiral grain, and the wood is quite susceptible to checking upon drying. It is very resistant to decay.
Common uses	Limited to the manufacture of pharmaceuticals and decorative stock.

3.3 Broadleaf Species

3.3.1 Alder

While there are several species of alder that grow in British Columbia, only one forms a tree that is of any current commercial value. That species is red alder (*Alnus rubra*). The other two varieties that grow in the province are speckled alder (*Alnus rugosa*) and Sitka alder (*Alnus sinuata*). Both are scrubby and do not reach commercial size.

The species is recorded as AL.

Logs	Not very large, short, and often crooked. Branching is irregular.
Bark	Smooth, light grey to almost white, with small, warty appearing outgrowths on the bark of young trees. On very old trees, bark may break into irregular, flat plates. The inner bark is bright reddish brown in colour.
Wood	Fine-grained, even textured and pale brown when first cut, though it will soon oxidize to a characteristic reddish brown colour. There is no visible contrast between sapwood and heartwood.
Leaves	Red alder leaves are oval shaped, tapered from the middle to both ends. They are thick, not sticky, and dull dark green above, greyish and hairy on the veins underneath. Veinlets form a ladder-like pattern.
Common defects and identifiers	Heart rot, rotten knots, crook, adventitious knots, and red heart.
Common uses	For the manufacture of furniture stock and palette stock.

3.3.2 Arbutus

Arbutus (*Arbutus menziesii*), also called Pacific madrone, is the only broadleaf evergreen native to Canada.

The species is recorded as AR.

Logs	Tend to be non-cylindrical and very crooked, with flattened surfaces, frequently showing irregular shaped depressions.
Bark	Thin, smooth, reddish brown in colour, and readily peels off in papery flakes and strips.
Wood	Heavy, hard, and fine-grained. It is pale yellowish brown to reddish brown in colour, with little distinction between sapwood and heartwood.
Leaves	Alternate on the twigs, are 7.5 to 12 cm long, are of thick, leathery texture. Colour is dark, glossy green above and lighter colour on the under surface. Leaves are hairless, with numerous veins, often branching.
Common defects and identifiers	Crooks, also checks badly on drying.
Common uses	Negligible at present.

3.3.3 Aspen

There are two species of aspen found in British Columbia: balsam poplar (*Populus balsamifera*) and trembling aspen (*Populus tremuloides*).

These species are recorded as AS.

Logs	Do not usually taper rapidly. While balsam poplar has been known to get as large as 130 cm in diameter, logs in general do not exceed 60 cm, and for the most part are smaller. Branching is irregular and logs are not as generally very straight.
Bark	Trembling aspen is smooth, waxy appearing, and pale green to almost white. On old trees it becomes furrowed into long, flat ridges. Balsam poplar bark is smooth and greenish brown. Bark of older stems becomes furrowed into ridges, separated by deep, V-shaped crevices.
Wood	Relatively light and moderately low in strength. Heartwood of trembling aspen is greyish white and not clearly defined. Sapwood is nearly white. Heartwood of balsam poplar is greyish brown and may be tinged with red. Sapwood is almost white.
Common defects and identifiers	Butt rot, white trunk rot, and crooked logs.
Common uses	For the manufacture of veneer, strand board, pallet stock, furniture stock, aspenite board, and occasionally, pulp.

3.3.4 Birch

Three species of birch grow in British Columbia, though two of them—Alaska birch (*Betula neoalaskana*) and water birch (*Betula occidentalis*)—are too small to be commercial. The third one is white birch (*Betula papyrifera*), which may occasionally be referred to as "paper" birch or even "canoe" birch.

The species is recorded as BI.

Logs	Small, rarely exceeding 60 cm in diameter, and tend to be crooked if cut in lengths over 3 m.
Bark	Very distinctive. Thin and smooth, reddish brown on young trunks, it becomes creamy white and peels off in large sheets from more mature stems. Peeling exposes a reddish-orange inner bark that oxidizes in time to black.
Wood	Hard, heavy, relatively strong, and a pale brown in colour with almost white sapwood.
Common defects and identifiers	Butt rot, white heart rot, and crooked logs.
Common uses	For the manufacture of finishing veneer, furniture, flooring, and panelling.

3.3.5 Cottonwood

The only species of this Cottonwood that grows in British Columbia is black cottonwood (*Populus trichocarpa*).

The species is recorded as CO.

Logs	Have irregular branching, are usually quite round, and can be as large as 160 cm in diameter.
Bark	On young trees is smooth and yellowish grey, turning dark greyish-brown and becoming furrowed with flat topped ridges separated by v-shaped crevices, similar in appearance to balsam poplar.
Wood	Light, soft, low in strength, and rather fuzzy in texture, with a slightly offensive odour. The sapwood is whitish in colour and blends gradually into the greyish white to light brown heartwood.
Leaves	Broad and egg-shaped and taper from below the middle to a drawn out tip. They are 7.5 to 12 cm long, with fine-toothed edges. Colour is dark green above and silver green below, often stained with brownish resin blotches.
Common defects and identifiers	Butt rot, crook, and adventitious knots.
Common uses	For the manufacture of veneer, pulp, and specialty lumber.

3.3.6 Maple

Three species of maple grow in British Columbia: vine maple (*Acer circinatum*), Douglas, or Rocky Mountain maple (*Acer glabrum*), and bigleaf, or broadleaf maple (*Acer macrophyllum*). However, only the latter achieves a size that makes it potentially commercial.

The species is recorded as MA.

Logs	Have irregular branching and frequently display burls or swellings, especially on the butt. Diameters range up to and may exceed 60 cm.
Bark	Light brown to milk chocolate brown and has a pattern similar to cottonwood with scaly ridges separated by v-shaped crevices.
Wood	Moderately hard and whitish yellow to light brown in colour. Cut ends will stain to many different shades.
Leaves	Broadleaf maple are quite large and may be 15 to 30 cm across and almost as long. They are five-lobed, shiny, and dark green above and paler on the underside. The leaf stalk exudes a milky sap when broken.
Common defects and identifiers	Rotten knots, burls, and crooks.
Common uses	Limited to the manufacture furniture.

3.4 Tables and Illustrations

Table 3.3 Alphabetic Species Listing

Common name	Reference Slide	Scaling code	Latin name
Alder (red)	#11	AL	<i>Alnus rubra</i>
Alder (Sitka)	#11	AL	<i>Alnus sinuata</i>
Alder (speckled)	#11	AL	<i>Alnus rugosa</i>
Arbutus (Pacific madrone)	#1	AR	<i>Arbutus menziesii</i>
Aspen (balsam poplar)	#26	AS	<i>Populus balsamifera</i>
Aspen (trembling)	#26	AS	<i>Populus tremuloides</i>
Balsam (alpine fir)	#29	BA	<i>Abies lasiocarpa</i>
Balsam (grand fir)	#29	BA	<i>Abies grandis</i>
Balsam (noble fir)	#29	BA	<i>Abies Procera</i>
Balsam (Pacific silver fir)	#29	BA	<i>Abies amabilis</i>
Birch (Alaska)	#24	BI	<i>Betula neoalaskana</i>
Birch (water)	#24	BI	<i>Betula occidentalis</i>
Birch (white)	#24	BI	<i>Betula papyrifera</i>
Cedar (western red)	#10	CE	<i>Thuja plicata</i>
Cottonwood (black)	#36	CO	<i>Populus trichocarpa</i>
Cypress (yellow-cedar, yellow cypress)	#5	CY	<i>Chamaecyparis nootkatensis</i>
Douglas-fir (coastal, interior)	#5B	FI	<i>Pseudotsuga menziesii</i>
Hemlock (western)	#9	HE	<i>Tsuga Heterophylla</i>
Hemlock (mountain)	#9	HE	<i>Tsuga mertensiana</i>

Larch (alpine)	#23	LA	<i>Larix lyalli</i>
Larch (tamarack)	#23	LA	<i>Larix laricina</i>
Larch (western)	#23	LA	<i>Larix occidentalis</i>
Lodgepole pine	#22	LO	<i>Pinus contorta</i>
Maple (broadleaf)	#13	MA	<i>Acer macrophyllum</i>
Maple (Douglas)	#13	MA	<i>Acer glabrum</i>
Maple (vine)	#13	MA	<i>Acer circinatum</i>
Ponderosa pine (yellow)	#25	YE	<i>Pinus ponderosa</i>
Spruce (black)	#32	SP	<i>Picea mariana</i>
Spruce (Englemann)	#32	SP	<i>Picea Englemannii</i>
Spruce (Sitka)	#32	SP	<i>Picea sitchensis</i>
Spruce (white)	#32	SP	<i>Picea glauca</i>
White pine (western white)	#14	WH	<i>Pinus monticola</i>
Whitebark pine	PRINT ONLY	WB	<i>Pinus albicaulus</i>
Limber pine	N/A	WB	<i>Pinus flexilis</i>
Yew (western Pacific)	#15	UU	<i>Taxus brevifolia</i>

3.4.1 Species Illustrations



Figure 3.1 Alder log, view from butt end.



Figure 3.2 Arbutus logs, view from butt end.



Figure 3.3 Aspen logs, decked.



Figure 3.4 Balsam logs, immature and mature. (Hemlock in background).

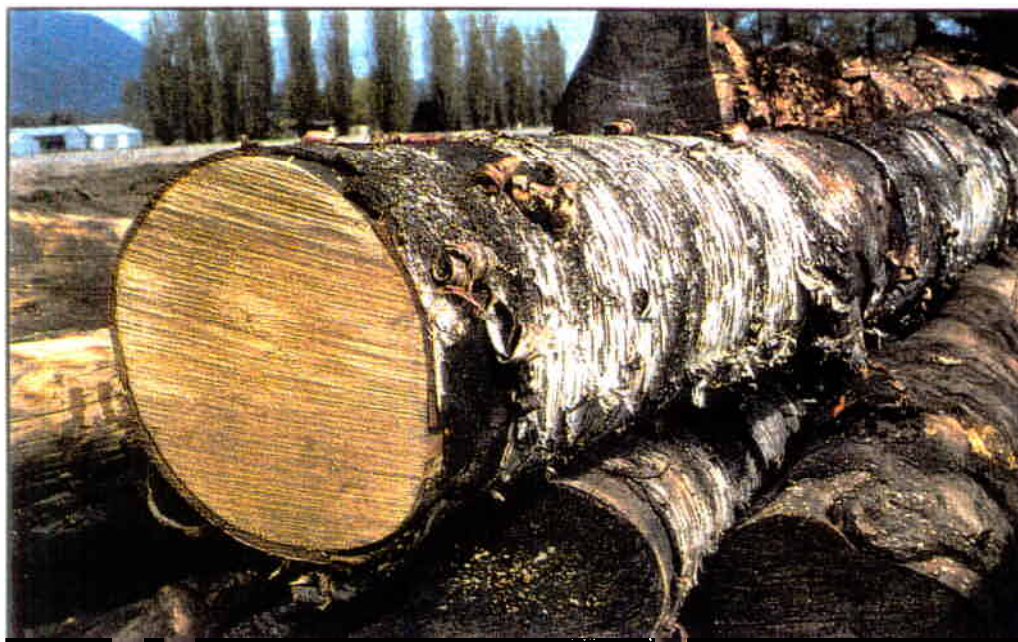


Figure 3.5 Birch logs in a deck.



Figure 3.6 Western red cedar logs spread for scaling.



Figure 3.7 Cottonwood log, view from butt end.



Figure 3.8 Cypress or yellow-cedar log, butt view.



Figure 3.9 Douglas-fir logs, immature and mature examples.



Figure 3.10 Hemlock logs, immature and mature examples.



Figure 3.11 Larch logs in a deck, butt cut log and top cut log.



Figure 3.12 Lodgepole pine logs spread for scaling.



Figure 3.13 Maple log, view from butt end.



Figure 3.14 Ponderosa (yellow) pine log, view from butt end.



Figure 3.15 Spruce log waiting for processing.



Figure 3.16 White pine log in a deck.



Figure 3.17 Whitebark pine logs ready for scaling.



Figure 3.18 Yew logs.

Common Defects

4

If all logs were smooth, round, and sound, scaling would be simple. Because they are not, it is necessary for the scaler to find the amount of volume lost from various defects. In general, the defects in logs with which the scaler is concerned will fall into three major classifications: defects due to rot fungi, defects due to other natural causes, and defects due to handling. This chapter will provide the scaler with a working concept of many common defects encountered in logs, but is not intended to be a comprehensive study of tree diseases.

4.1 An Overview of Rot Fungi

The sapwood of a tree is a living tissue capable of isolating damaged portions of itself and capable of interaction with invading micro-organisms. Healthy sapwood is divided into numerous compartments separated by special cells. When sapwood is wounded, the tree starts processes, called compartmentalization, that isolates the wound from normal tissues. The special cells near the wound produce and secrete substances that make the wood toxic or inhibitory to micro-organisms (fungi) and more or less impervious to water. These substances include gums, phenolic compounds, turpentine, and resins. Vessels that would normally conduct sap become plugged with these substances above and below the wound and near the wound edges. The surrounded wood dies and oxidation of phenolic compounds causes the wood to darken (stain).

The region of sapwood response around the wound is called the reaction zone and extends farther up and down the stem than inward or to either side because of the way the wood elements are arranged. The nearby cambium is also stimulated to produce chemicals like those mentioned above, resulting in a thin layer of new xylem (wood tissues) more impervious than the older wood. The newly formed barrier zone separates the sapwood present before wounding from that produced subsequently; the barrier zone therefore forms within a growth ring, forcing the rot, as it invades the wood, to follow a circular shape or ring.

As soon as a wound occurs, different micro organisms in succession, begin to invade and to spread into surrounding wood. Bacteria and molds that grow rapidly by utilization of simple carbon compounds in the wound are the first colonists. They include or are followed by fungi that are able to grow into the reaction zone and detoxify inhibitory chemicals or use them as nutrients. These organisms expand up, down, and inward from the wound, causing dark discoloration of the wood by converting chemicals in the reaction zone to coloured products, but they do not cause decay. After staining fungi detoxify the wood, the decay fungi move in, months to years after wounding. Decay fungi are able to degrade complex polymers- lignin, cellulose, and hemicelluloses - and use them as carbon sources. This is the main event in wood decay, and emphasizes the difference between stain and rot.

Micro organisms in succession, continually confronted by the reaction of the chemicals produced by the tree, slowly advance and cause discoloration followed by decay within wood that was present before wounding. The barrier zone however, is not breached. Therefore sapwood formed after wounding usually remains healthy. Some organisms, however, are specialized for invading sapwoods. A tree may sustain wounds at various times, resulting in multiple, overlapping zones of discoloration and decay, making assessment even more difficult for the scaler.

Rot fungi are sub-classified into root, and butt rots, heart or trunk rots and sap rots and stains according to their characteristic spread. The following list illustrates the typical areas of infection of many fungi common to British Columbia.

4.1.1 Common Root and Butt Rots

- Brown cubical butt rot (*Phaeolus schweinitzii*) or velvet top fungus,
- brown cubical trunk and slash rot (*Laetiporus sulphureus*) or sulfur fungus,
- cedar pocket rot (*Postia sericiomollis*) formerly *Poria sericiomollis* or *Polyporus asiatica*,
- stringy butt rot or Feather rot (*Perenniporia subicida*),
- annosus root and butt rot (*Heterobasidion annosum*) formerly *Fomes annosus*,
- tomentosus root rot or Red root and butt rot (*Inonotus tomentosus*) formerly (*Polyporus tomentosus*),
- armillaria root disease or shoestring root rot (*Armillaria ostoyae*), and
- laminated root rot or yellow laminated rot (*Phellinus weirii*).

4.1.2 Common Heart Rots

- Red Fomes rot or Brown top rot (*Fomitopsis cajanderi*) or rose conk (formerly *Fomes subroseus*),
- brown trunk rot (*Fomitopsis officinalis*) or elephant foot (quinine) fungus,
- red rot or red ray rot (*Polyporus anceps*),
- red ring rot or white pocket rot (*Phellinus pini*) formerly *Fomes pini*,
- brown stringy trunk rot (*Echinodontium tinctorium*) or Indian paint fungus,

- hardwood white trunk rot (*Phellinus igniarius*) formerly *Fomes igniarius*,
- aspen trunk rot (*Phellinus tremulae*) formerly thought to be *Fomes igniarius*,
- white stringy trunk rot or White spongy trunk rot (*Fomes fomentarius*),
- long yellow pitted rot (*Hericium abietis*),
- red heart rot (*Stereum sanguinolentum*) or bleeding fungus (conk) formerly (*Haematostereum sanguinolentum*),
- white mottled rot (*Ganoderma applanatum*) or Artist's conk,
- conks, general,
- rotten knots (Conk knots), and
- pipe or pocket rots, general.

4.1.3 Sap Rots and Stains

- Black stain root disease or Blue stain. (*Leptographium wageneri*, *Ceratocystis* and *Graphium*.),
- brown crumbly rot (*Fomitopsis pinicola*) or red belt fungus,
- brown cubical sap rot (*Gleophyllum saepiarium*) formerly *Lenzites saepiaria* (or *Trametes americana*, and *Trametes serialis*),
- grey-brown sap rot (*Cryptoporus volvatus*) formerly *Polyporus volvatus*, and
- pitted sap rot (*Trichaptum abietinum*) formerly *Herschioporus abietinus* and *Polyporus abietinus*.

4.2 Root and Butt Rots

4.2.1 Brown Cubical Butt Rot

Root rot and stump rot are often caused by the velvet-top fungus long known as *Polyporus schweinitzii* (now *Phaeolus schweinitzii*). It is one of the most common root and butt rots in both natural and planted coniferous forests, and it also causes damage to conifers in landscapes.

4.2.1.1 Species Affected

All British Columbia conifers are affected except juniper, and it is especially common on spruce, pine, fir, western red cedar, larch and hemlock. It does not occur in hardwoods. It is considered to be the most serious butt rot pathogen of conifers in old-growth forests. This fungus is often considered to cause significant butt rot, mainly in mature trees, but this is a misconception based on delayed discovery. The fungus may infect roots of any age and may enter the stems of young trees through roots or basal wounds. Decay eventually involves most of the cross-section of the butt and usually extends less than 3 m up the trunk before the tree breaks or is wind thrown during a storm. Decay columns extending more than 10 m into the trunks of pines and further in Douglas-fir have been reported.

4.2.1.2 Rot Description

Wood in the incipient stages of decay is stained pale yellow or yellow-brown to reddish brown. It loses strength rapidly, gradually becoming dry and crumbly, and in the later stages turns darker brown and cracks into more or less cubical pieces, often having a pungent odour like turpentine or oil of anise. It is interesting to note that cubical rot consumes the cellulose (fibre) and leaves the lignin (glue), whereas other rots will do the opposite. In combination, they leave nothing but a hollow space in the trunk.

4.2.1.3 Indicators of Decay

The annual conks of *Phaeolus schweinitzii*, generally develop on the duff around the base of decayed trees, although occasionally they develop on the butt of the tree. On trees they are thin and bracket-like; growing on the ground, they are more or less circular and stalked. The upper surface is reddish-brown and velvety or plush-like with concentric zones. The under surface is olive green on fresh growing conks and dark reddish-brown on dead ones. Basal scars are so generally invaded by this fungus that they are quite reliable indicators of decay. When red-brown butt rot is present in a tree, it is almost always visible on the lower end of the butt log.

4.2.1.4 Extent of Decay

This type of rot is generally conical in shape; the height of the cone is the distance the rot extends into the log. This distance is found mainly by experience gained from local conditions.

4.2.2 Brown Cubical Trunk and Slash Rot

A trunk rot caused by *Laetiporus sulphureus* or the sulfur fungus, it is similar in appearance to brown cubical butt rot and is treated as a butt rot by the scaler.

4.2.2.1 Species Affected

The sulfur fungus is responsible for trunk rot in a wide range of coniferous and deciduous hosts including spruce, white pine, fir, larch and yellow pine, but is most common in western hemlock, Sitka spruce and garry oak.

4.2.2.2 Rot Description

Laetiporus sulphureus decays the heartwood of living conifers and usually causes a butt rot. The rot is commonly observed in stumps and fallen trees. In the early stages of this rot, a light brownish discoloration or stain is observed; and the advanced stage is very similar to that of brown trunk rot. The wood becomes a brown, crumbly mass of more or less cubical chunks, sometimes having a rippled appearance, and conspicuous mats of white fungous tissue may form in the shrinkage cracks within the decay. On the ends of logs, the appearance of the rot is almost exactly like that of brown cubical butt rot; the cubical structure of the brown decayed wood and the white mats are very noticeable. The rot column is generally circular in outline; and in trees with long-established rot, hollow butts are common.

4.2.2.3 Indicators of Decay

Conks of *Laetiporus sulphureus*, often spreading profusely over a large area on the base of living trees, stumps, and fallen trees, are annual, thin, and bracket-like. They are a bright orange on the upper surface and sulfur yellow on the under surface, which has small circular pores. Fading out as the conk ages or is dried, the bright tones eventually become straw-coloured or almost white; the conks deteriorate rapidly in the late fall. Living trees are infected through basal wounds and dead branch stubs.

4.2.2.4 Extent of Decay

This rot is generally confined to the butt log and is one of the more common butt rots. It is generally conical in shape.

4.2.3 Cedar Pocket Rot

Brown pocket rot is caused by *Postia sericiomollis* (*Polyporus asiatica*). Also called cedar pocket rot, it is both a butt and trunk rot. Another brown pocket rot caused by *Lentinus kauffmanii* is responsible for an important butt and trunk decay in Sitka spruce.

4.2.3.1 Species Affected

Common in living Western red cedar and ranks second only to *Phellinus pini* as the most common fungus responsible for decay in red cedar. It is also a slash rot in other conifers.

4.2.3.2 Rot Description

Although brown pocket rot in cedars is most commonly found in the butt, it may extend throughout the length of the tree. The incipient or earliest stages of decay appears as straw coloured to a pale yellow-brown discoloration. Later the wood becomes soft and loses its natural lustre. In the advanced stages, the wood cracks extensively and breaks down into a fragile, crumbly mass of brown cubes; and whitish or cream-coloured fungus tissue develops in the cracks. The decay first develops in isolated, well-defined pockets. In the butt of the tree, these pockets run together and often form solid cylinders of rot. On ends of logs the rot commonly appears in small scattered pockets, concentric ring-shaped areas, or as solid circular areas. Large hollows often develop in the butt of older trees.

4.2.3.3 Indicators of Decay

Conks of *Polyporus sericeomollis* (*Pona asiatica*) rarely, if ever, appear on living cedars, even when the decay is extensive and long-established. Consequently there is no specific indication of decay on the living tree. Conks develop on dead material and are abundant on slash of other conifers. They are white, thin, and crust-like with small regular pores and have a very bitter taste.

4.2.3.4 Extent of Decay

In the earlier stages of decay, the rot is in round or cubical isolated sections. In advanced stages of butt rot, the rot may be treated as being conical. If the rot extends the length of the log, it is treated as a cylinder of rot.

4.2.4 Stringy Butt Rot or Feather Rot

This rot is known as spongy root rot white spongy rot and white stringy rot. It is caused by *Perenniporia subicida*.

4.2.4.1 Species Affected

This rot attacks a wide range of coniferous and deciduous hosts but is most damaging on balsams (true firs), spruce, and hemlock.

4.2.4.2 Rot Description

Stringy butt rot is one of the most common slash rots on conifer wood in British Columbia. It is found in dead standing trees, stumps, and stored logs. In addition, it occurs frequently as a butt and root rot of living trees, especially in western white pine. Faint pinkish to brownish discoloration of the wood mark the early stages. As decay progresses, elongated whitish streaks appear in the spring wood of the annual growth ring. These streaks enlarge and run together, and the wood separates easily at the annual rings. Black flecks often appear among the white fibres. As decay continues, the wood breaks down into a whitish stringy mass of soft, spongy, water soaked material. In the advanced stages of decay, cream-coloured mats of fungous tissue with golden brown flecks usually develop in the wood. On the ends of logs, this rot is roughly circular in outline; the white, stringy nature of the decayed wood and the fungous tissue serve to identify it.

4.2.4.3 Indicators of Decay

Conks of *Perenniporia subicida* are flat and crust-like with small circular pores. The perennial conks are cream to almost lemon yellow in colour. Conks develop in root crotches of living trees and on the under surface of dead material on the ground.

4.2.4.4 Extent of Decay

In old-growth timber, the rot characteristically hollows out the centre section and leaves a clear shell. This rot rarely extends beyond 5 m in length and is confined to the butt log. Therefore it is also treated as butt rot approximating the shape of a cone.

4.2.5 Annosus Root and Butt Rot

Formerly known as *Fomes annosus*, *Heterobasidion annosum*, this rot is also called spongy sap rot, white pocket rot, and brown root and butt rot.

4.2.5.1 Species Affected

Heterobasidion annosum is known throughout the temperate zone as the cause of butt rot of mature coniferous trees, and of butt and root rot that seriously affects the growth and survival of plantations and young forests. The fungus has a very wide host range including both coniferous and broad-leaved species. Hemlock appears to be the most highly susceptible of the native coniferous species.

4.2.5.2 Rot Description

Heterobasidion annosum causes a root and butt rot of living trees and is a common slash rot of conifers. In the early stages of decay the wood is firm and pinkish to reddish-brown in colour. White pockets of decay appear in the discoloured wood as decay progresses. These pockets are elongated parallel to the grain and frequently have black flecks in the centre, running parallel to the grain. The pockets enlarge and run together; the wood tends to separate at the annual rings, and a soft spongy mass of fibrous rotten wood with black flecks eventually results. In the early stages, the rot appears on the ends of butt logs as dark reddish-brown areas of discoloured heartwood or as circular areas of whitish, spongy, decayed heartwood surrounded by a dark zone of early decay. In the final stage, the wood is completely destroyed, leaving a hollow butt.

4.2.5.3 Indicators of Decay

Conks of *Heterobasidion annosum* are perennial and are generally inconspicuous, developing under logs and roots or in root crotches of living trees. The upper surface of the conk is grey to black with a hard, smooth crust. The under surface is cream coloured with small circular pores. Conks developing under logs or roots are commonly flat and cream coloured with a brownish-black margin. Resin flow may occur at the base of infected trees.

4.2.5.4 Extent of Decay

This rot is generally confined to the butt log and is approximately conical.

4.2.6 Tomentosus Root Rot

Tomentosus root rot is caused by *Inonotus tomentosus*.

4.2.6.1 Species Affected

Western white pine and yellow pine are the major hosts of tomentosus root rot in British Columbia. Engelmann spruce, western larch, lodgepole pine, Douglas-fir, and western hemlock are also decayed by this fungus.

4.2.6.2 Rot Description

Tomentosus root rot is generally confined to the lower portion of the butt log, the fungus entering the tree through basal scars or perhaps through injured roots. In the early stages of decay the wood is discoloured, dark reddish-brown, and firm. In the later stages, narrow, lens-shaped pockets develop parallel to the grain. These pockets are filled with white decayed wood and are separated by reddish-brown firm wood. The rot is important only in living trees and is of little consequence in the decay of slash.

4.2.6.3 Indicators of Decay

Conks of *I. tomentosus* develop on the ground near the roots of a decayed tree or on the butt of the tree. Conks on the ground are stalked with a thin circular cap, and those on trees are usually thicker and more or less bracket-like. Both are yellowish-brown with a velvety or plush-like upper surface.

4.2.6.4 Extent of Decay

This rot is generally confined to the basal portion of the first log, rarely extends beyond 2 or 2.5 m and is approximately conical in shape.

4.2.7 Armillaria Root Disease

Also known as Armillaria root rot or White butt rot, it is caused by *Armillaria ostoyae*.

4.2.7.1 Species Affected

Most conifers and hardwoods in British Columbia are susceptible to shoestring or Armillaria root rot. It is common in western white pine, yellow pine, Douglas-fir, and particularly in western hemlock, western red cedar and the balsams (alpine fir, amabilis fir and grand fir).

4.2.7.2 Rot Description

Armillaria ostoyae causes the decay and death of sapwood in the roots and butts of living trees. Entering the tree through the roots and growing upward past the root collar, it often girdles the tree completely. In the early stages of decay, the wood appears water soaked and shows a pale brownish discolouration. Eventually it becomes whitish, soft, and spongy or stringy with conspicuous narrow black zone lines running through the decayed wood. A white butt rot in the heartwood of older trees is also reported to be caused by *Armillaria ostoyae*.

4.2.7.3 Indicators of Decay

The presence of armillaria root disease may be indicated by abundant resin flow on the bark of the butt portion of the tree. Removal of bark from the root collar of infected trees reveals the presence of white fans of fungous tissue in the cambium region between bark and wood. Long, narrow, whitish to black strands of fungous tissue may be present under the bark and in the duff around the base of infected trees. These strands, called "rhizomorphs," have given rise to the common name of shoestring root rot. In the fall, conks of *Armillaria ostoyae* may develop at the base of infected trees and stumps; or they may develop on the ground from infected roots. The conks that often grow in dense clusters are honey-coloured mushrooms with circular caps; the under surfaces of the caps have radial gills.

4.2.7.4 Extent of Decay

Armillaria root disease usually extends up the trunk for only a short distance and is approximately conical in shape. Often the defect affects only a portion of the scaling cylinder, not forming a "full circle" of rot.

4.2.8 Yellow Laminated Root Rot

Also known as Poria root rot, it is caused by *Phellinus weirii*.

4.2.8.1 Species Affected

Phellinus weirii is widely distributed throughout British Columbia and the Pacific Northwest and it attacks most coniferous tree species; hardwoods appear to be immune. Poria root rot is regarded as the most important disease affecting immature forests of Douglas-fir. It also occurs as a butt rot in mature conifers, particularly western red cedar and western hemlock.

4.2.8.2 Rot Description

This common butt rot in western red cedar enters the tree through basal injuries, particularly fire scars. It is a common rot in fallen trees and cull logs left in the woods. In the early stages, the wood shows a yellowish discolouration, which darkens as the wood become softer. The wood then begins to separate along the annual rings, and a definite ring shake develops. The thin layers of decayed wood usually have small elliptical pits parallel to the grain. Brownish strands of fungous tissue also appear between the layers. On ends of logs the rot may appear in crescent or ring-shaped circular areas with conspicuous radial cracking. The thin layers of decayed wood can be readily pulled out of the log. In older infections, the butt may become hollow. These hollows are usually lined with the typical laminated, decayed wood. Yellow ring rot also occurs as a heart rot of other conifers and may kill young Douglas-fir and grand fir as a root rot.

4.2.8.3 Indicators of Decay

On living trees the conks develop under roots, in root crotches, and in hollow butts. They are perennial, dark chocolate brown in colour, flat and crust-like, and rather soft and light.

4.2.8.4 Extent of Decay

Laminated root rot is usually confined to the butt log of western red cedar and rarely extends more than 2 or 3 m up the bole of living trees. However, it can extend 10 m or more in severe decay.

4.3 Heart Rots

Heart rot is confined to the interior of a log and often extends through the entire length of the log. Where the heart rot is visible at one end of the log only, the scaler must look for occurrences of rotten knots, conks (fungus fruiting bodies), log seams, scars, abnormal swellings (goiters), or other indicators to decide the extent of the rot.

It is easy to confuse heart rot with butt rot, but they are usually different in their make-up. For instance, butt rot is commonly caused by the velvet-top fungus (*Phaeolus schweinitzii*) and Annosum root rot (*Heterobasidion annosum*). The Indian paint fungus (*Echinodontium tinctorium*) and Aphyllophorales (*Phellinus pini*) cause heart rots. The organisms' manner of entry into the tree are different and so is the pattern of decay. Experience and training will familiarize the scaler with rot pattern characteristics occurring in the different species in a local area.

4.3.1 Red Fomes Rot

Red fomes rot is caused by *Fomitopsis cajanderi* (*Fomes subroseus*) or rose conk.

4.3.1.1 Species Affected

Douglas-fir, balsam (grand fir), western larch, Engelmann spruce, western white pine, lodgepole pine, yellow pine, juniper, and western red cedar.

4.3.1.2 Rot Description

Heart rot caused by rose conk generally enters the tree through broken tops, localizes in the top of the tree, and is often limited to the non-merchantable top portion. This top rot is most common in Douglas-fir. The rot also occurs in stumps, dead trees, and stored logs. A yellowish-brown to dark brown discolouration develops in the early stage of decay. The advanced decay is characterized by the formation of irregular, crumbly brown cubes. Thin whitish, or pale, rose-coloured fungous tissue sometimes develops in the cracks between the cubes of decayed wood.

4.3.1.3 Indicators of Decay

The conks of *Fomitopsis cajanderi* are perennial, woody, and bracket-like to hoof-shaped. The upper surface is brown to black and is usually cracked and roughened. The under surface has small circular pores, simply, rose-coloured, as is the inner tissue of the conks. Although old broken tops may indicate the presence of this rot, they are not a specific indication, as tops may also be invaded by other decay fungi.

4.3.1.4 Extent of Decay

Red fomes rot is usually confined to the top portion of the trunk but in lodgepole pine, this rot very often travels the full length of the trunk.

4.3.2 Brown Trunk Rot

Brown trunk rot is caused by *Fomitopsis officinalis*, or elephant foot conk, or quinine fungus (sometimes called *Fomes laricis* in older literature). It is also known as dry rot or red-brown heart rot.

4.3.2.1 Species Affected

Brown trunk rot most commonly affects western larch, Douglas-fir, and yellow pine. It also occurs in western white pine, Engelmann spruce, lodgepole pine, western hemlock, and balsam. Western Larch is the only species known to be attacked extensively. Hardwoods are not affected.

4.3.2.2 Rot Description

This rot is one of the major heart rots of living western conifers and continues its decaying action in logs and stumps. The fungus generally enters the heartwood through broken tops and branch stubs, and the rot is common in the upper and middle portions of the trunk. When basal scars are invaded, decay occurs in the butt of the tree. A yellowish to faint reddish-brown stain, or in the case of Douglas-fir, a purple discoloration marks the early stage of decay. The stain may extend for a considerable distance beyond the advanced decay. As decay progresses, the wood becomes softer and eventually breaks down into a crumbly mass of yellowish-brown to reddish-brown cubical chunks that are interwoven with extensive mats of thick whitish, resinous fungous tissue. On ends of logs, the early stages of decay appear in roughly circular areas of yellowish-brown to reddish discoloration. In the late stages, these circular areas show extensive radial and concentric shrinkage cracks filled with white mats of fungous tissue.

4.3.2.3 Indicators of Decay

Conks of *Fomitopsis officinalis* develop only after extensive decay in the heartwood. They are perennial, hard, and chalky; and after many years of development, they tend to be long and cylindrical in shape. The tissue is white, chalky, and tastes extremely resinous and bitter. The outer layers of tissue usually become greyish or black and extensively cracked, while the under surface is white with small pores. Broken tops often indicate the presence of brown trunk rot, although top injuries may be invaded by other decay fungi.

4.3.2.4 Extent of Decay

Sporophores (conks) are formed relatively frequently only on larch, but on all tree species a single conk indicates that most of the wood volume has been destroyed.

4.3.3 Red Rot

Red rot is also known as western red rot. This rot is caused by *Polyporus anceps*.

4.3.3.1 Species Affected

Red rot is a heart rot that occurs in yellow pine. It is also a slash rot in that species as well as in Douglas-fir, balsam, Engelmann spruce, western white pine, western red-cedar, and lodgepole pine.

4.3.3.2 Rot Description

Red rot is common in living yellow pine, entering mainly through broken tops and dead branches and causing a trunk rot in that species. It also causes a common slash rot of yellow pine and the other conifers listed. In the early stages of decay, the wood develops a reddish-brown discoloration. Later, small white pockets of advanced decay develop parallel to the grain. These pockets are usually poorly defined, have blunt or almost square ends, and tend to run together. Usually the wood between the pockets is considerably softer than firm wood; eventually the wood becomes a white spongy mass. In the heartwood, the rot typically develops in distinct radial zones from the centre of the tree; and this distinctive radial pattern on the ends of logs is characteristic of this rot. As decay progresses, however, the entire heartwood may be invaded; and this radial pattern will not be apparent.

4.3.3.3 Indicators of Decay

The conks do not ordinarily develop on living trees, but are usually present on stumps, decaying logs, and slash. They are annual, white, crust-like, and bracket-shaped; although rather tough, they usually deteriorate rapidly. On dead material, a conspicuous white mat of fungous tissue develops between the bark and the wood.

4.3.3.4 Extent of Decay

The extent of rot column will vary with the size of the timber and possibly from one locality to another. In advanced stages of decay, the defect affects the entire heartwood. In earlier stages of decay, the defect appears as a cylinder or hole. *Polyporus anceps*, sometimes called "wagon wheel" decay, is a common defect in spike top yellow pine. It is not uncommon to find this rot extending as much as 13 m downward into the trunk of the tree.

4.3.4 Redring Rot

Redring rot is caused by *Phellinus pini* (also called *Fomes* or *Trametes pini* in older literature). This rot is also called conk rot, red ring rot, ring scale, red heart, pecky rot, honeycomb rot, white pitted rot, and white pocket rot.

4.3.4.1 Species Affected

Phellinus pini has a wide distribution throughout the northern temperate zone and is one of the most common wood-destroying fungi in British Columbia. All conifers except junipers and Pacific yew are affected. It is particularly damaging in mature Douglas-fir, Sitka and northern white spruce, western hemlock, and balsam. This rot is also of importance in western white pine, yellow pine, lodgepole pine, western larch, and Engelmann spruce.

4.3.4.2 Rot Description

Red ring rot is primarily a heart rot of living trees. Decay may continue in dead standing trees or in fallen trees, but it is not an important factor in the decay of slash. The fungus usually enters the tree through branch stubs and causes a trunk rot. It may occasionally enter through basal scars, causing a butt rot. In the early stages of decay the wood shows a pinkish to purplish-red discoloration and, in cross sections of logs, often develops as a well-defined ring, hence the common name redring rot. As decay progresses, small, white, lens-shaped pockets develop parallel to the grain. The wood between these pockets is discoloured but firm. On ends of logs, the discoloration and pockets are often localized in crescent-shaped areas or in more or less concentric rings. Frequently, however, the pockets are uniformly scattered throughout the decaying wood with no definite pattern of arrangement. A pronounced ring shake may develop as a result of the rapid deterioration of the spring wood and the separation of the wood along the annual rings.

4.3.4.3 Indicators of Decay

The brownish, perennial conks of *Phellinus pini* usually develop at branch stubs or on basal scars. They vary from thin and bracket-shaped to thick and hoof-like. The under surface and margin of growing conks is a bright yellowish-brown with large irregular pores, and the upper surface is dark brown to blackish with concentric zones and furrows. Interior, grown punky knots usually indicate decay in the heartwood. The location of punky knots may be indicated by conspicuous swellings commonly called swollen knots. Where punky knots have healed over with no conspicuous swelling, they are revealed by chopping through the bark into the knot.

4.3.4.4 Extent of Decay

This rot is usually confined to the heartwood of all resinous species. In western white pine logs, the defect associated with a single conk or "punk" is generally confined to one-half the diameter of the scaling cylinder. In yellow pine and lodgepole pine, the defect extends through the entire diameter of the heartwood. No hard and fast rule can be consistently applied, inasmuch as the extent of decay on individual trees will vary with the age of the tree and the length of time that the fungus has been active in the tree. *Phellinus pini* in lodgepole pine often enters trees at points of damage or injury. The most common source of entrance is at the limbs or knots. In addition to its ability to destroy heartwood, *Phellinus pini* can attack sapwood and cause tree death.

4.3.5 Brown Stringy Trunk Rot

Caused by *Echinodontium tinctorium*, the Indian paint fungus is known to exist only in Japan and western North America and is distributed throughout coastal and interior forests. It is one of the most destructive wood destroying fungi in British Columbia and is the most common defect found in both grand fir and hemlock in British Columbia. The nature of the decay and pattern of spread of *E. tinctorium* can seriously reduce the value of the affected forest for saw timber because even in early stages it weakens the wood in a manner that causes separation along the annual rings (ring rot or laminated rot, where rings are closely layered with firmwood).

4.3.5.1 Species Affected

Brown stringy trunk rot affects primarily grand fir (balsam) and western hemlock. Sub-alpine fir (balsam) and mountain hemlock are also frequently affected, and Engelmann spruce and Douglas-fir are occasional hosts. Brown stringy trunk rot is reported in a few other British Columbia conifers, but it is important only in balsam and hemlocks. It does not occur in hardwoods. Although most coniferous tree species are attacked, inter-regional differences in its abundance seem to be related to major climatic features; differences within regions are related to specific habitats, some of which exclude the fungus while others favour it to varying degrees. The true firs (balsam) are highly susceptible throughout their range, western hemlock is moderately to severely attacked in specific habitats, but Douglas-fir and spruce are seldom attacked.

4.3.5.2 Rot Description

Brown stringy trunk rot, which is of major importance as a trunk rot of living balsam and hemlock, usually enters the tree through branch stubs or frost cracks. Decay of slash is of little importance as the fungus apparently does not invade dead trees and logs. The first visible evidence of decay in the heartwood is a faint yellowish or light brown discoloration or water soaked stain. In this stage, separation of the wood along the annual rings tends to develop, especially after drying. As decay progresses, the colour darkens; a definite ring shake develops, and rusty-red streaks appear in the wood. In the late stages of decay, the wood breaks down into a brownish stringy mass. In larger trees, the rot may destroy the entire heartwood of the trunk down to the roots and may extend into the heartwood of larger branches. Infections of long standing may leave portions of the trunk virtually hollow. On ends of logs, the decay is usually seen as a ring, a solid circular core of discoloured softened wood, or as a hollow lined with soft, stringy brown wood.

4.3.5.3 Indicators of Decay

Conks of *E. tinctorium* are perennial, woody, and generally develop under branch stubs. The upper-surface becomes blackened and extensively cracked. Coarse cream-coloured to greyish spines form the under surface. The interior tissue of the conk, including the spines, is a distinctive rusty-red in colour. Frequently the knots where conks develop show a similar rusty-red discoloration caused by the build-up of fungus tissue in the later stages of decay. These are known as "rusty knots." After the conks have fallen or have been knocked from the tree during logging operations, they provide a reliable indication of decay in the heartwood.

Whenever butt logs show shake and stain, the log should be thoroughly inspected for the fruiting bodies of this rot or rotten knots. Shake and stain are indicators of this defect. Because of the heavy water content the extreme butts on both balsam and hemlock, the rot does not break down the wood fibre as quickly as it does in the upper portions of the tree.

4.3.5.4 Extent of Decay

Refer to the discussion of conk following this section.

4.3.6 White Trunk Rot

Confined to deciduous trees, white trunk rot is caused by *Phellinus igniarius*.

4.3.6.1 Species Affected

White trunk rot affects trembling (quaking) aspen, paper birch, alders, and other hardwoods. This rot is not found in conifers.

4.3.6.2 Rot Description

White trunk rot is the most important rot of living hardwoods in British Columbia. The rot continues to develop in dead material and is often found on dead and fallen trees and stumps. Pale yellowish discoloured areas first appear in the early stages of decay. These discoloured areas are commonly enclosed in broad, brownish-black, or greenish-brown zones. Narrow black zone lines develop in the decayed wood, which becomes uniformly softer than firm wood. The decayed wood has no pockets or mottling and lacks any stringy or laminated structure. In the advanced stages of decay, abundant yellowish-brown fungous tissue may develop in the decayed wood. The fungus enters mainly through branch stubs, and the rot is usually located in the middle trunk. The rot is often found associated with stem cankers on aspen.

4.3.6.3 Indicators of Decay

The conks of *P. igniarius* are perennial, hoof-shaped, hard, and woody. The upper surface is blackish and extensively cracked, and the under surface is dark brown with very small circular pores. The inner tissue of the conk is dark reddish-brown. On aspen, the conks develop under branch stubs, or in the centre of stem cankers when associated with the disease called "black canker of aspen." Out-growths of black, clinker-like structures called "sterile conks" occur frequently at branch stubs. Punky knots are common indicators of white trunk rot and are conspicuous by their dark, brown coloured fungous tissue.

4.3.6.4 Extent of Decay

In advanced stages of decay, the centre heartwood of the entire log is affected by both *Hydnum abietis* and *Phellinus igniarius*. In earlier stages the decay remains firm and coloured (incipient rot), and no firm wood deduction is made.

4.3.7 White Stringy Trunk Rot

White stringy trunk rot is caused by *Fomes fomentarius*.

4.3.7.1 Species Affected

Fomes fomentarius attacks a number of deciduous species but is most common on birch. It causes decay chiefly in dead timber but can also attack living trees.

4.3.7.2 Rot Description

Decay first appears as a slight brown discoloration (spalting), the wood remaining quite firm. Wood with advanced decay is yellow-white, soft, spongy, and frequently contains brown to black zone lines. Small radial cracks filled with yellow filaments may develop, giving the decay a mottled appearance.

4.3.7.3 Indicators of Decay

The conks are perennial, woody or leathery, and usually hoof-shaped. The upper surface is zoned, grey to brown, or grey to black in colour, smooth and with a thick crust. The lower surface is brown and porous; the pores are small and regular in outline. The body tissue is brown. Conks form on standing trees and on slash.

4.3.7.4 Extent of Decay

As with the other heart rots, the amount of decay is usually determined through observation of cut ends of the log. Unfortunately, conks are knocked off before the scaler has an opportunity to look for them.

4.3.8 Long Yellow Pitted Trunk Rot

Long yellow pitted trunk rot is caused by *Hericium abietis*. This rot is also known as long pitted trunk rot and long pocket rot.

4.3.8.1 Species Affected

Hericium abietis is responsible for a frequently occurring butt and trunk rot of western hemlock and balsam and is known to attack Sitka and Engelmann spruce.

4.3.8.2 Rot Description

This rot occurs frequently in the heartwood of living balsam and hemlock and is common in stumps, snags, and fallen trees. It also continues to develop in stored logs. In the early stages of decay, the wood, which remains firm, develops a yellow or pale brownish discoloration and often appears mottled with darker spots. As decay progresses, elongated pockets develop parallel to the grain. These pockets may be empty or may be partially filled with whitish or yellowish fibres of decayed wood. The wood between the pockets is discoloured but firm. On the ends of logs, the decay pattern is irregular; in the early stages, it appears as brownish discoloured areas, roughly circular in outline. In the advanced stage of decay, the pockets are visible in the discoloured areas.

4.3.8.3 Indicators of Decay

The white, coral-like, annual conks develop on living trees, stumps, slash, and on ends of recently cut logs. They are soft, extensively branched, and bear large numbers of pendant spines or teeth. Because of their soft, fragile consistency, these conks deteriorate very rapidly and are present as indicators for a relatively short period of time.

4.3.8.4 Extent of Decay

Yellow pitted trunk rot is generally confined to the bottom portion of the tree. Very little is known about the extent of decay caused by this fungus, but it is included here because of its common occurrence in hemlock and balsam (grand fir) in British Columbia.

4.3.9 Red Heart Rot

This is a common and important decay producing fungus of conifers in British Columbia caused by *Stereum sanguinolentum* or bleeding fungus (conk).

4.3.9.1 Species Affected

Red heart rot is responsible for extensive heart rot in mature pine, northern white and Engelmann spruce, and in balsams. In other hosts it is largely a slash-destroyer, although it may occasionally be responsible for heartwood stain and terminal die-back following entry through pruning wounds, logging scars, and lesions formed as a result of climatic injury. Until recently, the fungus was believed to gain entrance to trees chiefly through dead branches. Recent evidence, however, suggests that wounds may be more important as infection courts.

4.3.9.2 Rot Description

The incipient stage of decay in red heart rot is firm and appears as a red-brown heartwood stain. In the advanced stage, the wood becomes light brown to red-brown and soft and friable in texture. Thin, white mycelial fragments may develop in association with advanced decay. Finally, the wood becomes a brown, fibrous, stringy mass.

4.3.9.3 Indicators of Decay

Conks are common on the lower surface of fallen dead branches and on log ends, but they are rarely found on dead standing trees. They are annual, leathery, and flat or turned up at the margins, often forming thin, crust-like layers. The upper surface is grey to light brown and zoned. The lower surface is roughened, grey to light brown turning blood red when bruised, hence the common name, "bleeding fungus." Their small size, inconspicuous coloration and rare occurrence renders their presence of limited value as indicators of decay in living trees.

4.3.9.4 Extent of Decay

The extent of decay from red heart rot is variable, and not to be confused with stain. The extent of rot may be observed at the cut ends of logs.

4.3.10 White Mottled Rot

White mottled rot is caused by *Ganoderma applanatum* or Artist's conk, so named because the white underside of this fungus is excellent to draw on.

4.3.10.1 Species Affected

Ganoderma applanatum attacks a wide range of coniferous and deciduous hosts. It causes an important decay of dead trees but may gain entrance to living trees through wounds, causing extensive damage.

4.3.10.2 Rot Description

In the early stage of decay, the affected wood of most species becomes bleached and is encircled by a dark brown stain. In western hemlock, this stage is violet to lilac in colour. In the advanced stage, the wood becomes white, mottled, and spongy. Black zone lines may or may not be present.

4.3.10.3 Indicators of Decay

The conks (sporophores) are perennial, leathery to woody, and tend to be flat or plate-like. The upper surface is light brown to grey and deeply zoned. The margin, when fresh, may be white. The inner body is light brown but may possess a light grey zone. The lower surface is white, turning brown in old specimens or when bruised or marked, hence the common names "picture fungus" or "artist's conk."

4.3.10.4 Extent of Decay

The ends of cut logs may be observed to determine the extent of decay.

4.3.11 Conks, General

Conk is the common name for the fruiting bodies of decay fungi that infect the inside of a tree. Airborne spores produced by the fruiting bodies are the main agents for the spread of decay fungi. Infections are initiated through branch stubs and various kinds of stem or branch wounds caused by such things as animals, machines, lightning, and windfalls. Also, the *Armillaria* and *Tomentosus* family of root and butt rot can spread through soil or by root contact, but are not normally the types of rot to be hidden in a log. Although there are many different heartwood fungi, the *Phellinus igniarius* family are the most important trunk decay pathogens in northern hardwood forests, causing extensive damage in birch, maple, alder, willow, aspen, and cottonwood.

For the scaler, a knowledge of the characteristics of the fungi will provide valuable information on what to expect from these organisms. The **location** of decay (heart rot, sap rot, or butt rot), **pattern** of decay (pocket rot, stringy rot), and **type** of decay (white rot, brown rot), are different among the decay organisms. Therefore, the appearance of conks on the surface of a log that appears firm on both ends will no doubt indicate the presence of rot not visible to the scaler. This will give the experienced scaler a good idea of what to expect for the range of the decay within the log.

Conk rot is indicated by the fungal fruiting bodies (a conk) and/or rotten knots (conk knots). Conk rot is an external indicator of internal decay and may show as heart rot at one or both ends of the log, or may show simply as rotten knots. Some indicators are swollen knots where branches were shed many years earlier (blind conk), irregular bulges with exuding resin (goiter), resin flow from knots, and brown fungus parts (basidioscarps) at branch bases, branch stubs, knots, wounds, and cracks. "Punk knots" are included in this definition and are common in Douglas-fir, western larch, pines, and some spruces. A punk knot is a mass of brown fungus parts (hyphae) that extend from a decayed branch stub within the trunk to a local swelling on the surface, appearing like a blackened knot. Swelling is from a slight overgrowth of wood around the punk knot. Typically, dark yellowish brown to reddish brown fungal tissue is exposed where a punk knot is cut.

The extent of rot can range from a single rotten knot to extensive heart rot. The amount of rot in a log with conk is determined by the location, quantity, and species of the fruiting bodies, and local experience will allow the scaler to make accurate assessments of decay.

When conk rot shows only at one end of a log as heart rot, the presence of conk knots can indicate how far up the log the rot occurs.

Where conk rot shows at both ends of a log, refer to the methods already given in the heart rot section for through running heart rot.

Unfortunately, for those who are interested in the identification (morphology) of conks, logs delivered to a mill yard seldom maintain their conks because equipment handling removes them. The indicator then becomes a "conk knot" which is simply a rotten knot often showing fungus parts.

Because of the variability of the effects of conk, not only by fungus species but by the tree species and location around the province, it is very difficult to establish with conviction any conventions that apply across the province. Local conditions and experience will therefore determine which conventions or "rules of thumb" may be applied with conviction. The local Forest Service scaling representative will assist new scalers in making these judgements. Where there are conk knots and no sign of rot at the ends of a log, the scaler should, if possible, observe the processing of the log in order to get a better idea of the internal effects of conks.

4.3.12 Rotten or Hollow Knots

Rotten or hollow knots (limbs), other than indicators of *Phellinus Pini* or *Echinodontium tinctorium* (punk knots) and *Fomitopsis officinalis*, are encountered frequently in yellow pine, and occasionally in other species. Their reliability as indicators of either the presence or extent of decay is extremely variable between timber stands. Such knots have a rotten core within the heartwood of the limb, which may be associated with a pocket of rot within the heartwood of a log or, in some instances, be confined to the limb. The appearance of log ends that have been bucked through, or adjacent to such knots serve as good evidence of the probable effect of similar knots on the same log. Observations of a number of such log ends will aid the scaler in establishing a pattern of general characteristics for the particular timber stand and species being scaled. The normal course of log presentation restricts the number of meaningful observations that can be made and, where opportunity is afforded, logs should be intentionally bucked through such knots or observed while being milled for additional evidence of a general rot pattern. Generally, the pie-cut or sector method of deduction or, depending on the observed characteristics, another appropriate method may be used as described in Chapter Five, Firmwood Deductions.

4.3.13 Pipe or Pocket Rot, General

Pipe or pocket rot is often caused by fungus such as *Phellinus pini*. It infects most conifers in North America, with balsam, hemlocks, yellow pine, cypress and western red cedar commonly affected. Decay is usually in one column or several discrete columns that extend from branch stubs, where the disease starts. Wood in early stages of decay will have small pockets which slowly expand and merge into pipes or columns.

Pipe or pocket rot is defined as interior decay, other than butt rot, ring rot, or cylindrical heart rot, that frequently occurs at several locations of the same cross section of a log. Because this type of rot does not necessarily conform to the circular shape of the other rots described (e.g., butt rot, heart rot, sap rot), the scaler can use the "rectangular box" deduction method for these and many other kinds of defects that have a cubical or rectangular shape.

Each segment of decay is scaled either as a rectangular solid (i.e., cubical) or as a cylinder.

Where multiple pockets of rot are present, add the rot volumes together to calculate the total rot volume.

When the shape of the pocket is circular, refer to the heart rot section for the deduction methods.

4.3.14 Ring Rot, General

Ring rot is actually a form of heart rot where decay follows the growth rings but leaves a core of firm wood. The cylinder formula is used to calculate the volume enclosed by the outside diameter of the ring and to calculate the volume enclosed by the inside diameter of the ring. The inside volume is subtracted from the outside volume to find the volume of the rotten ring.

4.3.15 Goiter

Goiter is a swelling or abnormal growth on the bole of a tree; rot may be associated with this defect. Internal rot seldom travels more than 1 m above and below the goiter. Firm wood loss is based on scaler experience and judgement.

4.4 Sap Rots and Stains

Sapwood on logs cut from dead trees (snags or windfalls) is often in advanced stages of decay. If rotten sapwood extends over both the length and circumference of the log and the sapwood is still in place, the gross or outside diameter will be measured directly and the average diameter determined just as for green logs to obtain the gross volume. When the rotten sapwood has sloughed away, the gross or outside diameter will be determined by measuring the firm wood within the sapwood and adding the estimated thickness of the rotten sapwood. To obtain net scale, determine the average diameter of the firm cylinder inside the rotten sapwood (or surface checks) and treat it as a special scaling cylinder, considering any other defects that may be present. The difference between the gross scale of the outer scaling diameter and the net scale of the inner scaling diameter will be the deduction if no other defects are present.

Although living sapwood is relatively resistant to decay, certain fungi (*Daedalea unicolor* for example), is a common decayer of sapwood. It also colonizes living trees weakened by environmental stress. Several canker-rots (*Trametes versicolor*, *Schizophyllum commune*, and *Inonotus obliquus*) are widespread and infect living hardwoods (birch, cottonwood, aspen, and maple), eventually killing the tree.

Examine logs with dead sapwood carefully. Rot may extend into the heart in the form of pockets. In fire-killed or down timber, these pockets maybe on one side only. A large proportion of the scale volume of a log is in the outer few centimetres of wood. The outer 25% of a log contains 75% of the volume, so a relatively small error in measuring the amount of rotten sapwood may lead to a sizable error in the actual firmwood content. In some cases though, the identification of rotten sapwood becomes a problem. During the decay process of the wood, it is often quite difficult to distinguish between firm sapwood and infirm sapwood; the following indicators may serve as a guide for the scaler to warrant closer observation:

- Black sapwood from end to end of the log,
- Brown pockets of rot (more evident in fresh logs),
- Sapwood soft and separated from the heartwood,
- Conks of sap rot fungi on logs,
- Dark blue stain (probably in association with brown rot), and
- Bark loosened or completely shed.

4.4.1 Blue Stain or Sap Stain(Also Black Stain Root Disease)

Blue stain is caused by a large number of fungi, including species of *Ceratocystis*, *Graphium*, and *Leptographium*. Sapwood of virtually all species may be stained to some extent, but western white pine, yellow pine, lodgepole pine and Engelmann spruce are particularly susceptible. Blue stain in logs is not considered a defect for which deduction should be allowed, as firm or firm blue-stained lumber is merchantable. No deduction should be made in scaling logs affected with blue stain, unless the sapwood is broken down or rotten. In the latter case, the decay can be traced to some of the true wood-destroying fungi. The conditions favourable for the development of the bluing fungi - high moisture content and warm weather - are also highly favourable to the development of the true wood-destroying fungi; hence logs attacked by bluing fungi may at the same time be attacked by various fungi-producing decay. In scaling blue-stained logs that have broken down or rotted in the sapwood, a deduction must be made however, and such logs should be scaled to the average diameter inside the rotten sapwood.

Losses from surface checks may be scaled out in the same fashion, but this is a grading consideration rather than a scaling consideration because checks do not produce a significant firm wood volume loss.

4.4.2 Brown Crumbly Rot

Brown crumbly rot is caused by the red belt fungus or *Fomitopsis pinicola*, formerly *Fomes pinicola*.

4.4.2.1 Species Affected

The red belt fungus is one of the most frequently occurring decay-producing fungi in British Columbia, attacking a wide range of coniferous and deciduous tree species. It is very common on dead trees and has been termed the scavenger fungus because of its importance in reducing wood to forest litter. It occurs frequently as a sap rot, but can also gain entrance through wounds and cause considerable damage to the heartwood of living trees.

4.4.2.2 Rot Description

This rot is probably the most important slash rot of conifers in British Columbia. It occurs on dead standing trees, fallen trees, sawlogs, and pulpwood in storage. The rot usually develops in the sapwood, which is decayed rapidly, and then progresses into the heartwood. It has been reported as an occasional heart rot in living trees, entering the heartwood through basal scars; but its major role is in decay of slash and stored logs. The early stage of decay is marked by a faint brownish discolouration. In the later stages, the wood is reduced to a yellowish brown to reddish brown mass of cubical chunks with white mats of fungous tissue developing in the cracks in the decayed wood. The sapwood of dead spruce and pine is destroyed quite rapidly; where logs of these species are kept in decks for long periods, the losses in higher grades of lumber or pulp yields may be considerable.

4.4.2.3 Indicators of Decay

Conks of *F. pinicola* develop readily on dead standing and fallen trees and on stored logs. They are perennial, woody, and hoof-shaped to rather thin and bracket-like. The upper surface is crusted, grey to blackish, and often has a distinct reddish band around the margin. The under surface is smooth and cream-coloured with very small, circular pores. Small, whitish, crust-like conks often develop extensively over the sapwood on ends of decaying stored logs.

4.4.2.4 Extent of Decay

Because sapwood is vigorously attacked by this rot, scaling is generally accomplished by scaling inside the affected sapwood.

4.4.3 Brown Cubical Sap Rot

Many fungi cause a brown cubical sap rot but those most commonly found are caused by *Lenzites saeplaria*, *Trametes americana*, and *Trametes serialis*.

4.4.3.1 Species Affected

All commercial conifers and many deciduous species in British Columbia are affected by this rot and it is commonly associated with deterioration of fire-killed trees and slash. *Lenzites saeplaria* and *Trametes serialis* are occasionally found on living trees, on dead sapwood under fire scars, and on other wounds.

4.4.3.2 Rot Description

The decay first appears as a yellow to yellow-brown discoloration in the sapwood or outer heartwood. Advanced decay is characterized by a mass of crumbly, brown cubical wood that may or may not have thin mats of fungous tissue in the cracks in the wood. Decay on fallen trees, stumps, snags, and smaller material on the ground usually begins in the sapwood, which is rapidly destroyed, and progresses into the heartwood, which is also eventually decayed.

4.4.3.3 Indicators of Decay

Conks of these fungi are annual, tough, and persistent. *Lenzites saepiaria* conks are light to dark cinnamon brown, thin, and bracket-like, and have radial gills on the under surface. *Trametes americana*, which are similar, have large circular pores on the under surface. *Trametes serialis* conks are white, flat, and crust-like with large circular pores.

4.4.3.4 Extent of Decay

Brown sap rot indicates that the entire sapwood is unusable for lumber or pulp and that the log should be scaled inside the defective sapwood.

4.4.4 Grey-brown Sap Rot

Grey sap rot is caused by *Cryptoporus volvatus* or pouch fungus.

4.4.4.1 Species Affected

Extremely common in fire-killed Douglas-fir, it also invades balsam (grand fir), Engelmann spruce, yellow pine, western hemlock, and western larch.

4.4.4.2 Rot Description

Grey-brown sap rot develops very rapidly in dead standing trees and is common in recently-cut stored logs, particularly grand fir logs and pulpwood. The rot is generally superficial, being limited to the outer 6 mm of sapwood. Dark grey streaks and flecks appear in the wood, which remains quite firm.

4.4.4.3 Indicators of Decay

Conks of *Cryptoporus volvatus* usually appear on trees the year after death occurs, often developing by the thousands over the entire trunk surface as well as on the larger branches. These conks indicate the rapid and extensive development of the decay in the newly-dead sapwood. Apparently, conks develop during one season, are quickly eaten by insects, and do not occur again on that particular tree. They are cream-coloured and often resemble small eggs or pouch-like structures attached to the bark of a tree. Larger conks, up to 5 cm in diameter, are more or less hoof-shaped. The underside of the conk has a small circular hole near the base, opening into a cavity that frequently contains insects that spread the spores of the fungus.

4.4.4.4 Extent of Decay

Because of the superficial nature of this rot, no deduction is made unless the sapwood is broken down. If the sapwood is broken down, deduction should be made by scaling inside the affected area.

4.4.5 Pitted Sap Rot

Caused by *T. abietinum* or purple conk, this rot is also known as hollow pocket rot.

4.4.5.1 Species Affected

Virtually all conifers in British Columbia are invaded by this rot with the possible exception of junipers and Pacific yew. It is of primary importance as a deteriorating agent but it is also capable of causing sap rot and heart rot in living trees. It has been reported to have attacked unseasoned wood after manufacture into lumber.

4.4.5.2 Rot Description

Pitted sap rot usually attacks only dead material and is one of the most common decay fungi on stumps, logs, and slash in the woods, it also develops on decked sawlogs and pulpwood. Occasionally it decays dead sapwood on cat faces of living trees. *T. abietinus* does not cause heart rot of living trees, although heartwood on dead material may be decayed. The first evidence of decay is a yellowing and softening of the wood. Tiny empty pockets that are elongated parallel to the grain appear. As decay progresses, these pockets become larger and more numerous until the wood has a fragile, lace-like appearance. Pitted sap rot develops rapidly in wood that still has bark on it.

4.4.5.3 Indicators of Decay

Conks of *T. abietinus* usually develop abundantly on decaying material. They are flat and crust-like on the under-surface of logs and slash; and they are thin and bracket-shaped on dead standing trees, stumps, and the upper surfaces of down material. The conks are grey with faint radial zones on the upper surface and purplish with large, irregular pores on the under surface. As the conks age, the purple colour fades to a pale brown. On the sapwood at the ends of logs, the conks commonly appear in large numbers, sometimes completely covering it.

4.4.5.4 Extent of Decay

As conks develop readily on the bark over the entire surface area of the decaying sapwood, the distribution of the conks usually indicates the extent of decay. Sapwood of logs on which conks of *T. abietinus* appear is considered unfirm and should be deducted for accordingly. Such logs are scaled inside the affected sapwood.

4.5 Other Natural Defects

Surface defects take a variety of forms, showing up as either rotten and charred wood or missing wood such as catface, deadside, and miscellaneous scars.

Due to the nature of these defects, it is necessary to use judgment in determining the best deduction method to use. In some cases, a diameter reduction is made, as with sap rot. In others, the shape of the defect, cylindrical, conical, or cubical determines the best method to use. Often, very little volume is involved and no deduction can be made because the smallest volume deduction increment possible is 0.1 m.

With experience, it will become clear that many forms of defect will suit a shape for which a calculation method has already been described in the Measurements and Deduction sections of this scaling manual.

If the defect extends to the pith, scale as a sector of an arc or pie shape.

If the defect does not extend to the pith, scale as a portion of a cylinder, portion of a cone, or by "squaring up" the defect.

Portions of defects outside the scaling cylinder are not measured (i.e., flared portion of a log).

The following list illustrates many typical natural defects that involve missing wood.

4.5.1 Cat Face - Fire Scar

A depression in the outer surface of a log where the tree failed to renew following an injury, such as an abrasion or fire scar.

4.5.2 Dead or Missing Side

Dead side is decay extending from the surface to the pith of a log, resembling a pie shape in cross section of the log.

4.5.3 Lightning Scar

Lightning can damage a tree enough to provide entrance of fungal spores or cause other structural defects.

4.5.4 Fire Scar, Burn Saddles

Fire scars take several shapes, usually affecting the outer surface of the tree. Burn saddles are saddle shaped pockets burned into a stem where two trees lay diagonally across each other in a fire.

4.5.5 Bark Seam, Frost Check

After a tree has split from frost, it most often heals itself, leaving a seam of ingrown bark. Occasionally, decay organisms will invade the wound, causing rot.

4.5.6 Worm Holes, Insect Damage

Insect burrows that are sufficient to result in a significant loss of firmwood are not common in healthy trees. However, storage for long periods in salt water allows toredo borers to do extensive damage and storage in land decks can allow boring insects to infest the sapwood. Lumber loss can be significant if the damage is extensive enough to affect merchantability.

4.5.7 Burls

Burls are abnormal swellings of the main stem or branches and are among the most conspicuous of the stem diseases. They vary considerably in size, reaching 1 m or more in diameter in some cases but rarely occur in sufficient abundance to warrant concern. Burls result from the abnormal development in number or size of wood cells following disturbance to the cambial layer, the cause of which in most cases remains unknown. Dwarf mistletoes cause burls in several coniferous species. Because of their size, burls will add volume to a log but are unsuitable for manufacturing lumber. Although they can affect the quality of underlying wood, it is not significant enough to warrant a grade deduction. In fact, burl wood and surrounding wood can demand premium market prices depending on species because of the very appealing grain structure revealed in specialty products manufactured from it, such as automotive trim veneers and furniture.

4.5.8 Galls

Galls are localized trunk or branch swellings in which bark tissues are mainly affected with little or no damage to the underlying wood. Small galls, approximately 1 to 3 cm in diameter are relatively frequent on Douglas-fir and western hemlock, those on Douglas-fir have been attributed to a bacterial agent but in western hemlock the cause is still unknown. Because of their minimal effect on volume or wood quality, galls are ignored in scaling.

4.5.9 Cork Bark

Cork bark is an unusual condition of bark-ridging sometimes encountered in balsam (Sub-alpine fir). Restricted areas of the main stem, seldom exceeding 1 m in length, are affected. The condition is characterized by a very thick and deeply furrowed bark, contrasting sharply with normal, relatively smooth bark. Studies have shown that wood quality is adversely affected, and may be a consideration when determining grade. It is important for the scaler to allow for the increased bark thickness when calipering a log to obtain a diameter inside the bark.

4.5.10 Witches Brooms

Witches brooms occur on a number of tree species and are characterized by a ball of very densely intertwined branches high on the tree, often looking like a shaggy bird's nest. Mistletoe, rusts, and needle diseases cause brooming; other brooms of unknown cause occur, sometimes very large and involving much of the tree crown. Because brooms seldom, if ever, arrive in a log scaling yard, they are not considered in scaling or grading.

4.6 Mechanical Defects

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

It is important to perform a scale as soon as possible after harvesting to avoid the problems of determining whether a defects are natural or induced by storage. There are two different appraisal systems in place in British Columbia, and the approaches to scaling and grading for mechanical defects differ depending on the method of appraisal. It is necessary for the scaler to contact the Forest Service Scaling Representative for instruction on the correct approach. Typical mechanical defects are discussed in the following subsections.

4.6.1 Undercut

A heavy undercut in a butt log will reduce the amount of wood available to cut lumber but no firmwood deduction is made. The preferred undercut is the "Humbolt cut" where the wedge of wood is cut out of the stump instead of the butt log, improving utilization. Mechanical harvesting methods do not have an undercut but there may be some shattering if the felling machine is not functioning properly.

4.6.2 Barber Chair or Slabbed Logs

Barber chair is a very dangerous occurrence, where the tree splits up the trunk from the hinge during the felling process. The handling process can split or "slab off" logs, such as a tree bound up during skidding or split while being handled in the landings or yards. Heavily leaning trees may also cause this defect when felled. A common deduction method is to use the cylinder formula and apply a factor representing the missing wood. Refer to the Measurement Section of this manual for methods of obtaining the net volume of slabbed logs.

4.6.3 Shatter or Broken End

Shatter is another defect resulting from the handling process and is caused by the same factors that cause slabbing. When felled, a tree will often break or shatter if the stem hits a rock or other object and also can be broken during skidding, decking, loading, or unloading. Shattered ends are usually bucked clean but will often show up in a scaling yard. The Measurements Section of this manual will provide the scaler with the correct techniques for measuring the lengths of logs with broken ends.

4.6.4 Stump or Sliver Pull

A defect associated with felling caused by a portion of the wood in the butt log being left on the stump, or a portion of the stump being left on the butt log. If the sliver pull is out of the butt log, an actual loss in volume occurs and may be significant enough to deduct from the gross volume by using the "rectangular box" formula. If the sliver is out of the stump, there will be a volume increase, but in practice these are never scaled. The faller or bucker will usually remove these pieces or "snipes" for safety reasons immediately at the logging site, so they will rarely show up in a scaling yard.

4.7 Multiple Defects

Disease, environmental damage and equipment damage will all affect the volume of firm wood in a log. Often, these defects are combined on one log, such as catface and heart rot, missing wood, and butt rot, requiring the scaler to use two or more methods to obtain the net volume. It is also quite possible for the defects to overlap, so a scaler may have to use different methods to obtain the net volume. Where overlap occurs, the scaler must ensure that a deduction will not be made twice in the overlapping area.

Acknowledgement

The B.C. Forest Service wishes to express its appreciation to Dr. Eric Allen of Forestry Canada for contributing the photographs which make up Section 4.8.

4.8 Illustrations of Common Fungal Organisms



Figure 4.1 Brown cubical butt rot (*Phaeolus schweinitzii*) in pine.



Figure 4.2 Tomentosus root rot (*Inonotus tomentosus*) in pine.



Figure 4.3 Cedar pocket rot (Postia sericiomollis). It is found both as a butt rot and a heart rot.



Figure 4.4 Brown stringy trunk rot (Echinodontium tinctorium), incipient stage.



Figure 4.5 Brown stringy trunk rot, advanced stage.



Figure 4.6 Brown stringy trunk rot, cross section.



Figure 4.7 The notorious Indian paint fungus (Echinodontium tinctorium), responsible for Brown stringy trunk rot.



Figure 4.8 Aspen trunk rot (Phellinus tremulae), indicating the relationship between the heart rot and the fruiting body (conk).

Firmwood Scaling Procedures

5

Scaling plays an important role in fulfilling government's mandate in the systematic and equitable assertion of its financial interests and in the administration of the provincial harvest. Scaling must also serve the needs of the timber manufacturing industry and others, including the general public.

Many parties are dependent upon an accurate and meaningful scale. To give this assurance and ensure scale results mean the same thing to all users, all scaling must conform to standard measurement methods and conventions.

Scale results in British Columbia are reported in terms of the net firmwood volume in cubic metres. A cubic metre (m^3) of timber can be viewed as a cubic metre of solid wood, free of any rot, hole, or char; hence the expression "net firmwood volume."

Sections 5.1 to 5.4 of this chapter explain:

- the B.C. Metric Scale and its derivation,
- the various measurements which are taken to calculate scale volumes, and
- how the scale stick is used to take measurements and calculate volumes.

Sections 5.5 to 5.9 explain:

- how firmwood deductions are made to determine the net firmwood content of each log.

The other component of scaling which is assessing the quality of timber or grading is discussed under Chapter 6. The scaling of special forest products is discussed under Chapter 8.

5.1 Measurements

5.1.1 Units of Measure

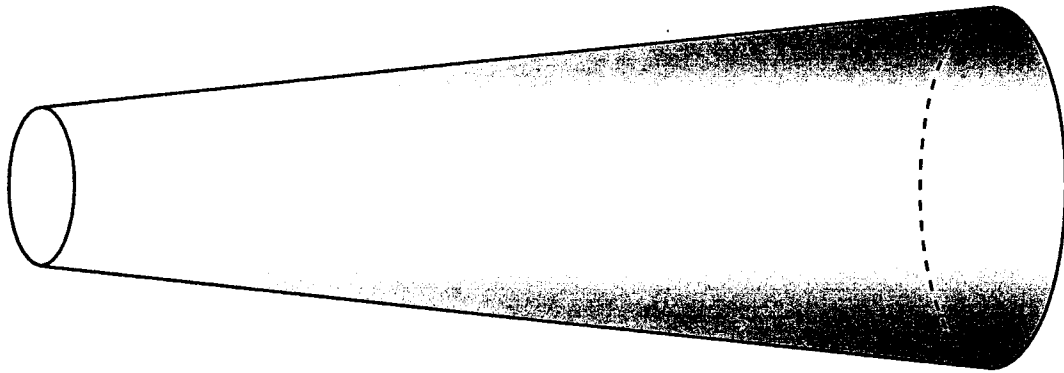
The legal units of measurement for scaling in British Columbia have been based upon the *International System of Units (SI)* since the late 1970s. The *SI* system is commonly referred to as the Metric System.

The units used fall into two general categories:

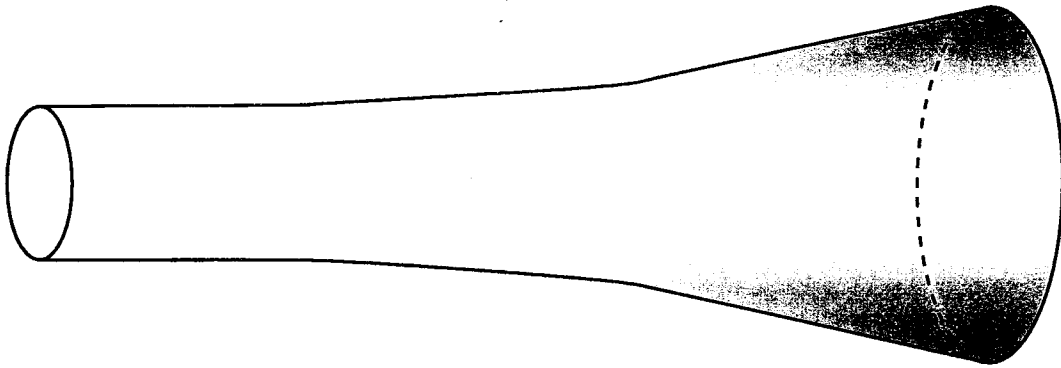
- a. base units (i.e., those measurements actually taken such as length, radius and mass):
 - the metre and the decimetre are used for lengths,
 - the centimetre and "rad" are used for radii, widths and thicknesses,
 - the kilogram and tonne are used for mass (weight scaling - see Chapter 9), and
 - whole number units are used for piece counts (e.g., 527 Christmas trees - see Chapter 8),
- b. derived units (i.e., those units calculated from the base units such as cubic metres):
 - the cubic metre, cubic decimetre and the stacked cubic metre are used for volumes,
 - the square metre and square decimetre are used for areas, and
 - the weight scale ratio is expressed in cubic metres per tonne (see Chapter 9).

5.1.2 The British Columbia Metric Scale

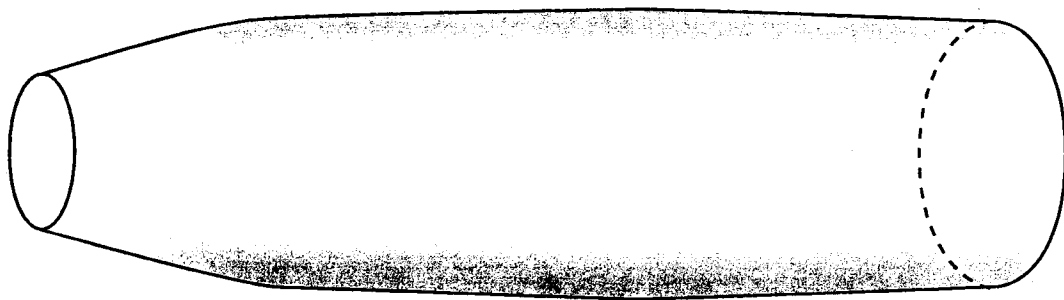
In British Columbia the official scale rule for purposes of scaling under the *Forest Act* is the *British Columbia Metric Scale*. This scale rule uses Smalian's formula to calculate the volumes of individual logs. The net firmwood volumes, expressed in cubic metres, are recorded.



a) Conoid (truncated cone)



b) Neiloid



c) Paraboloid

Figure 5.1 Exaggerated depictions of the three typical log forms.

5.2 Smalian's Formula

Smalian's formula states that the volume of a log can be closely estimated by multiplying the average of the areas of the two log ends by the log's length. Of course, the units of the areas and the length must be compatible (e.g., square metres and metres.)

Smalian's formula is commonly expressed as follows:

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

where:

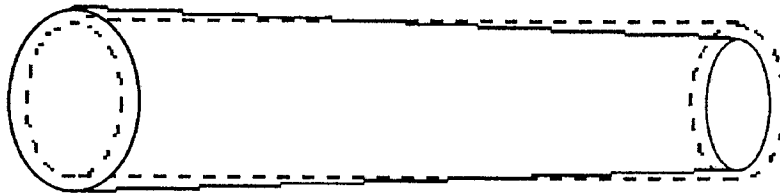
- V = The volume of the log (in cubic meters in B.C.),
- A_1 = The area of the small end (in square meters in B.C.),
- A_2 = The area of the large end (in square meters in B.C.), and
- L = The length of the log (in metres in B.C.).

5.2.1 Smalian's Formula - Illustrated

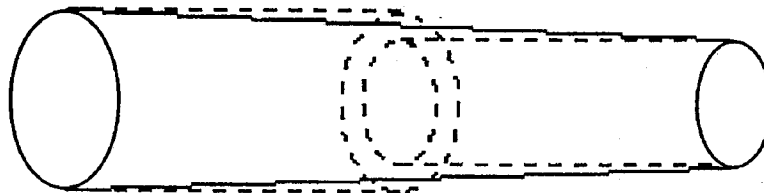
Although logs may appear as cylinders, most are frustums of cones, neiloids or paraboloids. These three log forms are shown, exaggerated for illustration, in Figure 5.1. While it is generally accepted that Newton's formula provides more accurate estimates of the volumes of these types of shapes, it is also recognized that it is a more complex formula and requires more measurements and that at least one of these (mid-point area) is difficult to accurately obtain. Smalian's formula is an acceptable compromise to practicality and works very well where logs are bucked prior to scaling.

Figure 5.2 illustrates how Smalian's formula may be visualized as either one cylinder projecting the average of the areas of the large and small ends for the full log length, or as two cylinders; one projecting the area of the small end for exactly one half the log length and the other projecting the area of the large end for exactly one half the log length. Either view will produce the same results; a volume equivalent of the log represented.

Normally, the differences between the areas of the small and large ends of a log are not too great and Smalian's formula is an accurate reflection of the true log volume. However, the greater the difference in diameter between the log ends, the less reliable will be the estimates obtained using Smalian's formula. Experience has shown that where the difference between the top and butt log diameters approaches 30%, Smalian's formula is not an accurate estimate of log volume. Where excessive taper exists, the Forest Service may order that logs be bucked prior to scaling to improve accuracy.



Here, the solid represented by the dashed outline represents a cylinder with a cross-sectional area equal to the average of the top and butt areas (i.e., $\frac{A_1 + A_2}{2}$)



In this second example the solid represented by the dashed outline shows two cylinders - one with an area equal to the top area the other the butt area and both running half the log length. This is how the scale stick calculates Smalian volumes.

Figure 5.2 Two ways to visualize Smalian's formula.

5.2.2 Smalian's Formula in Detail

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

$$A_1 = \frac{\pi T^2}{10\,000}, \text{ and}$$

$$A_2 = \frac{\pi B^2}{10\,000}$$

The fully expressed Smalian formula becomes:

$$V = \left(\frac{\frac{\pi T^2}{10\,000} + \frac{\pi B^2}{10\,000}}{2} \right) L$$

where:

- V = volume of the log in cubic metres
- π = 3.141 592, (to 7 significant figures or 6 decimal places)
- T = radius of the small end in cm (or the diameter in rads)
- B = radius of the large end in cm (or the diameter in rads)
- L = length of the log in metres

(Division of the top and butt areas by 10 000 converts square centimetres to square metres.)

(Division of the two end areas by 2 determines the average log area.)

A "rad" is equal to two centimetres. Thus, if a log is measured across its diameter in rads, using the stick, the recorded measurement be the radius of the log in centimetres.

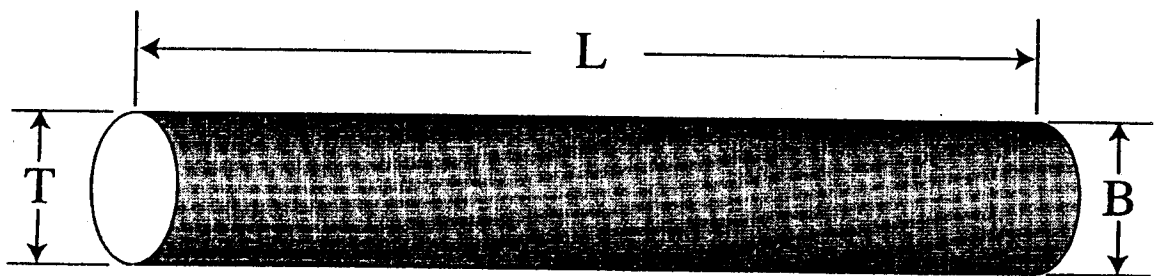


Figure 5.3 Example log for calculation shown in Section 5.2.3.

5.2.3 Smalian's Formula - Example Calculation

The log illustrated in Figure 5.3 has a top radius "*T*" of 9 cm, a butt radius "*B*" of 11 cm, and a length "*L*" of 9 m.

Recall that Smalian's states:

$$V = \left(\frac{\frac{\pi T^2}{10\,000} + \frac{\pi B^2}{10\,000}}{2} \right) L$$

Substituting the log's dimensions we get:

$$V = \frac{\frac{\pi 9^2}{10\,000} + \frac{\pi 11^2}{10\,000}}{2} \times 9.0$$

Step 1, calculate the area of the two ends in square centimetres:

$$V = \frac{\frac{254.468952}{10\,000} + \frac{380.132632}{10\,000}}{2} \times 9.0$$

Step 2, divide each area by 10 000 to change square centimetres to square metres:

$$V = \frac{0.0254468952 + 0.0380132632}{2} \times 9.0$$

Step 3, sum the areas of the two ends together and divide by two to average the areas:

$$V = 0.0317300792 \times 9.0$$

Step 4, multiply the average end area by the length in metres to yield the volume:

$$0.031\,730\,079\,2 \times 9.0 = 0.285\,570\,712\,8 \text{ m}^3,$$

$$\text{Volume} = 0.2855707128 \text{ cubic metres.}$$

Step 5, round the volume of the log to the nearest cubic decimetre (i.e., 3 decimal places):

$$0.285\,570\,712\,8 \text{ m}^3 \text{ rounds up to } \underline{\underline{0.286 \text{ m}^3}}$$

5.2.4 Smalian's Formula - Abbreviated

Smalian's formula states:

$$V = \left(\frac{\frac{\pi T^2}{10\,000} + \frac{\pi B^2}{10\,000}}{2} \right) L$$

Combining the constants (i.e., " π ", "10 000", and "2"), Smalian's formula becomes:

$$V = \left(\frac{\pi}{\frac{10\,000}{2}} * (T^2 + B^2) \right) L$$

We can now re-name the consolidated constants $\frac{\pi}{\frac{10\,000}{2}}$ as a single new constant C :

$$\begin{aligned} C &= \frac{\pi}{\frac{10\,000}{2}}, \\ C &= \frac{0.0003141592}{2}, \text{ and} \\ C &= 0.0001570796. \end{aligned}$$

Using the consolidated constant provides for an abbreviated "Smalian's" formula:

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

where:

$$\begin{aligned} V &= \text{the volume of the log in cubic metres,} \\ T &= \text{the top radius in centimetres,} \\ B &= \text{the butt radius in centimetres,} \\ L &= \text{the length in metres, and} \\ C &= 0.0001570796 \text{ (the constant).} \end{aligned}$$

5.2.5 Smalian's Abbreviated Formula - Example Calculation

Let us now calculate the volume of the log illustrated in Figure 5.4 (overleaf) using the abbreviated Smalian's formula.

By substituting the log dimensions from Figure 5.4 into the formula we get:

$$V = (09^2 + 11^2) \times 9.0 \times 0.0001570796,$$

$$V = (81 + 121) \times 9.0 \times 0.0001570796,$$

$$V = 202 \times 9.0 \times 0.0001570796,$$

$$V = 1818 \times 0.0001570796, \text{ and}$$

$$V = 0.28557071.$$

Rounded to three decimal places, the volume is = **0.286 m³**.

5.2.6 Practical Use of Smalian's Formula

Most scalers derive their volumes from the B.C. Metric Scale Stick, an FS 546 *Table of the Half Volume of Cylinders in Cubic Decimetres* or from computer software. All of these methods, while still based upon Smalian's formula, save scaler from unnecessary arithmetic.

The stick can be lost or broken, the FS 546 torn or misplaced, and computers have been known to crash. Therefore, in a pinch the scaler must be ready and able to use Smalian's formula from scratch.

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

All persons designing software for scaling purposes must also employ Smalian's formula and have the software approved by the Ministry of Forests. Additional information on volume calculation and compilation standards is found in Chapter 7, Appendix 7B and information on approval procedures can be obtained from the regional Ministry office.

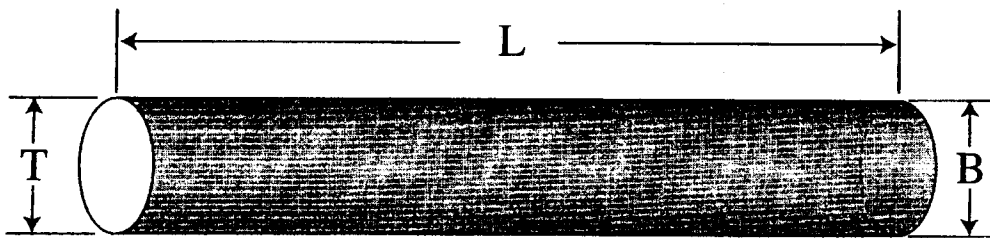


Figure 5.4 Example log for volume calculation using abbreviated formula.

5.3 Scaling Tools

- Tally sheets are used to record the net scale data. The data is then key-punched into computers which use Smalian's formula to calculate volumes, or hand-compiled from the scale stick or *FS 546 Table of the Half Volume of Cylinders in Cubic Decimetres*. The summarized information is then submitted. Chapter 7 details the selection and use of the approved forms to be used in different types of scales,
- Hand-held computers and data capture units, using Ministry approved scaling software are now preferred over the tally sheet and summary sheet system. After entering the data, the machine will generate a detailed log listing and a summary report including volumes by species and grades automatically. These computer generated forms may be submitted in lieu of the above tally sheet system, thereby substantially reducing the time required to manually determine volumes and complete the forms,
- The *FS 546 Table of the Half Volume of Cylinders in Cubic Decimetres* contains half volumes of cylinders with lengths from 2 m to 29.9 m and radii from 1 cm to 100 cm. It is often used to assist in hand compiling log volumes,
- The metric steel loggers' tape, calibrated in tenths of metres (decimetres), is used to measure log lengths, and
- The B.C. Metric Scale Stick is the most important scaling tool. It can be used to measure log radii and lengths; and to calculate volumes and defect deductions. The stick is manufactured in three lengths; one metre, one and one-half metres, and two metres. The handles of the one metre and the one and one-half metre sticks are in addition to the stick length, whereas the handle is included in the length of the two metre stick. Scale sticks are also manufactured in left or right handed styles, and in a version which is somewhat slimmer than standard sticks.

All scaling computation software and measuring devices must comply with Ministry of Forests and/or CSA standards for accuracy (CSA CAN3-0302.1-M86-12.x). It is the responsibility of scalers to ensure the accuracy of their equipment.

5.3.1 The B.C. Metric Scale Stick

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

Smalian's Formula requires the measurement of a log's radius and length to calculate volume. However, when scalers measure the ends of logs, they traditionally have measured across the log's diameter since doing so provides a more practical convenient and accurate dimension.

To accommodate the need for the radius in the formula, the scale stick is marked off in 2 cm increments (radius class units or *rads*). This design allows the scaler to read off the radius in centimetres when the log diameter is measured in "rads". Figures 5.5 through 5.12 on the following pages illustrate the parts and use of the scale stick.

The approved BC Metric Scale stick specifications are documented in Appendix 5A.

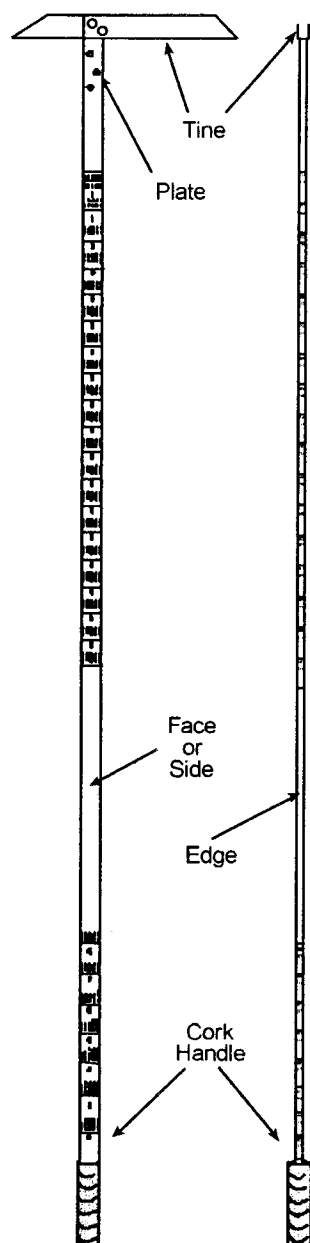


Figure 5.5 Parts of the official B.C. Metric Scale Stick

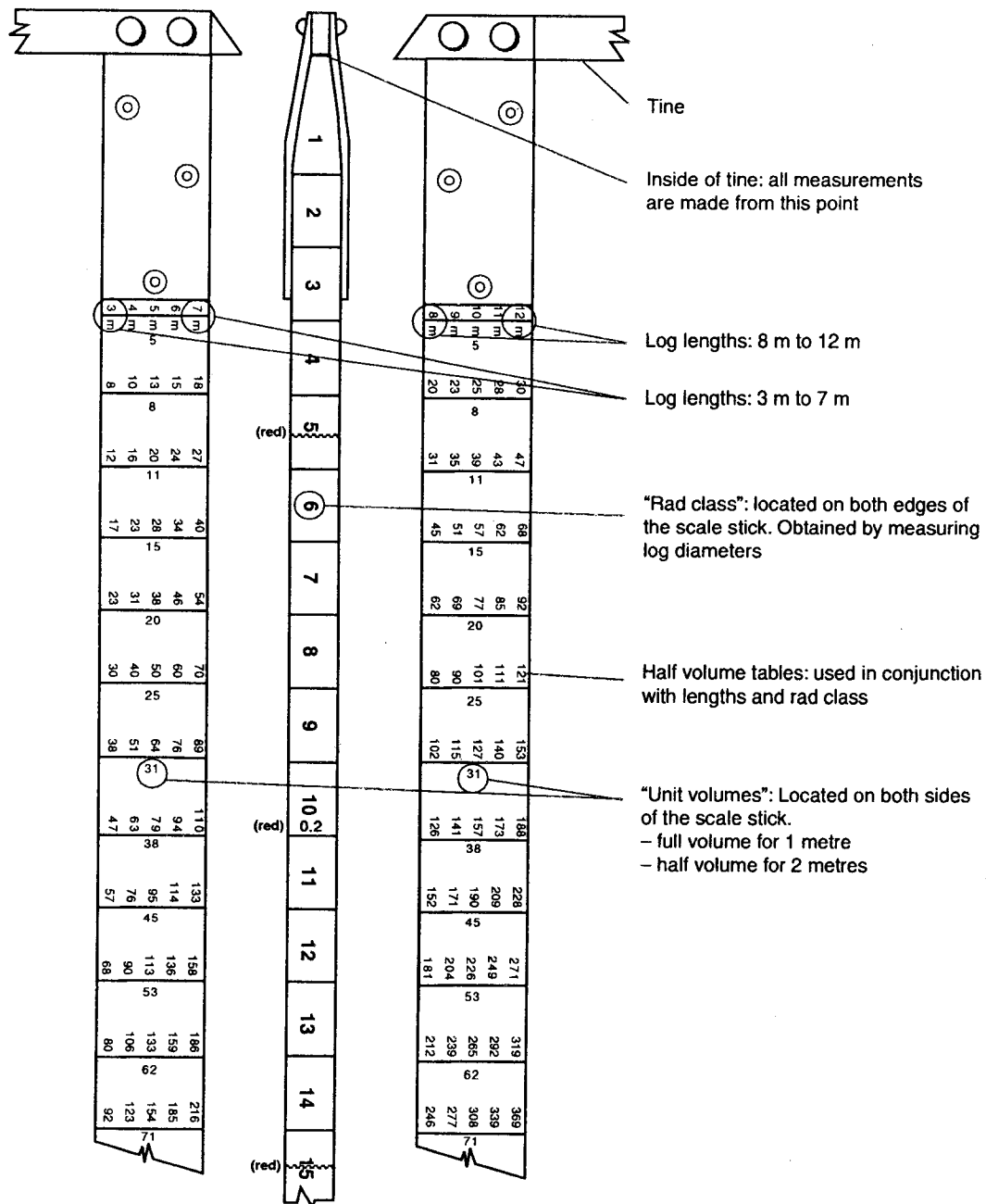


Figure 5.6 Sides and edge of a B.C. Metric Scale stick.

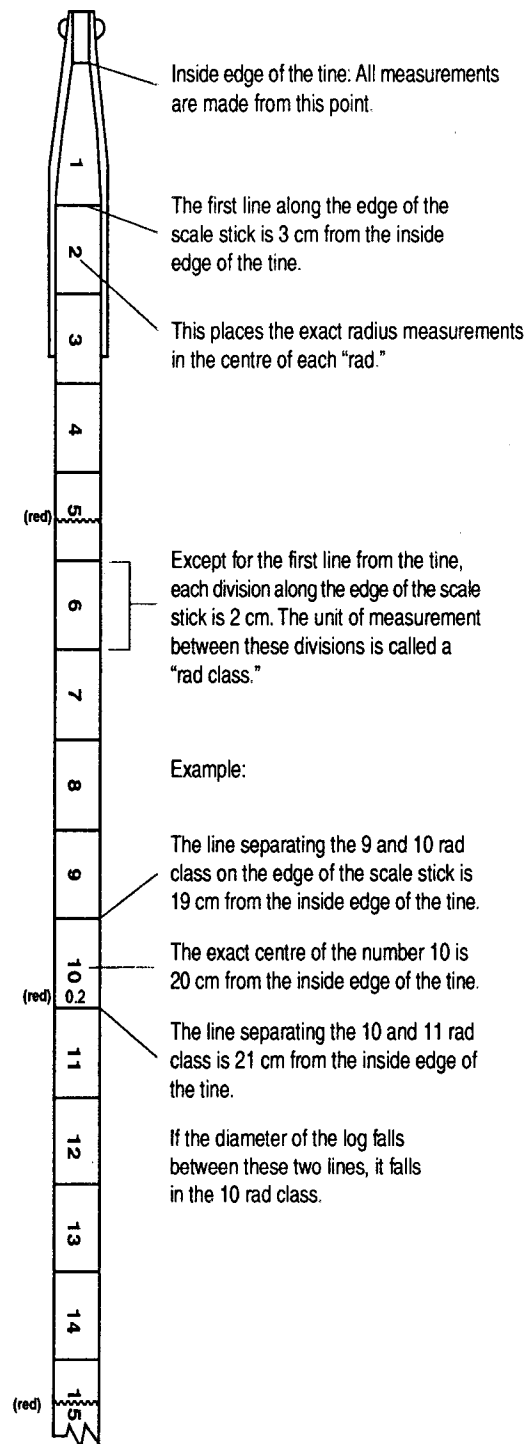


Figure 5.7 Information on the edge of the stick.

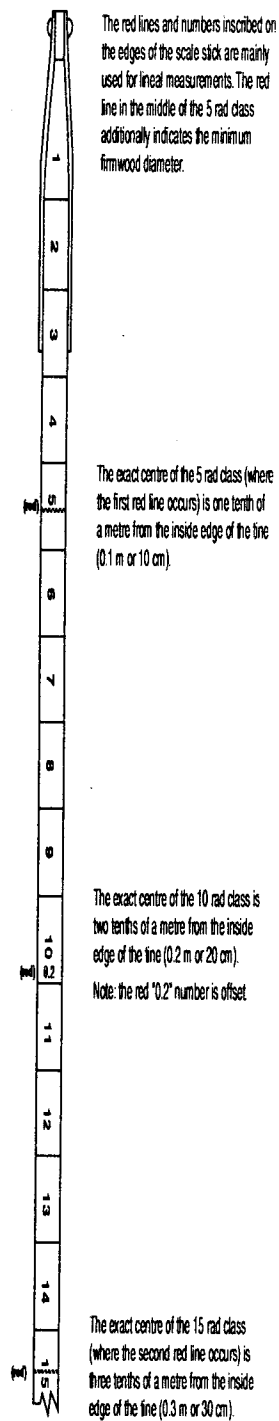


Figure 5.8 B.C. Metric Scale Stick edges showing the purpose of red markings.

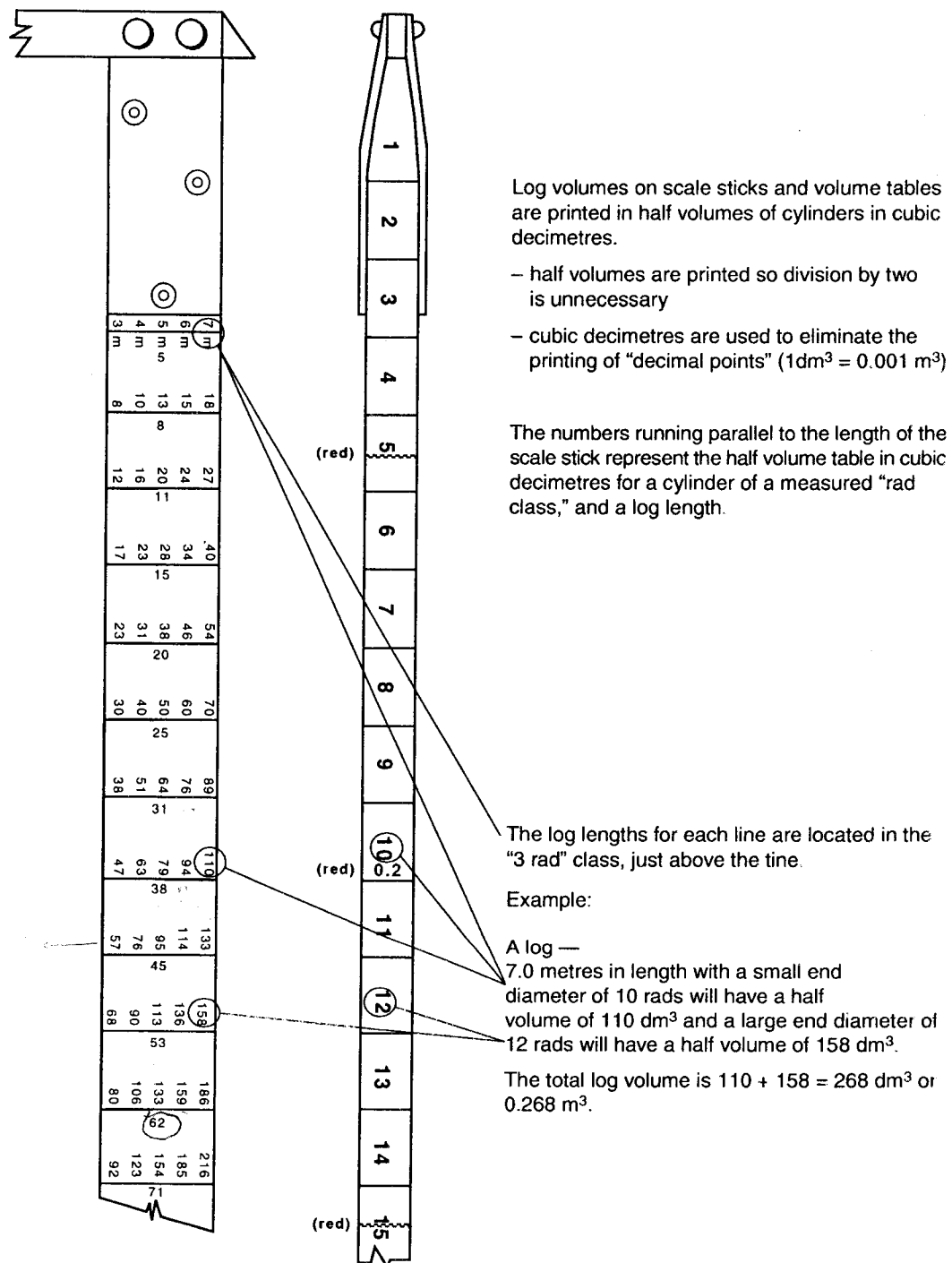


Figure 5.9 Using the stick to calculate half volumes.

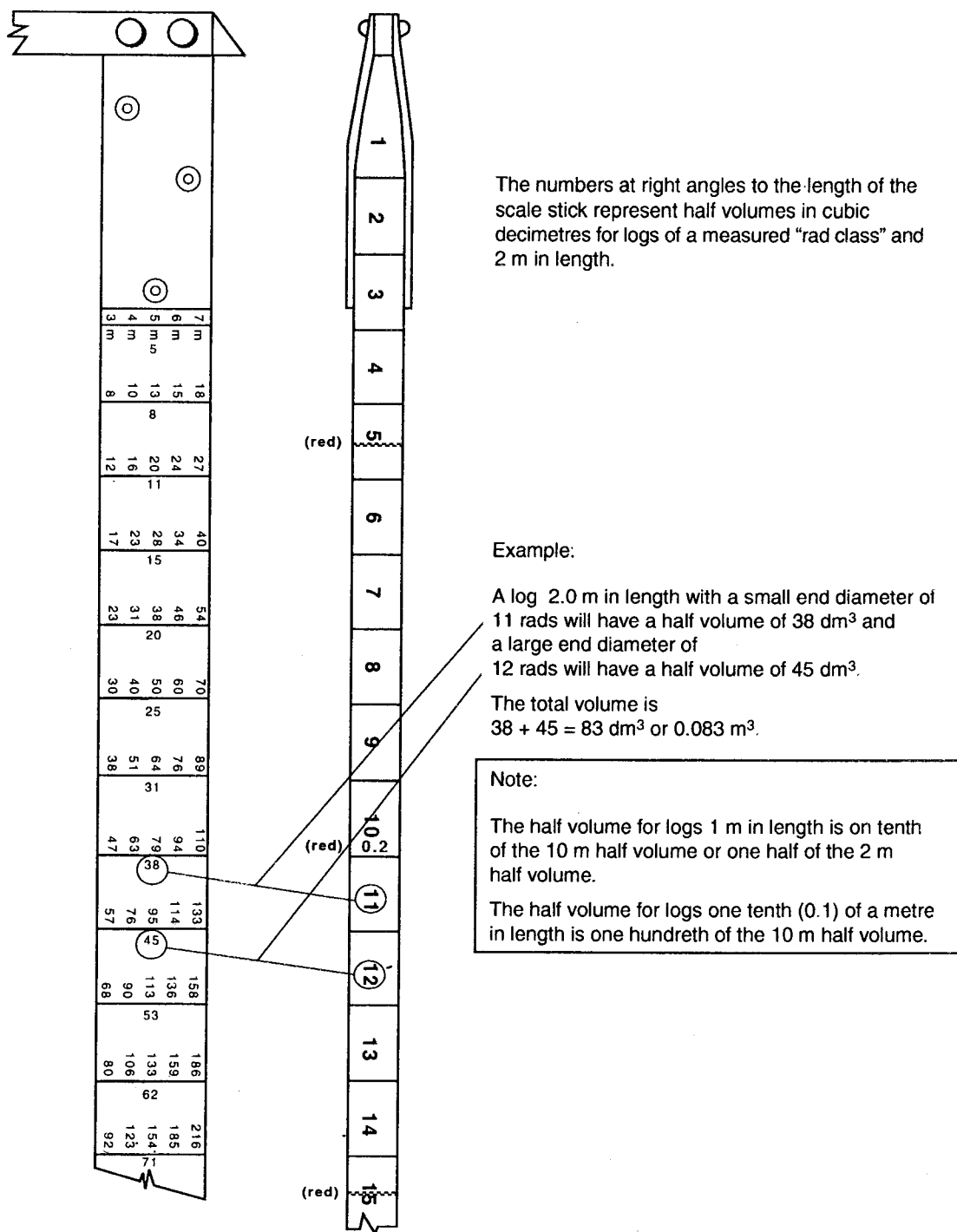


Figure 5.10 Use of the face (side) and edge of the stick in calculating 2 m volumes.

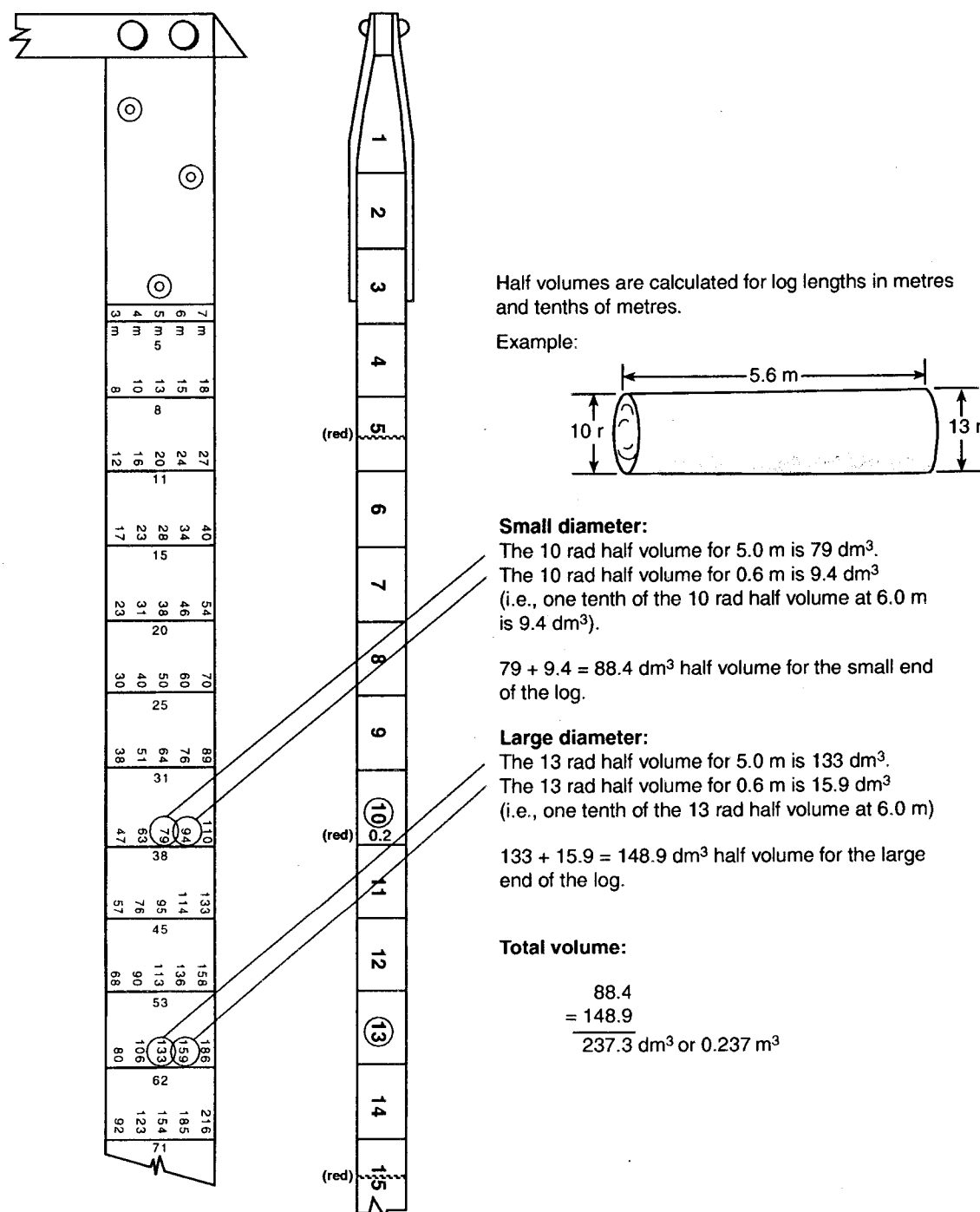


Figure 5.11 Using the side and edge of the stick for lengths in tenths of metres.

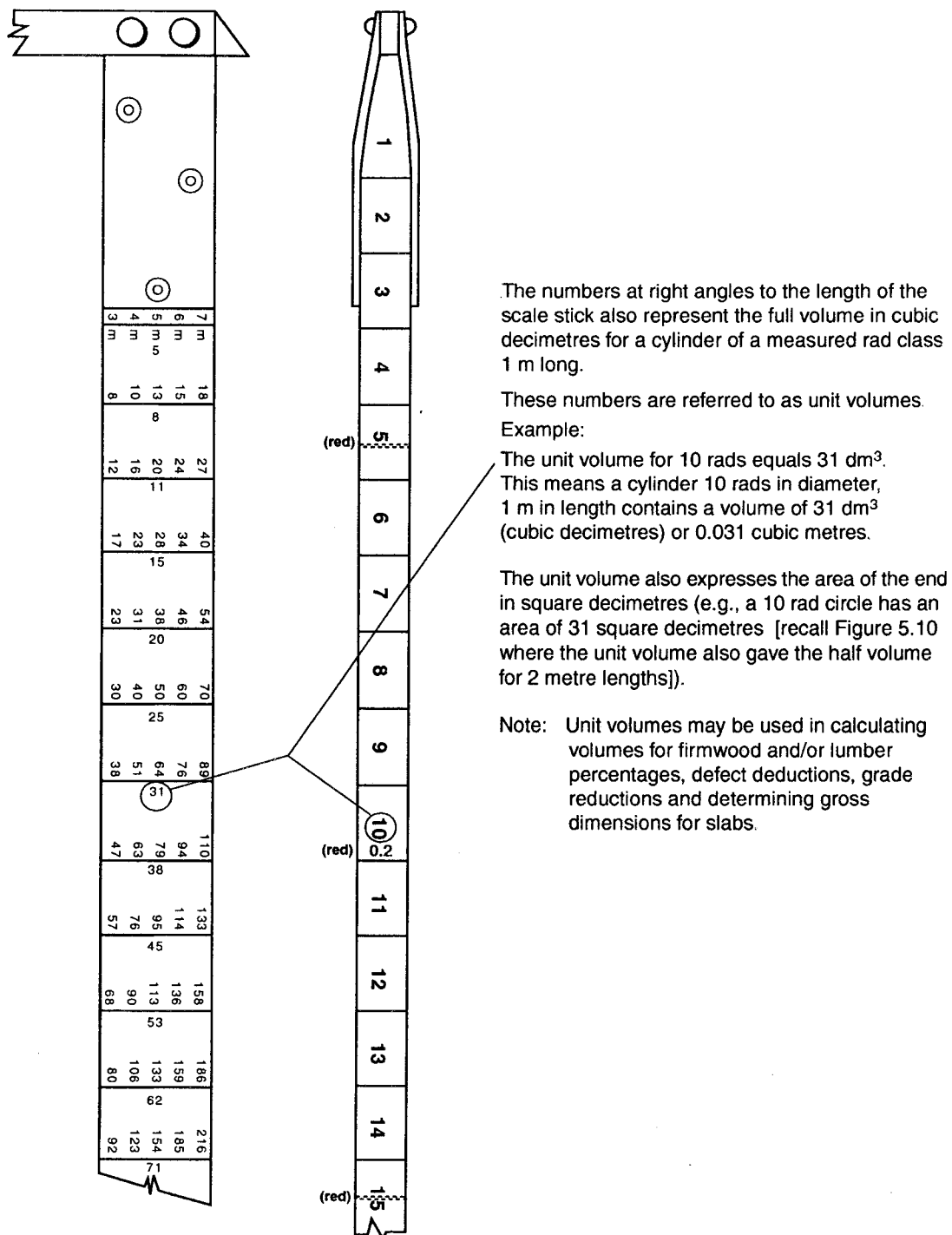


Figure 5.12 Obtaining unit volumes (or "factors") from the stick.

5.4 Measuring Log Dimensions

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

Where Chapter 5 describes the measurements required for the determination of volume, Chapter 6 contains more information about measuring logs or slabs for the purpose of determining grade, also defined in the *Scaling Regulation*.

5.4.1 Measuring End Diameters

With the use of a B. C. Metric Scale Stick, radii are found by:

- measuring, in rads, across the diameter, inside the bark,
- taking more than one measurement at each end, through the geometric log centre, to compensate for oval or irregular shapes and variations in symmetry,
- averaging the measurements,
- rounding the radius to the nearest even number where the averaged measurement falls exactly half-way between two radius classes, and
- recording the rounded, average radius in centimetres.

Figure 5.13, on the next page, shows where measurements are taken and how they are averaged:

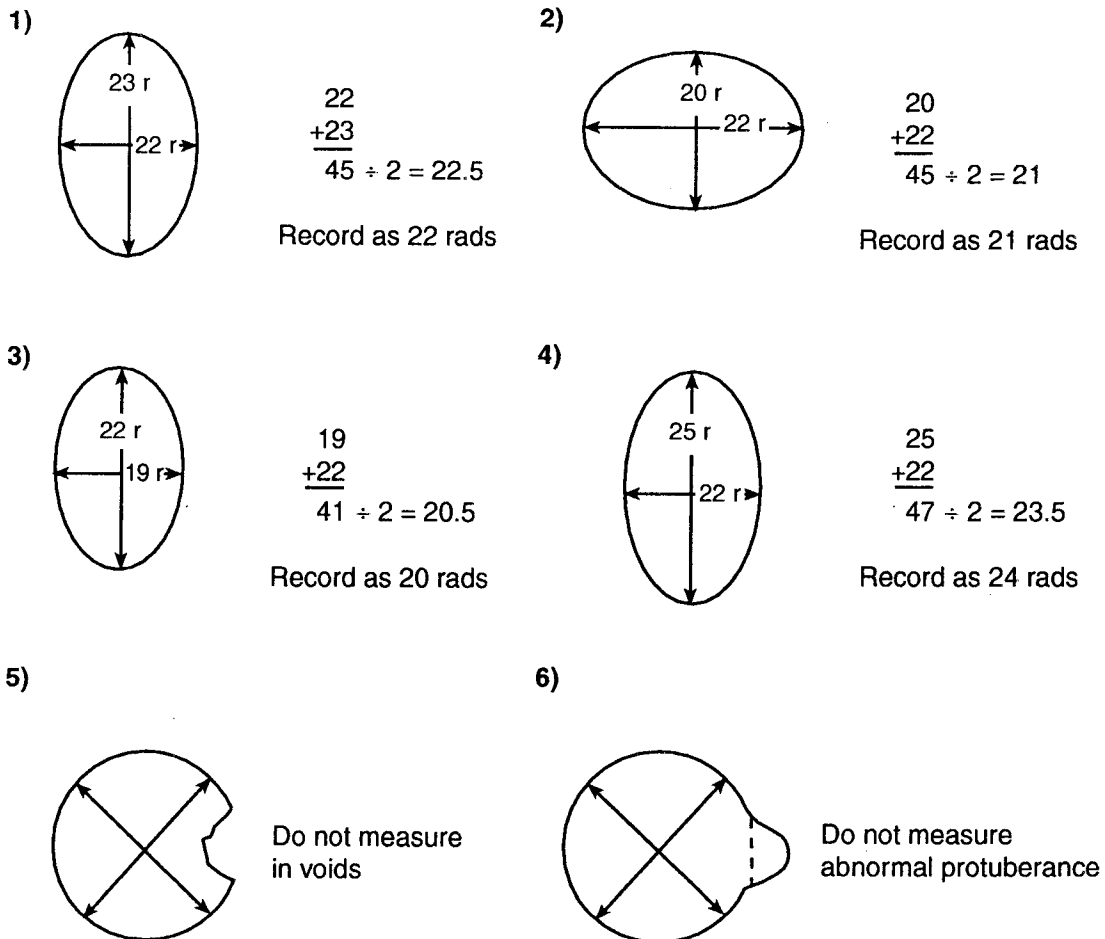


Figure 5.13 Diagram of the procedures used for measuring and averaging diameters.

5.4.2 Measuring Flared Butt Diameters

The bottom of many trees is buttressed by way of a flared, swollen or fluted portion that develops in response to wind stress and degree of root spread. Logs bucked from this area (i.e., butt logs) are typically neiloidic in shape (refer back to Figure 5.1).

Smalian's formula tends to overestimate the volumes of neiloids. It is, therefore, important that scalers compensate by reducing the actual end radius to eliminate any swell flare or fluting. Failure to do so is the single largest cause of overscaling.

There are two common methods - calipering and projecting the normal line of taper. It is a good practice for scalers to use both methods on the same log from time to time, comparing the results to develop confidence and confirm technique.

5.4.2.1 Calipering

"Calipering" a log means obtaining a radius at a point other than at the cut face by placing the scale stick across the log and projecting two perpendicular sight lines to the points where the measurement is read (see Figure 5.14). The novice scaler may practice calipering by first selecting a log without flare and directly measuring across its end in the normal manner. Calipering this log at a point close to the end (allowing for bark) should give the same measurement. Practice will build confidence in calipering.

The larger the log, the more skill and care is required to get accurate dimensions and the greater the potential to overscale if the technique is poor.

Some points to remember when calipering are:

- select a spot just above the flare,
- keep sight lines perpendicular to stick,
- take two or more measurements on out of round logs,
- caliper inside bark or subtract bark thickness,
- project the normal line of taper from the caliper point to the butt end face and add an extra rad or two (if required), and
- practice and compare results to the other method from time to time.

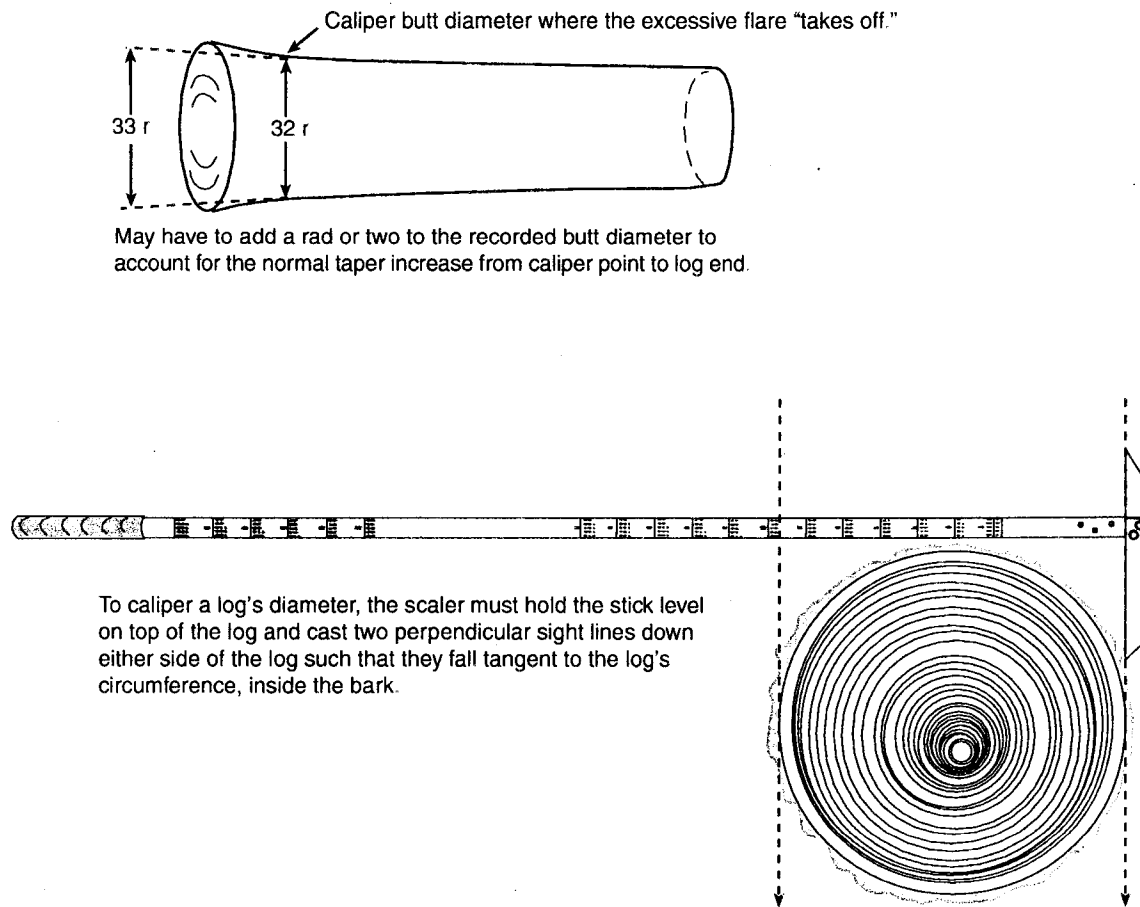
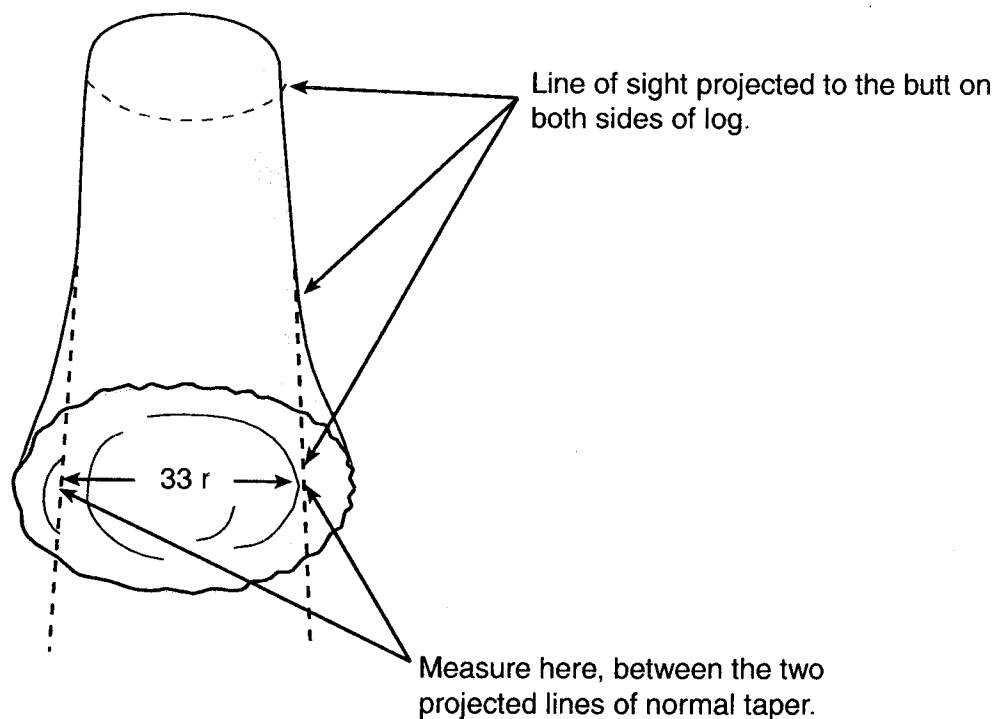


Figure 5.14 Diagram showing the method of measuring butt diameter by calipering.



Scaler stands 1.5 m to 3 m in back from the butt and projects the normal lines of taper through the flare.

Figure 5.15 *Projecting the normal log taper through butt flare.*

5.4.2.2 Projecting the Normal Line of Taper

The other common method for measuring flared butts is for the scaler to stand behind the flared end and project the normal line of log taper through the flare to the cut face. See Figure 5.15 (previous page).

Novice scalers often find it helpful to hook their logger's tape on one edge of the log's top circumference, bring it back down the log and drape it over the flare. When pulled taut, the tape can be made to follow the taper and a mark can be placed upon the butt face. The tape can then be attached to the opposite edge of the top and the process repeated. Measuring between the marks in rads should give the projected radius. This is not only a good way to learn the technique (which, when mastered, can be done by line of sight) but also can be useful, even to the expert, on the more challenging flared specimens.

Where logs are out of round, gravity dictates that they most frequently are presented to the scaler with their larger diameter in the horizontal plane. Since one of the log's sides, along which the line of taper for the narrower radius runs, is on the ground (and potentially in the mud or snow), and, given that most scalers have taken to walking upright, this method is not well suited to out of round logs. Scalers should bear this in mind and consider adjusting the projected measurement or calipering the narrower radius.

Projecting the normal line of taper is most commonly used on larger logs where calipering is difficult or even dangerous due to the risk of falling. On smaller flared logs it is generally expedient to caliper. Scalers should become adept at both methods.

Points to remember when projecting the line of taper:

- stand back from the butt end (approximately 1.5 to 3 m),
- project the normal line of log taper to the butt end face,
- measure, at the butt face, between points where the projected lines of taper intersect the butt face,
- exercise caution on out of round logs, and
- practice and compare results with the other method.

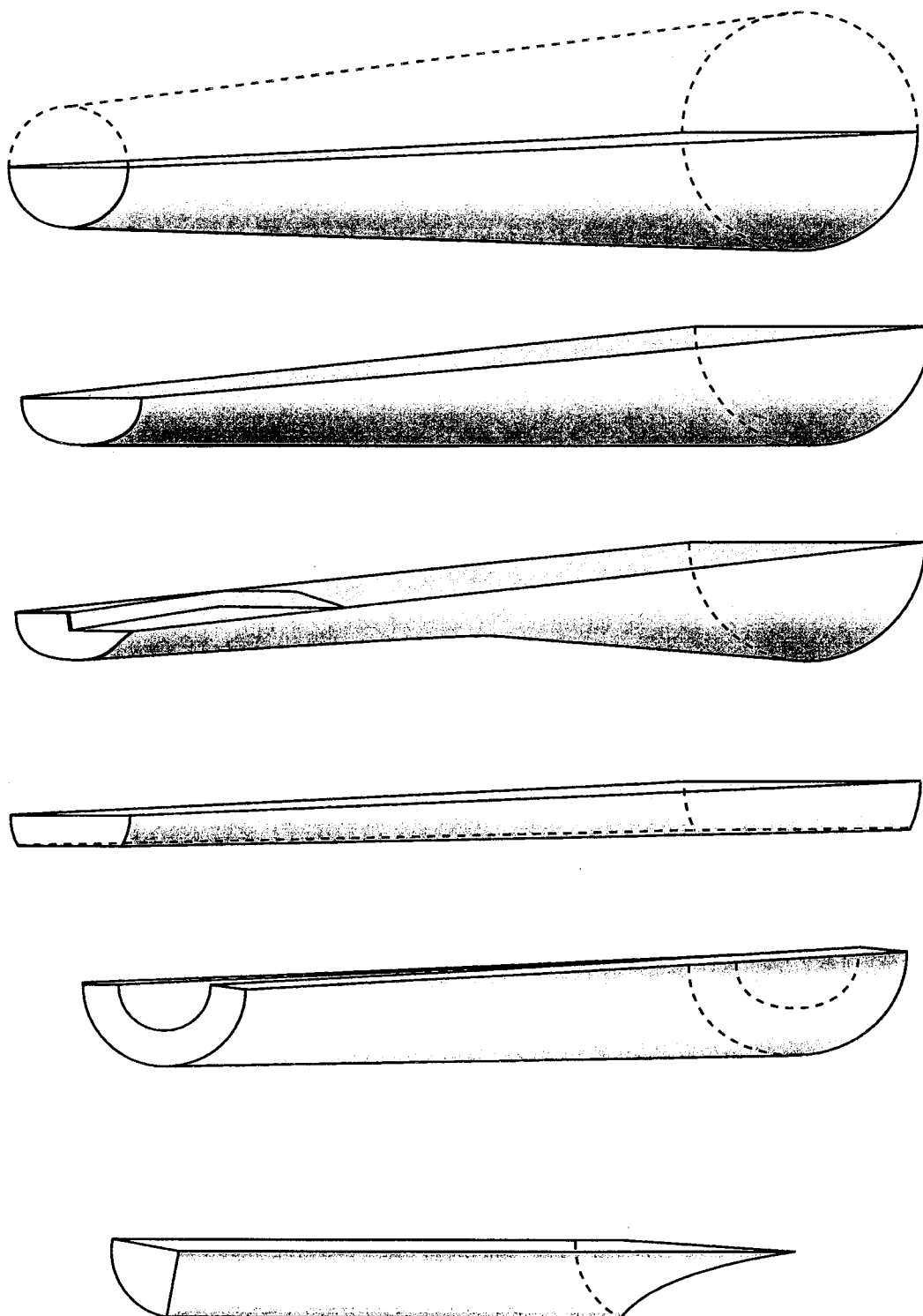


Figure 5.16 Typical Slabs.

5.4.3 Measuring the Ends of Slabs

In scaling jargon, a slab is a piece of timber that has fractured along a plane that is roughly parallel to the longitudinal axis of the original log. The shapes of slabs are quite variable, ranging from nearly "plank-like" to virtually perfect semicylinders; however, most fall between the ideals (see Figure 5.16). Even so, they can be seen as roughly triangular, rectangular or semicircular in end view.

As stated earlier, Smalian's formula uses an average of the two end areas projected over the length of the piece to determine the volume. It follows that the challenge to the scaler measuring a slab is to record two radii which fairly represent the areas of the respective slab ends and which, when inserted into Smalian's formula, will yield the firmwood volume. This "effective radius" can be determined either by enclosing the end area with one of a "semicircle", a "pie wedge", a rectangle or a triangle, depending upon which most nearly matches the slab end shape.

5.4.3.1 Measuring Slab Radii

5.4.3.1.1 Semicircular Ends

The most frequently encountered slab shape has a "semicircular" end profile. A true semicircle is exactly one half the original circle. Normally logs are not perfect circles and rarely do they fracture exactly in the middle. Therefore, what we are calling a semicircle is more properly the area transcribed by the intersection of a circle and a chord.

The conventional manner for getting an effective radius on "semicircular" ends is to measure the slab's width in rads between the points where 10 cm faces can be obtained nearest their outer corners. Another measurement in rads is then taken at the point of maximum thickness between these faces (ignoring minor irregularities). These width and thickness measurements are then averaged and recorded as the mean effective radius (see Figure 5.17).

5.4.3.1.2 Quadrants and other pie or wedge shaped slab ends

Sometimes logs will conveniently split into quarters or thirds of their original end profile. Other times a more exotic and less convenient fraction will result. These types of ends are roughly triangular in profile and leave the scaler with several measurement options.

If the end is a convenient fraction (e.g., $1/3$, $1/4$, $1/6$, etc.) of the original parent log (i.e., looks like a wedge of pie), then the scaler can simply take the appropriate proportion of the parent log's unit volume and interpolate the respective effective radius class. If the shape is not a convenient fraction then the simplest solution is likely to treat the end like a triangle.

Figure 5.18 depicts a quadrant (i.e., 1/4 of a circle). The measurements A and B (in cm) are actually two radii of the original log end.

If the original log was a true circle, A and B will be identical. If the original log end was an oval, they will differ and the original radius would be their average.

Therefore, to determine the parent log's unit volume (U.V.), we can measure A and B in cm and determine their average. This will be assumed to be the effective radius of the parent log and we can easily read its unit volume off the scale stick (refer back to Figure 5.12).

In the example in Figure 5.18, A = 12 rads or 24 cm, while B = 14 rads or 28 cm. The average radius of the parent log is assumed to be:

$$r = \frac{24 \text{ cm} + 28 \text{ cm}}{2} = 26 \text{ cm}$$

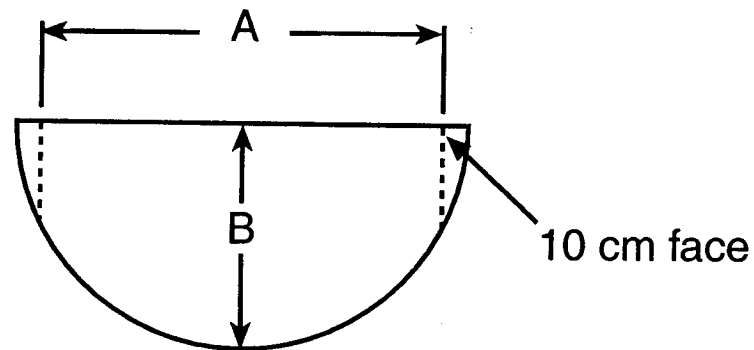
The unit volume for 26 cm is 212 dm³. Since this slab is a true quadrant (i.e., 1/4 of the original circular end), we multiply the parent U.V. by 1/4 which gives us 53 dm³. From the scale stick we can interpolate that this gives us an effective radius of 13 cm.

If this slab had been two thirds or one sixth of the parent log end, we would have multiplied the parent U.V. by 2/3 or 1/6, respectively, to get the slab U.V.

To illustrate the principle, we have actually done more arithmetic in the above example than is needed. Converting the measurements of A and B from rads to centimetres and then averaging them is really the same as multiplying by 2 then dividing by 2. If, instead, we just add A and B in rads we get the same answer.

Therefore we can generalize:

The U.V. of the a pie or wedge shaped slab end equals the U.V. of (A + B) rads times the fraction of the original log end that the slab represents



A = width (in rads) between 10 cm faces

B = maximum thickness (rads)

$$\text{effective radius} = \frac{A + B}{2}$$

$$A = 32 \text{ rads}$$

$$B = 20 \text{ rads}$$

Figure 5.17 Semicircular slab end.

On semicircular slabs such as the one depicted in Figure 5.17 (opposite), the long-standing convention has been to term the dimension "A" which falls across what is, more or less, the parent log's diameter as the width. The other dimension "B", perpendicular to "A", and which is, more or less, the parent log's radius is termed the thickness.

The width "A" is measured in from the edges between those two points where 10 cm faces can first be obtained. The thickness "B" is measured at the point of maximum depth between these two 10 cm faces, ignoring any minor protuberances or voids.

The assumed effective radius of the slab is taken to be the average of these two measurements, A and B.

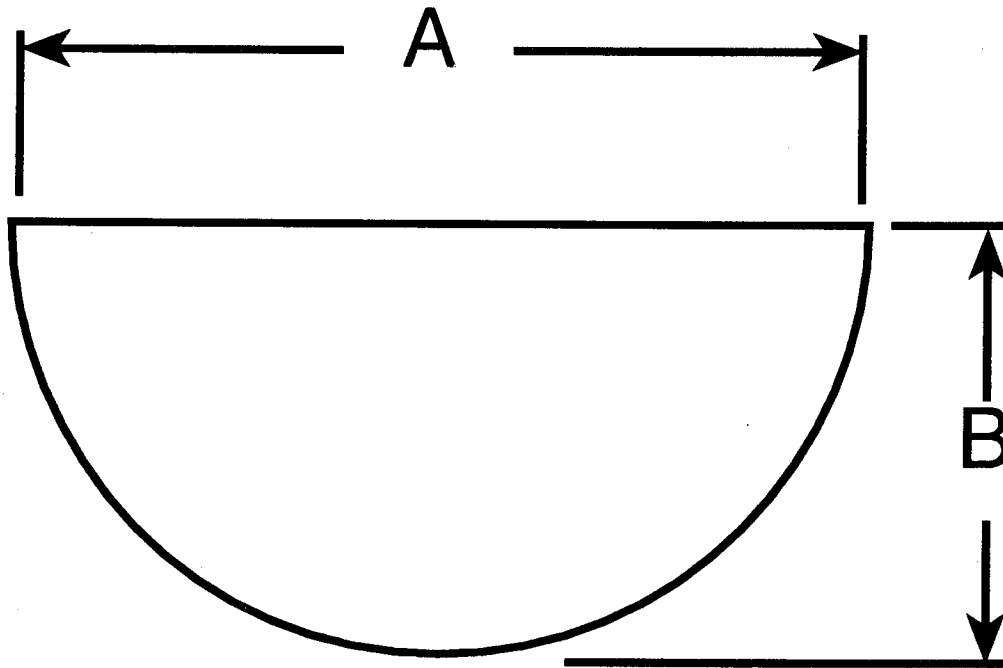
Thus in the example:

$$A = 32 \text{ rads}$$

$$B = 20 \text{ rads}$$

$$\text{radius} = \frac{32 + 20}{2} = 26 \text{ cm}$$

Therefore the scaler would record 26 cm as the radius.



This example is 1/4 of an out of round circle (ie oval) with A=14 rads and B=12 rads. The unit volume of the effective radius is 1/4 of the U.V. (14 rads + 12 rads) or $212 \times 1/4$. This gives us a slab unit volume of 53. From the stick we can see that this corresponds to a radius of 13 cm. Please refer to Section 5.4.3.1.2 a fuller and more detailed explanation.

Figure 5.18 *Determining the effective radius of quadrants and other pie shaped ends.*

5.4.3.1.2 Rectangular ends

Although logs rarely break up into truly rectangular cross-sections unless a sawmill is involved, slab ends sometimes are more or less rectangular.

Figure 5.19 (overleaf) depicts such a slab end. As suggested in the diagram, the width and height measurements are taken so that the voids (depicted as Y's on the diagram) balance the protuberances (depicted as X's.)

The area of a rectangle is its width times its height. We are making the calculation to obtain the unit volume of the rectangular slab end so that we may convert it back to an equivalent effective radius. We do this by comparing the calculated rectangular slab unit volume with the unit volumes printed on the scale stick.

The unit volumes on the stick are in dm^3 . To make our comparison meaningful we must calculate the slab's unit volume in dm^3 also. If we first calculate the area of the rectangle in dm^2 and then multiply by 1 m (10 dm) we will have the unit volume in cubic decimetres because the definition of a unit volume is the volume found in one metre of the log's (or as in this case, the slab's) length.

Recall that 1 rad = 2 cm and that there are 10 cm in a decimetre. To convert each of the height and width measurements read off the stick into decimetres, we must multiply by 2 and divide by 10 or, in other words, multiply by 0.2.

However, since we must then multiply the height by the width to get the area we can arithmetically combine the 0.2 constant for the height and the 0.2 constant for the width into one constant, 0.04. We then multiply this by the 1 m (10 dm) length because a unit volume is, by definition, the volume found in one metre of log length.

That is:

Rectangular Unit Volume = (0.2) Width in rads X (0.2) Height in rads X 10 dm per metre

Rectangular Slab Unit Volume = (0.4) Width in rads X Height in rads.

For the example in Figure 5.19:

Unit volume of the slab end = (0.4) (20) (17) = 136 dm^3 .

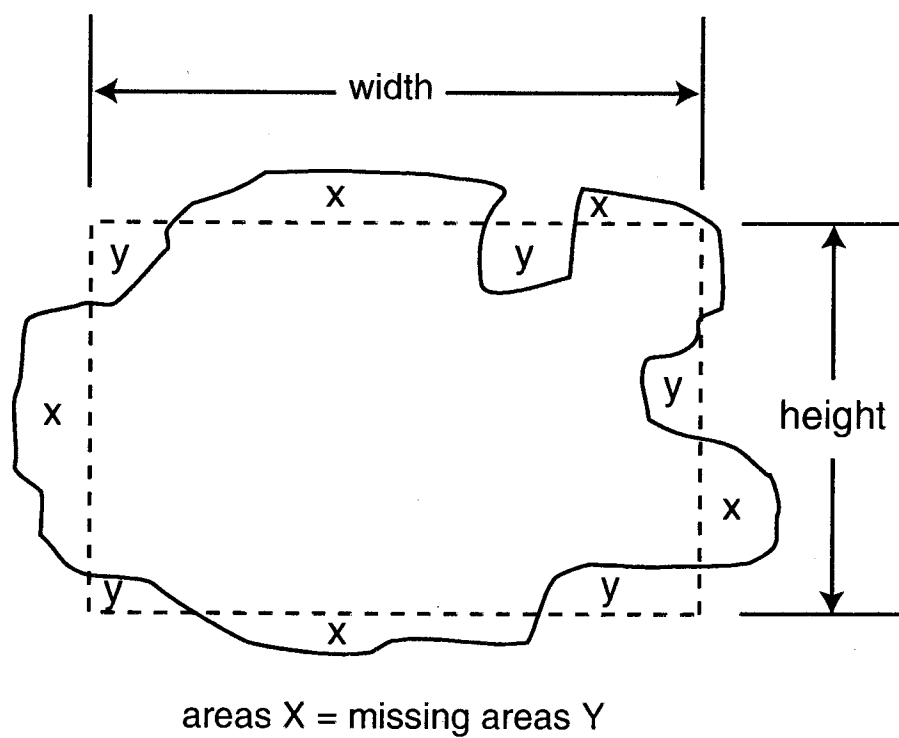


Figure 5.19 A rectangular shaped slab end.

5.4.3.1.4 Triangular Slab Ends

The formula for finding the area of a triangle is one half its base times its height.

As with the rectangular end, we are performing the area calculation to obtain the unit volume of the slab end so that we may convert it back to an equivalent radius by comparing the with the unit volumes printed on the scale stick. The unit volumes on the stick are in dm^3 . If we calculate the area of the rectangle in dm^3 and multiply by 1 m (10 dm) we will have the unit volume in cubic decimetres.

Recall that 1 rad = 2 cm and that there are 10 cm in a decimetre. To convert both of the base and the height measurements (read off the stick in rads) into decimetres, we must multiply each one by 2 and then divide it by 10 or, in other words, multiply by 0.2.

However, since we must then multiply the base by the height to get the area we can arithmetically combine the 0.2 constant for the height and the 0.2 constant for the width into one constant, 0.04. However the formula says that a triangle is one half the base times the height, so we must also multiply by 0.5. This makes the constant 0.02. We then multiply this by the 1 m (i.e., 10 dm) length because a unit volume is, by definition, the volume found in one metre of log length. Thus the constant is now 0.2.

That is:

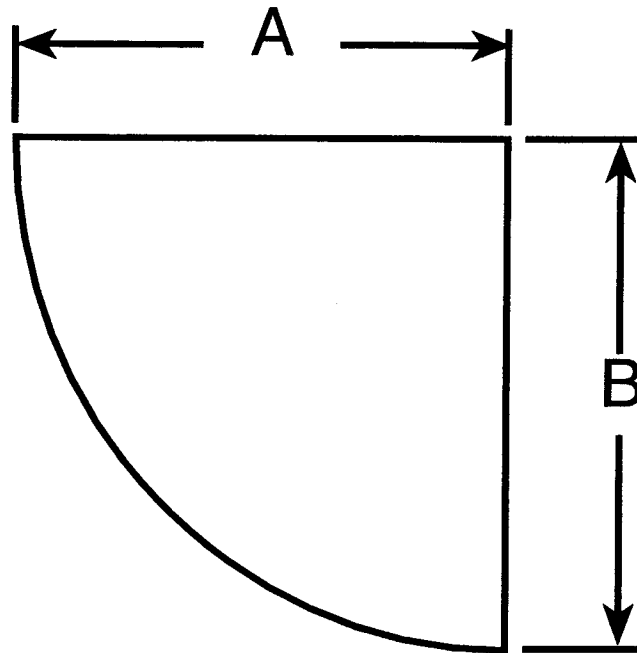
Triangular U.V. = $1/2 (0.2) \text{ Base in rads} \times (0.2) \text{ Height in rads} \times 10 \text{ dm per metre}$

$\text{Triangular Unit Volume} = (0.2) \times (\text{Base in rads}) \times (\text{Height in rads})$

Therefore for the example in Figure 5.20 which has a base of 14 rads and a height of 16 rads the effective end radius is found by interpolating the U.V. matching its end area:

$$\text{Unit volume} = (0.2) (14) (16) = 44.8 \text{ dm}^3$$

The nearest corresponding radius class from the scale stick is **12 rads** which has a U.V of 45.



Base = 14 rads

Height = 16 rads

Figure 5.20 A triangular shaped slab end.

5.4.4 Measuring Lengths

The length of a log or slab is the distance between planes that are perpendicular to the longitudinal axis and which intersect the geometric centres of the two ends.

Most logs are bucked perpendicular to their longitudinal axis and measuring from the edge of one end face to the matching edge of the other end face gives the same result. On bias cut ends, however, the scaler must estimate where the geometric centres are and measure to these points. See Figure 5.21 (overleaf.)

Lengths are measured in metres to the nearest tenth of a metre (0.1 m or dm) by using a scale stick or a steel tape. The steel tape is more accurate and preferred. Tapes must be used for measuring weight scale sample logs.

Where the measurement is 0.05 m from the nearest tenth of a metre, the length is recorded to the nearest even tenth of a metre.

Examples: 12.34 is recorded as 12.3

12.35 is recorded as 12.4

12.25 is recorded as 12.2

The gross length of a log or slab is measured from where the log diameter or slab thickness first becomes 10 cm or greater when measuring from the smaller end. Lengths for log diameters or slab thickness less than 5 rads must be recorded separately as firmwood rejects (see Figure 5.22.) This is the only instance where a single physical piece of timber is recorded as two separate scale data entries.

Figures 5.22 through 5.29 illustrate a number of length measurement principles.

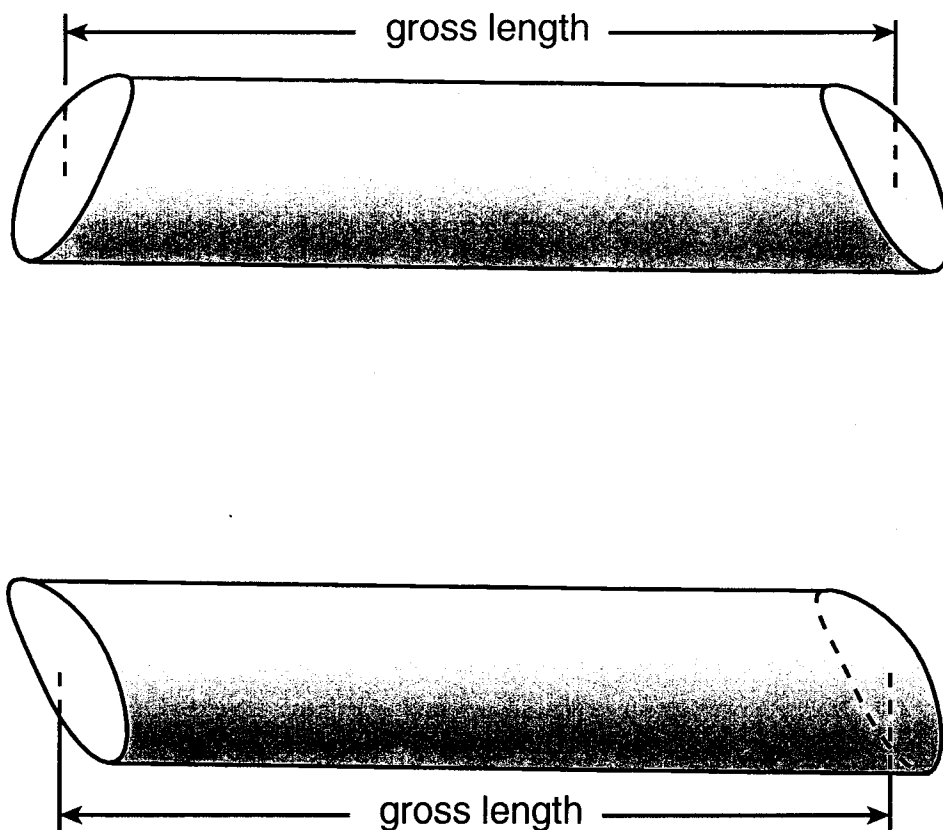


Figure 5.21 Logs bucked on the bias.

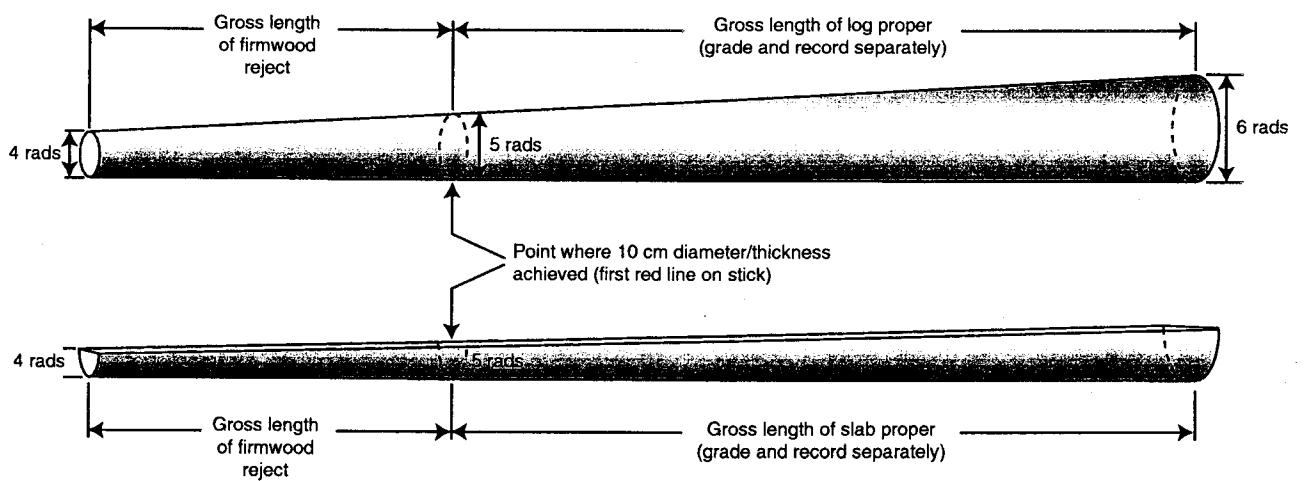
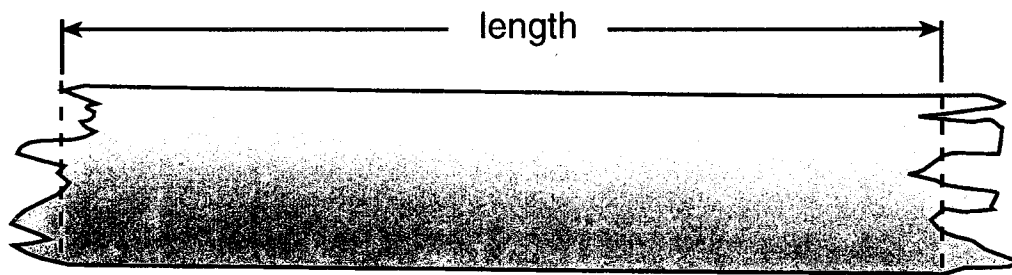


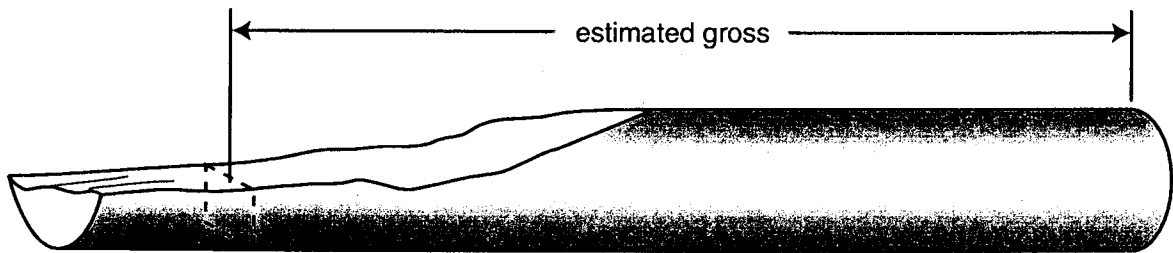
Figure 5.22 A log and a slab, each with a segment under 10 cm.



select your measuring planes such
that the volume of the protrusions
compensates for voids

Logs with shattered ends offer another challenge. The scaler must "visually fold in" the protrusions to compensate for the missing wood in the voids.

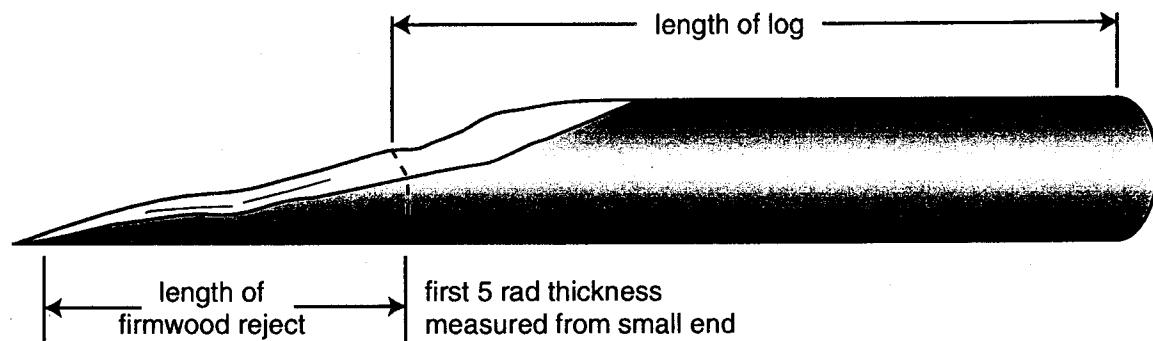
Figure 5.23 Shattered ends.



Lengths are measured to the cut ends if the thickness is 10 cm or more.

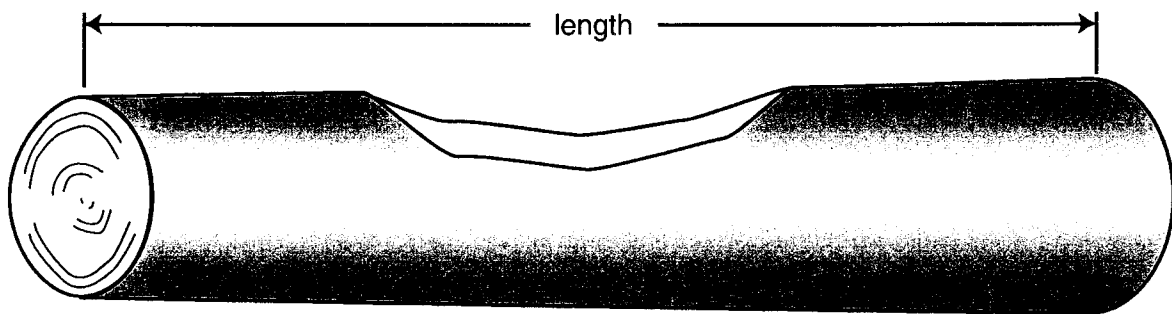
Where the thickness is under 10 cm another length measurement must be made for the firmwood reject portion of the log. (Refer also to Figure 5.22)

Figure 5.24 *A log with a bucked split-back end.*



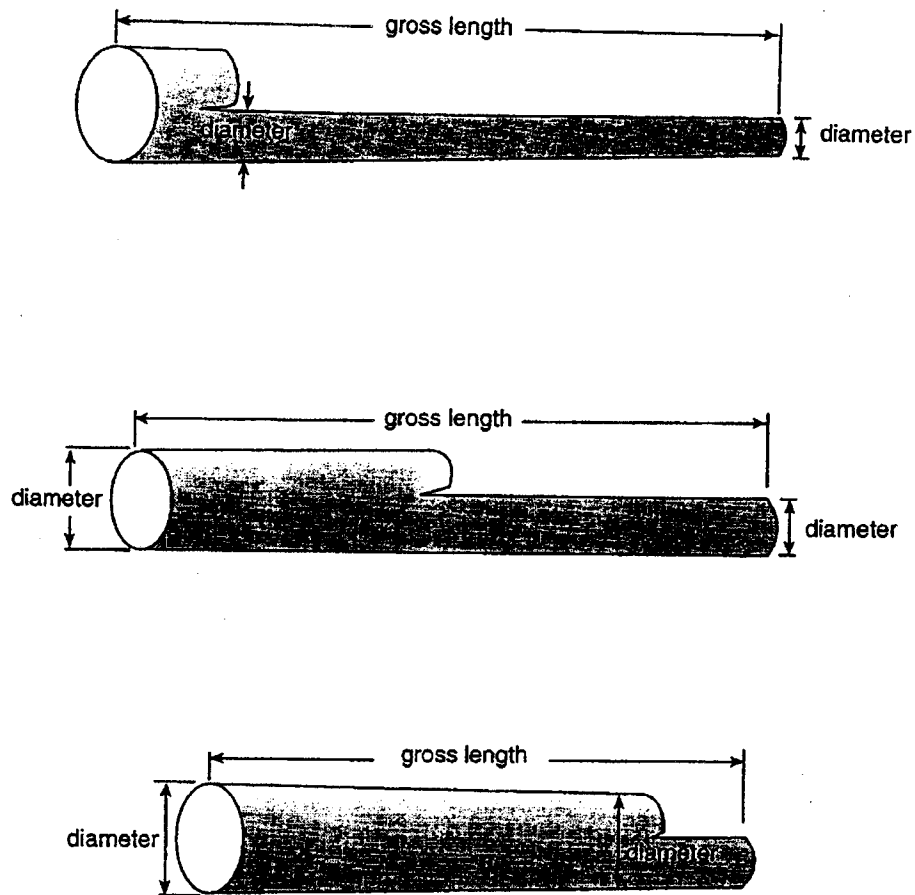
Measure the length of a "sniped" end to a point where it has a 10 cm thickness. Where the thickness is under 10 cm another length measurement must be made for the firmwood reject portion of the log. (Refer also to Figure 5.22)

Figure 5.25 *A log with an unbucked split-back (or sniped) end.*



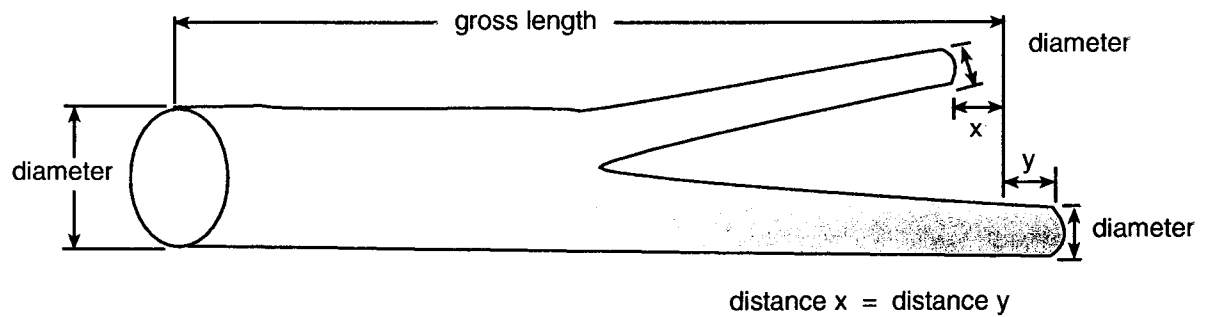
Sometimes a scaler will encounter logs with burned saddles or missing chunks in the central portion of the log. On such logs measure the gross length to the cut ends and make a firmwood deduction for the missing volum between the ends.

Figure 5.26 A log with a missing chunk.



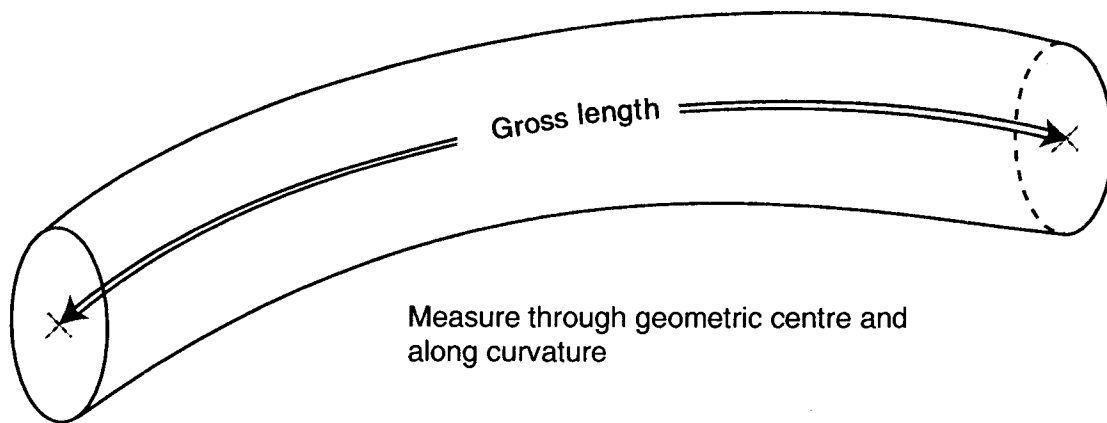
Forked logs that have had their forks bucked off are scaled as one piece. The diameter or length may need adjustment in order to get a fair and accurate dimension for the log.

Figure 5.27 Logs with forks bucked off.



Conventions vary. These types of logs may be measured as one, two or three pieces. When scaled as a single piece, the scaler may add the two top unit volumes and record a radius corresponding to their sum. The length would then be recorded as falling between the two forked tops.

Figure 5.28 *A log with forks attached.*



Length measurement for a log that has a sweep follows the contour through the geometric centre of the log.

Figure 5.29 A log with sweep.

5.5 Firmwood Deductions

The following sections of Chapter 5 demonstrate the accepted methods for determining the net firmwood content of logs containing firmwood defects. For each defect shape, there is a *formal calculation method* and one or more *field approximation methods*.

The formal calculation can be thought of as the method a computer would use when presented with the required measurements and shapes. Apart from their inclusion in handheld scaling computer software, these formal calculations are most frequently used when analyzing theoretical logs in a classroom setting, when dealing with particularly challenging or borderline logs or when arithmetic skills are strong and time is not a factor. Scalers with well developed arithmetic skills may wish to use them exclusively. They are expressed in full detail in Appendix 5B.

The field methods are based upon proven field experience and are provided for practicality and ease of use. Although the results truly only approximate those of the formal calculations, experience has shown that differences are rarely significant enough to be of concern. The field methods typically rely on reducing one or more of the gross dimensions of a log so that the recorded net dimensions closely approximate the net firmwood volume.

5.6 Introduction to Firmwood Deductions

The firmwood volume of timber excludes all rot, hole, char, and missing wood. Deductions are made from the gross volume of a log for these defects. A deduction is made by subtracting the volume of the defect(s) from the gross volume of the log. Two *field methods* of recording the outcome of a scale are used, depending on the tools available to the scaler.

- The *net dimensions method* is normally used when recording the scale on a manual form and consists of reducing the measured lengths or radii of the timber so that the recorded net dimensions will calculate the correct firmwood volume.
- The *gross/net method* requires the use of a hand held computer or an approved non-standard data capture form. Here the gross measurements of the log are recorded, as are the dimensions and form of the defect(s).

The gross volume of the log and the volume of the defect are calculated and the latter is subtracted from the former to yield the net volume. Where this method is employed, the computer will produce a detailed log listing showing the gross volumes, defect types, defect volumes, and net firmwood volumes as well as the standard data submission forms such as the FS 531 and FS 72. For more detailed information on these forms see Chapter 7.

Where a formal calculation using formulas is rigid and structured, the field methods are more dynamic, allowing the scaler to use more than one proven method to come up with an accurate result. Production scalers will soon adopt ways of bypassing excessive calculation if tools, such as computers or calculators, are not available to automate the process. Although the use of hand held computers is becoming common, all scalers must have the ability to scale without the use of them. It is a requirement of their certification to acquire and maintain competence in the traditional field methods.

5.6.1 Geometric Shapes

Four approaches for determining the net firmwood volume of a log are discussed in this section. These procedures are based on the standard geometric shapes (see Figure 5.36, next page) that most closely approximate the form of the defect.

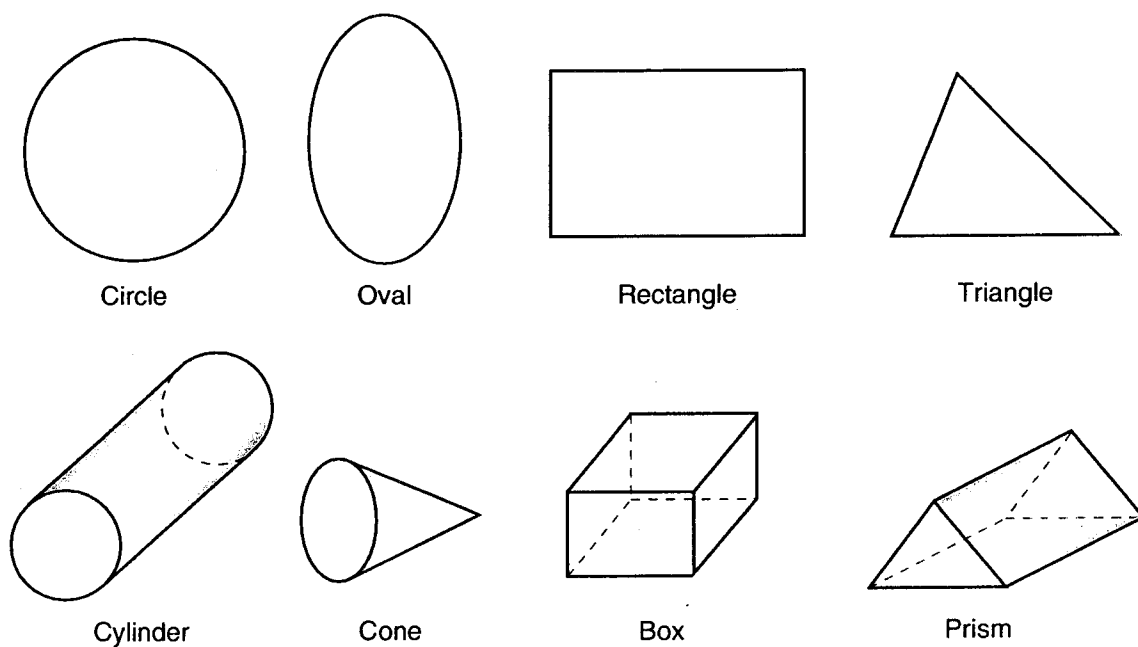


Figure 5.30 *The geometric shapes used in scaling.*

By using three basic shapes, every conceivable deduction can be dealt with, either by itself or in combination with other shapes. These shapes are round or oval (cylindrical, conical), rectangular (cubical), and triangular (prismatic). The formulas are based on four geometric forms of the cylinder, the cone, the rectangular box and the prism.

Each procedure is described by example, using proven field methods. The results of the formal calculations in *Appendix 5* are provided to substantiate the methods.

Two ways of finding net dimensions equivalent to net volumes are available to the scaler:

- the length deduction, and
- the diameter deduction.

Both methods make use of "average unit volumes" described below.

5.6.2 Average Unit Volumes

References to unit volumes are made throughout this manual. A unit volume is simply the volume of a one metre length of a log, which happens to be exactly the same as the end area of the same section. When a scaler finds the area of the end of a log, log segment or defect, the unit volume is also found. An average unit volume is the same as the average of the top and butt areas.

Different terminology is used from region to region when discussing half volumes, such as the "factor", the "two metre half volume" or "one tenth of the ten metre volume". These terms are derived from various methods of finding the unit volume or average unit volume on a scale stick, and should not be mis-interpreted as something else.

There are two simple ways to derive an average unit volume from the scale stick. Both are commonly used by scalers according to individual preference. In the first, measure both ends of the log. Add the two corresponding unit volumes for the measured ends and divide by 2. In the second, add the 10 m half volumes corresponding to the log ends and dividing by 10. For example, a log of given length has a top diameter of 25 rads and a butt diameter of 32 rads. Part 1 of this chapter shows where unit volumes are located on the scale stick. From the scale stick:

the 1 m volume of 25 rads	=	196 dm ³
the 1 m volume of 32 rads	=	<u>322</u> dm ³
the sum of the volumes	=	518 dm ³
and divided by 2	=	259 dm ³ , the average unit volume

or,

the 10 m half volume of 25 rads = 982 dm³

the 10 m half volume of 32 rads = 1608 dm³

the sum of the half volumes = 2590 dm³

and divided by 10 = 259 dm³, again the same result.

It is incorrect to take the short cut of using the unit volume of the average of the top and butt radii, because the unit volume of the average of two log ends is less than the average of the two unit volumes of those ends. Volume will be understated as shown in the following calculation:

the diameter of	18 rads and the unit volume	102 dm ³
plus the diameter of	<u>26</u> rads and the unit volume	<u>212</u> dm ³
equals	44 rads is	314 dm ³
and divided by 2 is	22 rads is	157 dm ³

The unit volume of 22 rads is 152 dm³, or 5 dm³ less than what it should be. While obtaining unit volumes from average diameters is not described and while it may give the wrong answer, some scalers use it where there is little spread between the two ends.

5.6.3 Length Deduction

Although this method requires more arithmetic, length deduction can be used for all defects and can usually accommodate a smaller deduction than the diameter deduction method, particularly in smaller logs. To perform a length deduction, the scaler must first determine the volume of rot, then the unit volume of the log, and finally divide the rot volume by the unit volume to find the required length deduction.

5.6.4 Radius Reduction or Diameter Deduction

Radius reduction or diameter deduction, as it is often called, is the easiest and quickest of the basic deduction procedures for a through running defect. The scaler has only to subtract the unit volume of the rot from the unit volume of the log and interpolate the radius class that most closely matches the resulting mathematical difference. Unfortunately this approach has limited application to through-running defects and defects running exactly half the length of the log.

5.6.5 Rounding Net Volumes

All examples in this chapter will show slightly different volumes between the formal calculations and the field methods because the field methods rely on reducing gross dimensions to net dimensions approximating the desired net volume. Usually a length deduction will produce a result closer to the actual net volume than a diameter deduction will. There are two reasons for this:

- a deduction of 1 rad (the minimum that can be taken) is usually a higher volume than a deduction of 0.1 m. Therefore, some defects are of too low a volume to allow a deduction of 1 rad, but will allow a deduction of 0.1 m or more, and
- a given diameter deduction increases in volume as log length increases. A given length deduction is the same volume irrespective of log length, and this is the reason diameter deductions are usually restricted to defects which travel the full length of a log.

Where either deduction method can be used, the one whose resultant net dimensions yield a volume closest to the calculated net volume is naturally the best. With experience, the scaler will begin to intuitively use an appropriate deduction for a given defect, keeping in mind that a length deduction will allow a finer increment of volume in smaller diameter logs and a radius reduction a finer increment of volume large diameter logs.

For example, a one metre segment of a 20 rad log contains 126 dm³. A 1 rad diameter deduction will reduce the volume by 13 dm³. A length deduction of 0.1 m will reduce the volume by the same amount, so at this point the two methods increment equally. If the log happens to be 10 m long, a 1 rad diameter deduction will reduce the volume by a whopping 130 dm³, where the 0.1 m length deduction will still reduce the volume by the same 13 dm³. If a scaler does not consider log length when making diameter deductions for defects which do not affect the full length of a log, there is a risk of over-deducting. Therefore, it is easier for the scaler to develop a sense of proportion using length deductions.

5.7 Required Measurements

To find gross volume, defect volume and net volume, the following measurements are required (defect measurements specific to type of defect are listed). Measurements are described in detail in Sections 5.1 to 5.4 of this chapter.

5.7.1 Measurements for Gross Volume

- the length of the log in metres, and
- the diameter of both ends of the log in rads (i.e., the radius in cm.)

5.7.2 Measurements for Defect Volume

5.7.2.1 Butt Defect - Partial Length of Log

- the defect length in metres (often estimated), and
- the defect diameter visible at log end in rads. Visible decay at the butt end of a first cut log (the butt log) is always considered to be conical in shape.

5.7.2.2 Heart Defect - Partial Length of Log

- the defect length in metres (often estimated), and
- the defect diameter visible at log end in rads.

In defects with only one end visible, the diameter of the unseen end is assumed to be the same as at the measured end. However, in longer logs with high taper, this assumption may not be reasonable. Please refer to Section 5.8 for details on these measurements.

5.7.2.3 Heart Defect - Through Running

- the defect length in metres (same as gross length of log), and
- both defect end diameters in rads.

5.7.2.4 Ring Defect - Through Running

- the defect length in metres (same as gross length of log),
- the outside diameter of the ring defect at the top end in rads,
- the inside diameter of the ring defect at the top end in rads,
- the outside diameter of the ring defect at the butt end in rads, and
- the inside diameter of the ring defect at the butt end in rads.

5.7.2.5 Ring Defect - Partial Length of Log

- the defect length in metres (estimated),
- the outside diameter of the ring defect visible at the log end in rads, and
- the inside diameter of the ring defect visible at the log end in rads.

In defects with only one end visible, the diameter of the unseen end is assumed to be the same as at the measured end. However, in some long logs with high taper, this assumption may not be reasonable.

When the ring defect is not a complete circle, the defect volume is multiplied by a percentage factor representing the portion of the defect circle that is present.

5.7.2.6 Sapwood Defect

- the defect length in metres,
- the net top end diameter (inside the defect) in rads,
- the net butt end diameter (inside the defect) in rads, and
- when the sapwood defect is not a complete circle, multiply the defect volume by a percentage factor equal to the portion of the defect circle that is present.

5.7.2.7 Pocket Defect - Through Running

- the defect length in metres (same as gross length of log),
- if rectangular, the height and width of both defect ends in rads, and
- if circular or oval, measure the end diameters.

5.7.2.8 Pocket Defect - Partial Length of Log

- the defect length in metres (estimated),
- if rectangular, the height and width of the defect visible at the log end in rads, and
- if circular or oval, measure the end diameter in rads.

In defects with only one end visible, the dimensions of the unseen end are assumed to be the same as the measured end when making calculations.

5.7.2.9 Catface Conical

- the defect length in metres, and
- the width and height (big end) of the defect in rads.

5.7.2.10 Catface Double Conical

- the defect length in metres, and
- the width and height at the largest point (usually near the middle) of the defect in rads.

5.7.2.11 Missing Wood and Other Surface Defects

- the calipered diameter of the log at the point where the log is not affected by the defect,
- a factor (percentage) for the missing portion of the log, and
- if triangular or pie shaped, measure the width and height of the defect.

5.7.3 Determining Net Volume

5.7.3.1 Net Volume Using Gross/Net Method

To obtain the net volume of a log with defect(s), follow these steps:

- calculate the gross volume of the log,
- calculate the volume of the defect(s), and
- subtract the defect volume from the gross volume to get the net volume of the log.

5.7.3.2 Net Volume Using Net Method - Length Deduction

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

- calculate the Average unit volume of the log,
- calculate the volume of the defect,
- divide the volume of the defect by the unit volume of the log,
- the result is the length in metres to be deducted, and
- subtract the deduction from the gross length of the log.

5.7.3.3 Net Volume Using Net Method - Diameter Deduction

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

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

5.8 Conventions for Estimating Rot

In order to provide consistent scaling practices and maintain sound scaling principles throughout British Columbia, basic conventions or "ways of doing things" are outlined below to help the scaler in producing consistent and accurate results. In making volume deductions for defect, the scaler must pay close attention to the following conventions, which have been developed over many years of practical application. Other conventions may be developed from time to time to suit local conditions but they are not described in this section. Scalers working in a new area should discuss local conventions with a district scaling representative.

5.8.1 Common Conventions

Firmwood deductions can be made only for rot, hole or charred wood.

No firmwood deduction is made for discoloration or stain (incipient decay).

Until sufficient field experience is gained, the scaler may have difficulty determining the difference between stain or incipient decay (not a volume deduction) and bona fide rot. In scaling, rot is taken to be that level of decay where wood begins to lose its strength and fibre integrity. That is, when the attacking fungus has begun breaking down the cellulose and/or lignins. (See Chapter 4 for more a more detailed discussion.)

This point of deterioration is usually determined by using the tine of the scale stick to remove some wood from the suspect area and testing it for strength and fibre integrity by attempting to break and pull it apart with the fingers. Initially, or if uncertain, it may be beneficial to remove another sample of wood from a sound area of the log adjacent to the area suspected of being rotten. The two samples can be compared for relative strength and integrity.

No firmwood deduction is made for twist, crook or checks, even though these may indicate a grade deduction.

A condition which may be considered a grade defect in a log is not necessarily considered a firmwood defect in a log. Firmwood scaling is concerned with determining the volume of sound or firm wood fibre in timber. Grading, on the other hand, is concerned with the potential quality and quantity of end product available from that timber.

For the purposes of grading, the same formulae and methods described in this chapter may be used to calculate the portion of a log that can be manufactured into an end product. Grading is detailed in Chapter 6.

5.8.2 Butt Rot Conventions

Butt rot volume will be assumed to be the volume of a cone with the same basal diameter as the average diameter of the visible end section of the rot.

The diameter of butt rot used for deduction calculations must not exceed that of the recorded butt measurement where the actual measurement of butt rot exceeds the line of normal taper. This is a common occurrence in decadent logs with a great deal of butt flare.

Where rot appears only in the butt of a first cut log, treat as butt rot unless other indicators are present, such as rotten knots or conk. Butt logs are usually identified by observing the large end for flare and fluting or faller's signs such as an undercut or hinge. It is important not to confuse heart rot and butt rot.

Butt rot that extends the full length of a log may be treated as though it is through running heart rot.

5.8.3 Heart Rot Conventions

Decayed heart wood may be visible at one or both ends of a log and will be circular or semi-circular in shape.

A first cut log or butt log which shows rot at the butt end only, must be considered to be butt rot. Butt logs are usually identified by observing the large end for flare and fluting or faller's signs such as an undercut or hinge. It is important not to confuse heart rot and butt rot.

If rot is visible at both ends of the log, scale out the cylinder of rot as if it were a log inside the first log.

If advanced heart rot is visible only at one end of a short log (8 m long or less) and there are no indicators (i.e., rotten knots) to suggest how far it penetrates, it is often assumed to penetrate one-half the gross log length. In all cases, good judgment must be used. The best basis for developing this judgement or "log sense" is to observe the manufacture of rotten logs or to cut into the log with a saw or an axe.

5.8.3.1 Assessing Conk, Indian Paint Fungus and Pin Rot

"Conk" is another name for a fungal invasion of a tree and refers to the fruiting body often seen on standing timber. The scaler may encounter a "conk knot", which is a rotten knot usually showing traces of the conk, or "conk rot" which is defined in this manual as heart rot. Therefore, an indication of a conk is also an indication of a high probability of heart rot. More detailed information is found in Chapter 4.

Unfortunately for those who are interested in the identification (taxonomy) of conk-fruiting fungi, logs delivered to a scale site seldom have any conks remaining because equipment handling removes them. The remaining indicator is a conk knot or "punky" knot, a rotten knot often showing fungus parts.

Because of the variability of the effects of conk, not only by fungus species but by the tree species and location around the province, it is very difficult to establish with conviction any conventions that apply across the province. Local conditions and experience will therefore determine which of the following conventions apply:

- conk can appear in several ways on logs and the methods for making firmwood deductions and grading differ according to the indicators present. The location of conk knots and the diameter of rot on log ends are used to determine the distance that rot travels. That is, the more frequent the conk knots and the larger the diameter of the rot in relation to the log, the more extensive the rot will be,
- unless there is no evidence to the contrary, it is presumed that no lumber will be recovered in the length of a log affected by conk. This is a Grade consideration, not a firmwood deduction, but if, among the enclosed rot, there is a substantial amount of firm wood that can be recovered in chips, then the defect diameter should be reduced proportionately for the firmwood volume determination, and
- where very large and/or numerous conks are present, an additional length deduction may be required to compensate for the "funnel" effect of the path of rot from the outside of the tree into the central cylinder of rot.

If the scaler observes a conk knot but no rot shows at the ends of a log, the following conventions are common:

- given no other indicators, conk is presumed to extend further down from the conk knots than up. Experience has shown that, as a rule of thumb, rot extends 2 to 3 m above the highest conk knot and 3 to 4 m below the lowest conk knot as a minimum. Given no other indicators, presume that the conk rot extends 2.5 m above the highest conk knot and 3.5 m below the lowest conk knot. Where a conk knot is located 2.5 m or less from the top end or 3.5 m or less from the butt of a log, presume that the defect will travel one half the distance between the knot and the log end,
- when there are two or more indications of conk, presume they are connected,
- when a conk knot is the only indication of conk and the severity of the rot is unknown, the firm wood deduction is estimated as one quarter to one half the length of the defect. It is impossible to determine the diameter of the rot without being able to see it, but it is reasonable to assume that, on average, it will be half the average diameter of the log, and
- where there are conk knots and no sign of rot at the ends of a log, the scaler should, if possible, have the log bucked and/or observe the processing of the log to get a better idea of the internal effects of conks. Experience shows that the effects are different in different species of timber and fungi and even different in the same species from different areas. Therefore, scalers should not rely on any particular convention unless supported by experience and observation.

If a scaler observes one or more conk knots and conk rot showing in one end of a log, the following guides will serve in the assessment of the log:

- because the rot is showing in one end the log, the diameter of the decay is obtainable by measurement, and may be assumed to be the same diameter at both ends in short logs with little taper. It is important to remember that rot tends to follow growth rings, and in longer logs and/or logs with high taper, the diameter of the rot at the unseen end should be increased or reduced in order to follow the natural taper of the log, by projecting the collar thickness from the measurable end to the unmeasurable end,
- if conk rot shows in the top end of a log, assume that the heart rot continues to a point 3.5 m below the lowest conk knot, unless the lowest conk knot is 3.5 m or less from the butt end. It is then presumed to travel one-half the distance between the knot and the butt end,

- if conk rot shows in the butt end of a log, assume that the heart rot continues to a point 2.5 m above the highest conk knot, unless the highest conk knot is 2.5 m or less from the top end. It is then presumed to travel one half the distance between the knot and the top end, and
- in logs where conk shows in one or more knots and only a small amount of rot is present in the log end, and the scaler is positive that the rot showing in the end is not representative of the severity of the defect, then a length deduction may be increased to one half the length that the conk extends through the log.

When a log is encountered with conk rot (heart rot) showing in one end of the log but there are no indications of conk:

- the diameter to enclose the defect may be used to assist in determining the length that the rot extends into the log. Generally, the larger the diameter of the rot, the further it will travel up the log. District and Regional scaling specialists will assist the scaler in making judgments for logs originating from a particular area, and
- if local experience is not available, it is reasonable to assume that the rot extends for one half the length of the log, if the log is 8 m or less in length.

5.8.3.2 Assessing Goiter

Goiter is a swelling or abnormal growth on the bole of a tree and rot may be associated with this defect. Internal rot seldom travels more than 1 m above and below the goiter. Firmwood loss is based on scaler experience and common sense.

5.8.4 Ring Rot Conventions

The length deduction method is normally used for ring rot unless the ring penetrates all the way through the log. Scalers should also consider that the radius reduction method is based on a class measurement and can result in over deductions or under deductions on individual logs.

Ring rot often does not form a complete circle. The volume should be calculated as if it were a full circle, then a factor is applied to obtain the true volume. That is, if the ring travels approximately two thirds of the way around its circumference, the "unit volume" or factor of the ring area is also two thirds of what a full circle of rot would be.

5.8.5 Pocket Rot Conventions

Pocket rot, unlike heart rot, is not confined to growth rings and is therefore not often circular in profile. Each segment of decay may be enclosed in an area which most resembles the shape, rectangular, triangular or circular. Part 1 of this chapter defines ways to enclose log segments for finding the end area (unit volume) of a segment, and these same methods apply equally to irregular rot shapes. When calculating a deduction, the scaler then uses a method appropriate to the chosen shape.

Where multiple pockets of rot are present, scalers will often add the individual rot volumes together visually rather than carrying out a number of discrete calculations.

5.8.6 Sap Rot Conventions

The commonest approach is to simply determine the average radius of the sound core inside the rotten sapwood.

To obtain a gross-net scale, scale the outside diameter of the log, (the gross scale), scale the sound core of wood inside the rotten sapwood (the net scale). The difference between the gross scale of the outer scaling diameter and the net scale of the inner scaling diameter will be the deduction volume if no other defects are present.

5.9 Examples and Calculations

5.9.1 The Relationship of Field Methods to Formulas

In field methods, formulas are not normally used because it is not practical. Gross dimensions are reduced to net dimensions in order to obtain net volumes closely approximating the application of a formula. Net dimensions often require rounding to the nearest 0.1 m in a length deduction or 1 rad in a diameter deduction, and the resultant volume may be slightly different than if determined from the formal calculation. These differences, which show in the examples in this chapter, are not considered significant enough to be of concern.

5.9.2 Conical Defects

5.9.2.1 Butt Rot (Conical)

This method of calculation is usually used for defects found in and confined to the butt end of a first cut or butt (flared) log (i.e., butt rot), but this method may be used for all defects that have a geometrical shape of a cone or portion of a cone.

5.9.2.1.1 Example and Illustration - Butt Rot

Figure 5.37 on the next page depicts a typical log with conical butt rot measuring 25 rads in diameter and penetrating 3.6 m.

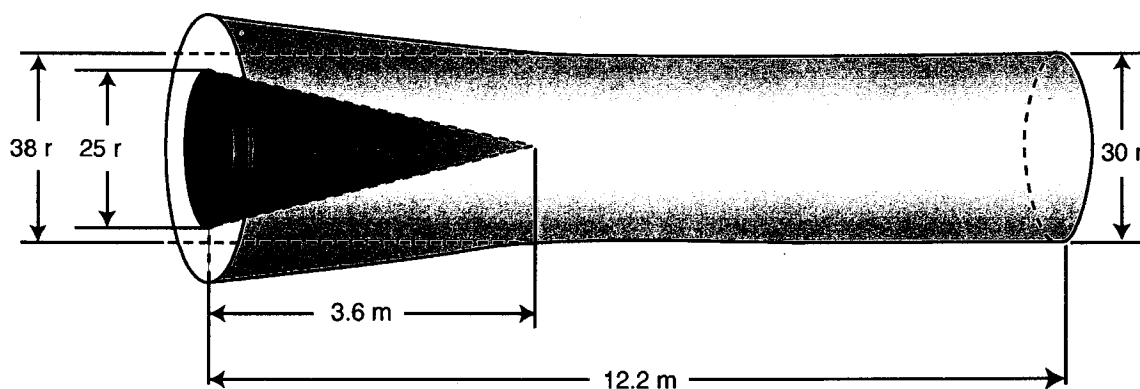


Figure 5.31 Log with butt rot.

5.9.2.1.2 Formal Calculation

Using the cone deduction formula described in Appendix 5B, the net volume of the log is calculated to be 4.256 m³.

5.9.2.1.3 Field Calculation - Length Deduction

The gross length of a log is reduced by an amount equal to the defect volume. The result is a log with a net length equal to the net volume.

Defect volume

Half volume of 3.0/25	=	295 dm ³
Half volume of 0.6/25	=	<u>59</u> dm ³
Half volume of 3.6/25	=	354 dm ³
Full volume of 3.6/25	=	708 dm ³ (2 x 354)

Divide cylinder volume by three to obtain the volume of a cone of equivalent diameter and height:

708 divided by 3	=	236 dm ³
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Calculate the one metre unit volume (AUV) of the log by adding the ten metre half volumes of the end measurements of the log and dividing by ten.

Half volume of 10/30	=	1414 dm ³
Half volume of 10/38	=	<u>2268</u> dm ³
Full volume of 10/30/38	=	3682 dm ³
Full volume of 01/30/38	=	368 dm ³ (AUV)

Or, calculate the one metre unit volume of the log by adding the unit volumes of the end measurements and dividing by two:

unit volume of 30	=	283 dm ³
unit volume of 38	=	<u>454</u> dm ³
Total	=	737 dm ³
Divided by 2	=	368 dm ³ (AUV)

Calculate the length deduction by dividing the defect volume by the average unit volume of the log:

$$\frac{236}{368} = 0.64 \text{ m}$$

The length deduction rounded is 0.6 m.

Calculate the net length by subtracting the length deduction from the gross length of the log.

$$12.2 - 0.6 = 11.6 \text{ m}$$

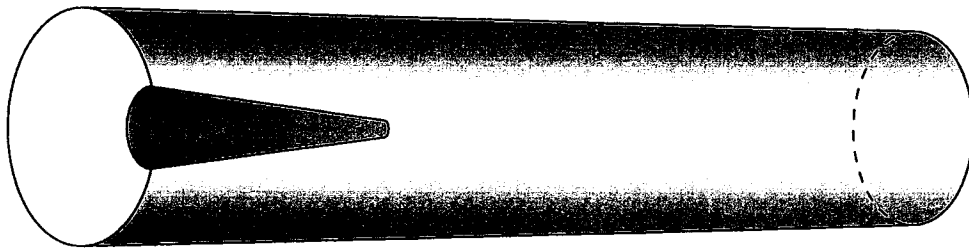
$$\text{Volume} = 4.271 \text{ m}^3 \times 4271 \text{ dm}^3$$

Record the net dimensions as 116 30 38

5.9.2.2 The Catface (Conical)

5.9.2.2.1 Example and Illustration - Catface

In the example illustrated on the next page (Figure 5.38), a portion of the tree's circumference has been scarred. As a result, it does not form a cylinder for part of its length. Where the catface tapers out as illustrated, the defect approximates the shape of a segment of a cone.



This log is 7.0 m long with a 20 rad top and a 24 rad butt. The conical catface is 4.8 m long and is 18 rads wide by 10 rads deep at the butt face.

Figure 5.32 A log with conical catface.

5.9.2.2.2 Formal Calculation

Using the cone deduction formula described in Appendix 5, the net volume of the log is calculated to be 0.974 m³.

5.9.2.2.3 Field Calculation - Length Deduction

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

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

Calculate the defect volume by first looking up the half volume for 4.8 m 14 rads.

$$\text{Half volume of 4.0/14} = 123 \text{ dm}^3$$

$$\text{Half volume of 0.8/14} = 25 \text{ dm}^3$$

$$\text{Half volume of 4.8/14} = 148 \text{ dm}^3$$

Next calculate the full volume by multiplying the half volume by two.

$$148 \times 2 = 296 \text{ dm}^3$$

Finally calculate the volume of the cone by dividing the cylinder volume by three.

$$\frac{296}{3} = 99$$

$$\text{Defect volume} = 99 \text{ dm}^3$$

Calculate the one metre unit volume of the log by adding the ten metre half volumes of the end measurements of the log and dividing by 10, or by adding the unit volumes of the measurements and dividing by 2.

$$\text{Half Volume of 10.0/24} = 905 \text{ dm}^3$$

$$\text{Half Volume of 10.0/20} = 628 \text{ dm}^3$$

$$\text{Full Volume of 100/20/24} = 1533 \text{ dm}^3$$

$$\text{Unit volume of 010/20/24} = 153 \text{ dm}^3$$

Calculate the length deduction by dividing the defect volume by the unit volume of the log.

$$\frac{99}{153} = 0.64 \text{ m}$$

Length deduction is rounded to 0.6 m

Calculate the net length of the log by subtracting the length deduction from the gross length of the log.

$$\begin{array}{rcl} 7.0 \text{ m} - 0.6 \text{ m} & = & 6.4 \text{ m} \\ \text{Volume} & = & 0.981 \text{ m}^3 \text{ or } 981 \text{ dm}^3 \end{array}$$

Record the net dimensions as 064/20/24.

5.9.2.3 The Catface (Double Conical)

5.9.2.3.1 Example and Illustration - Double Catface

In Figure 5.39 (next page) a full double conical catface affects a 7.0 m log. A defect of this shape can also be caused by equipment damage (fork puncture), where a portion of the tree's stem has been scarred and does not form a cylinder for part of its length. Where the catface tapers out on both ends as illustrated, the defect approximates the shape of two cones attached at the base.

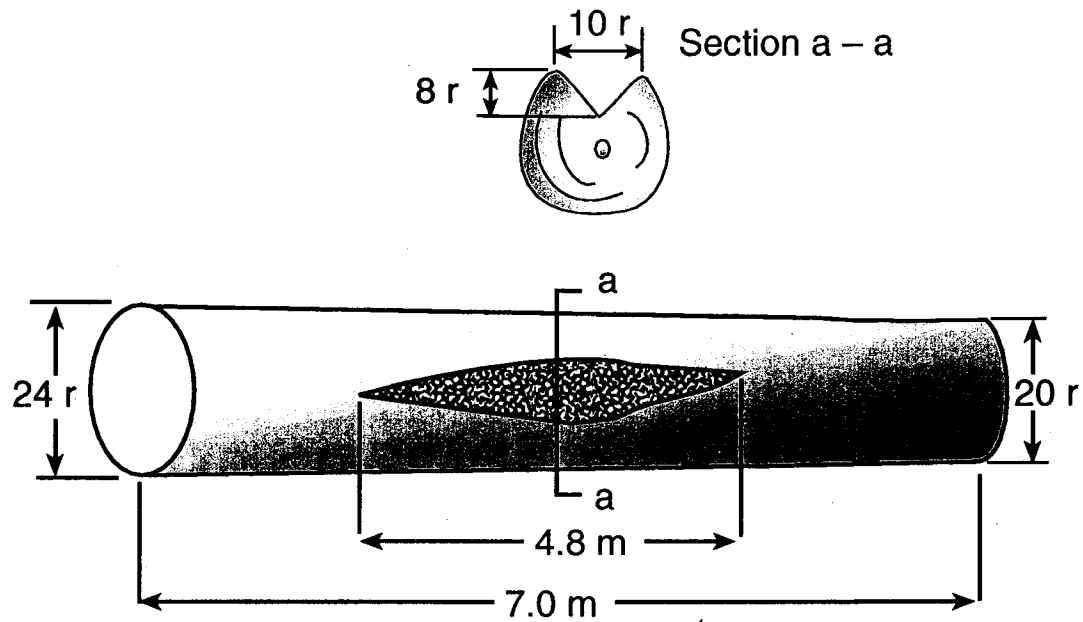


Figure 5.33 Log with a double conical catface.

5.9.2.3.2 Formal Calculation

Using the cone deduction formula described in Appendix 5B, the net volume of the log is calculated to be 1.032 m³.

5.9.2.3.3 Field Calculation - Length Deduction

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

$$\frac{8 + 10}{2} = 09 \text{ rads}$$

Calculate the defect volume by looking up the half volume for half the length of the defect, or 2.4 m and 09 rads.

$$\text{Half volume of } 4.0/09 = 51 \text{ dm}^3$$

$$\text{Half volume of } 0.8/09 = \underline{10} \text{ dm}^3$$

$$\text{Half volume of } 4.8/09 = 61 \text{ dm}^3$$

$$\text{Full volume of } 4.8/09/09 = 122 \text{ dm}^3 (2 \times \text{half volume})$$

$$\text{Full volume of cone } 4.8/09 = \frac{122}{3} = 41 \text{ dm}^3 \left(\frac{1}{3} \times \text{full volume}\right)$$

Calculate the one metre unit volume of the log by adding the ten metre half volumes of the end measurements of the log and dividing by ten, or adding the unit volumes of the end measurements of the log and dividing by two.

$$\text{Half volume of } 100/24 = 905 \text{ dm}^3 \text{ or Unit vol. } 24 = 181$$

$$\text{Half volume of } 100/20 = \underline{628} \text{ dm}^3 \text{ Unit vol. } 20 = \underline{126}$$

$$\text{Full volume of } 100/20/24 = 1533 \text{ dm}^3 \text{ Sum} = 307$$

$$\text{Unit volume of } 010/20/24 = 153 \text{ dm}^3 \text{ Divide by } 2 = 153$$

Calculate the length deduction by dividing the defect volume by the unit volume of the log.

$$\frac{41}{153} = 0.267 \text{ m}$$

Length deduction is rounded to 0.3 m.

Calculate the net length of the log by subtracting the length deduction from the gross length of the log.

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

$$\text{Volume} = 1.025 \text{ m}^3 \text{ or } 1025 \text{ dm}^3$$

Record the net dimensions as 069/20/24.

5.9.3 Cylindrical Defects

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

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

5.9.3.1 Heart Defect - Through running

5.9.3.1.1 Example and Illustration - Heartrot, Full Length

Heart rot extends completely through the log in Figure 5.40 on the next page and is measurable at both ends.

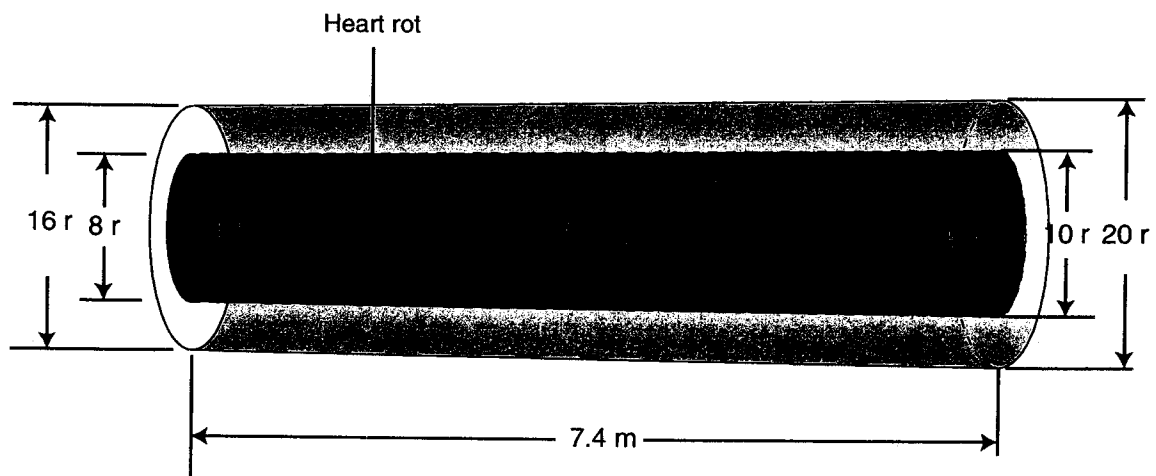


Figure 5.34 A log with through-running heart rot.

5.9.3.1.2 Formal Calculation

Using the cylinder deduction formula described in Appendix 5B, the net volume of the log is calculated to be 0.572 m³.

5.9.2.1.3 Field Calculation - Length Deduction

To reduce the recorded length measurement of the log to create a log with net dimensions equal to the net volume in the example, follow these steps:

With the scale stick, look up the volume of a cylinder of the diameter and length of the defect by adding the:

Top defect half volume

$$\text{Half volume of } 7.0/08 = 70 \text{ dm}^3$$

$$\text{Half volume of } 0.4/08 = \underline{4} \text{ dm}^3$$

$$\text{Half volume of } 7.4/08 = 74 \text{ dm}^3$$

to the butt defect half volume

$$\text{Half volume of } 7.0/10 = 110 \text{ dm}^3$$

$$\text{Half volume of } 0.4/10 = \underline{6} \text{ dm}^3$$

$$\text{Half volume of } 7.4/10 = 116 \text{ dm}^3$$

$$\text{Full defect volume of } 7.4/08/10 = (74 + 116) = 190 \text{ m}^3$$

Calculate the one metre unit volume for the log by adding the ten metre half volumes of the end measurements of the log and dividing by ten.

$$\text{Half volume of } 10.0/16 = 402 \text{ dm}^3$$

$$\text{Half volume of } 10.0/20 = \underline{628} \text{ dm}^3$$

$$\text{Full volume of } 10.0/30/38 = 1030 \text{ dm}^3$$

$$\text{Full volume of } 01.0/30/38 = 103 \text{ dm}^3$$

Calculate the length deduction by dividing the defect volume by the one metre unit volume (the sum of the top one metre half volume and the butt one metre half volume) of the log:

$$\frac{190}{103} = 1.84 \text{ m}$$

The length deduction rounded is 1.8 m.

Calculate the net length by subtracting the length deduction from the gross length of the log.

$$7.4 - 1.8 = 5.6 \text{ m}$$

$$\text{Volume} = 0.564 \text{ m}^3 \text{ or } 564 \text{ dm}^3$$

Record the net dimensions as 056/16/20.

5.9.3.1.4 Field Calculation - Diameter Deduction

Using unit volumes off the scale stick, find the unit volume for the top end measurement and subtract the unit volume of the defect.

$$\text{Unit volume, top (16 r)} = 80 \text{ dm}^3$$

$$\text{Less the unit volume, top defect (8 r)} = \underline{20} \text{ dm}^3$$

$$\text{Net unit volume} = 60 \text{ dm}^3$$

Find the rad class corresponding closest to the unit volume of 60 dm³, which is 14 rads

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

$$\text{Unit volume Butt (20 r)} = 126 \text{ dm}^3$$

$$\text{Less unit volume Butt defect (10 r)} = \underline{31} \text{ dm}^3$$

$$\text{Net unit volume} = 95 \text{ dm}^3$$

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

The volume corresponding to the net dimensions of 7.4 m by 14 r by 17 r is 565 dm³.

Record the net dimensions as 074/14/17.

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

5.9.3.2 Heart Defect - Partial Length of the Log

5.9.3.2.1 Example and Illustration - Heartrot, Partial Length

The heart rot visible at the top end of the log shown in Figure 5.41 (next page) is estimated to travel 4.4 metres and the diameter of the rot is assumed to be the same at both ends (10 rads). Although not demonstrated in this example, the diameter deduction method may be used when rot is assumed to travel exactly half-way or through and through a log.

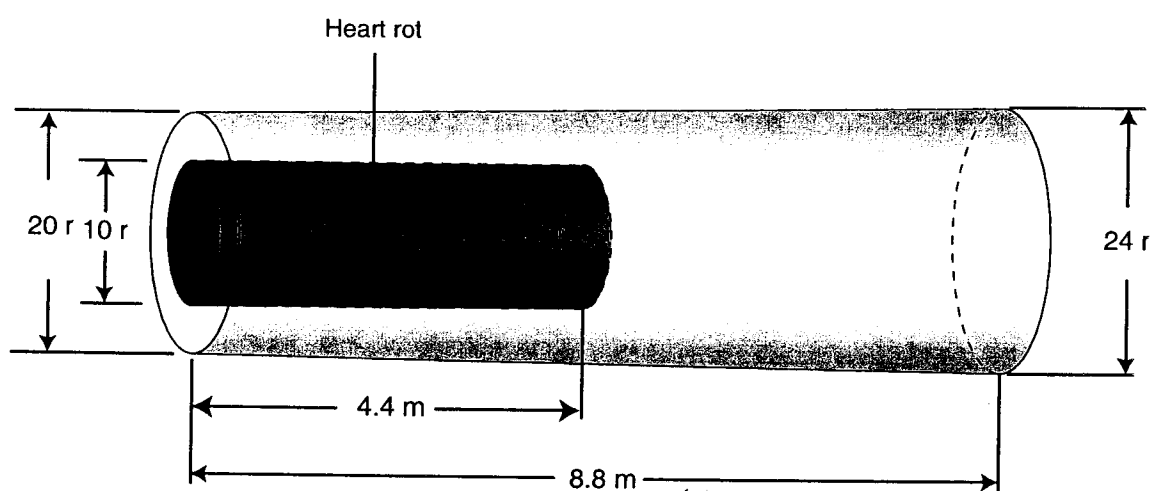


Figure 5.35 A log with partial length heart rot.

5.9.3.2.2 Formal Calculation

Using the cylinder deduction formula described in Appendix 5B, the net volume of the log is calculated to be 1.211 m³.

5.9.3.2.3 Field Calculation - Length Deduction

To reduce the recorded length measurement of the log to create a log with net dimensions equal to the net volume in the example, follow these steps:

Top defect volume

$$\begin{aligned}
 \text{Half volume of 4.0/10} &= 63 \text{ dm}^3 \\
 \text{Half volume of 0.4/10} &= \underline{6} \text{ dm}^3 \\
 \text{Half volume of 4.4/10} &= 69 \text{ dm}^3 \\
 \text{Full volume of 4.4/10/10} &= 138 \text{ dm}^3 \text{ (2 x the half volume)}
 \end{aligned}$$

Calculate the one metre unit volume for the log by adding the ten metre half volumes of the end measurements of the log and dividing by ten.

$$\begin{aligned}
 \text{Half volume of 10.0/20} &= 628 \text{ dm}^3 \\
 \text{Half volume of 10.0/24} &= \underline{905} \text{ dm}^3 \\
 \text{Full volume of 10.0/20/24} &= 1533 \text{ dm}^3 \\
 \text{Full volume of 01.0/20/24} &= 153 \text{ dm}^3
 \end{aligned}$$

Calculate the length deduction by dividing the defect volume by the one metre unit volume of the log:

$$\frac{138}{153} = 0.902 \text{ m}$$

The length deduction rounded is 0.9 m.

Calculate the net length by subtracting the length deduction from the gross length of the log.

$$8.8 \text{ m} - 0.9 \text{ m} = 7.9 \text{ m}$$

$$\text{Volume} = 1.211 \text{ m}^3 \text{ or } 1211 \text{ dm}^3$$

Record the net dimensions as 079/20/24.

5.9.3.3 Ring Defect - Through Running

Ring rot does not always form a full circle. The simplest method of determining the volume of a ring which does not form a full circle is to:

1. apply the methods described below as if it were a full circle,
2. estimate the arc of the rot as a percentage of the full circle, and
3. apply this percentage factor to the full circle.

The result is the net volume of the partial ring.

5.9.3.3.1 Example and Illustration - Ring Rot, Full Length

In the example illustrated on the next page (Figure 5.42), a fungus has caused a ring shaped rot to destroy the wood fibres for the full length of the log. The rot volume may be visualized as a cylinder of rot containing another, smaller, cylinder of firm wood that is subtracted from the rot cylinder, leaving the volume of the ring.

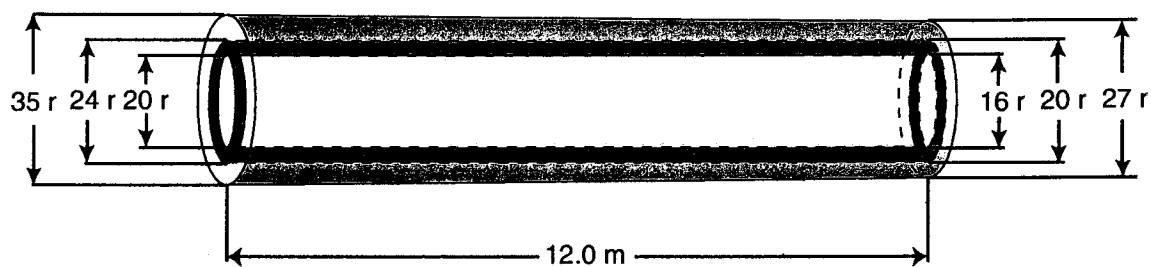


Figure 5.36 A log with through-running ring rot.

5.9.3.3.2 Formal Calculation

Using the cylinder deduction formulas described in Appendix 5B, the net volume of the log is calculated to be 3.080 m³.

5.9.3.3.3 Field Calculation - Length Deduction

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

1. Find a volume using the outside diameters and length of the ring,
2. Find the volume of the sound core using the inside diameters of the ring, and
3. Subtract the volume of the sound core to get the volume of rot within the ring.

To reduce the gross length of the log to create a log with net dimensions equal to the net volume in the above example:

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

Outside diameter cylinder volume

$$\text{Half volume of 120/24} = 1086 \text{ dm}^3$$

$$\text{Half volume of 120/20} = \underline{754} \text{ dm}^3$$

$$\text{Full volume of 120/20/24} = 1840 \text{ dm}^3$$

Inside diameter cylinder volume

$$\text{Half volume of 120/20} = 754 \text{ dm}^3$$

$$\text{Half volume of 120/16} = \underline{483} \text{ dm}^3$$

$$\text{Full volume of 120/20/24} = 1237 \text{ dm}^3$$

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

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

A factor may be applied at this point for a partial ring defect (i.e., if the ring arc forms only one third of the circumference, multiply the above volume by 0.333).

Calculate the unit volume for the log by adding the ten metre half volumes of the end measurements of the log and dividing by 10.

$$\text{Half volume of } 100/27 = 1145 \text{ dm}^3$$

$$\text{Half volume of } 100/35 = \underline{1924} \text{ dm}^3$$

$$\text{Full volume of } 100/27/35 = 3069 \text{ dm}^3$$

$$\text{Full volume of } 010/20/24 = 307 \text{ dm}^3$$

Calculate the length deduction by dividing the defect volume by the unit volume of the log:

$$\frac{603}{307} = 1.964 \text{ m}$$

The length deduction rounded is 2.0 m.

Calculate the net length by subtracting the length deduction from the gross length of the log.

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

$$\text{Volume} = 3.069 \text{ m}^3 \text{ or } 3069 \text{ dm}^3$$

Record the net dimensions as 100/27/35.

5.9.3.4 Ring Defect - Partial Length of Log

5.9.3.4.1 Example and Illustration - Ring Rot, Partial Length

Ring rot is visible at only one end of the log in Figure 5.43. The rot is estimated to travel one half the length of the log and the rings' inner and outer diameters are assumed to be the same at both ends.

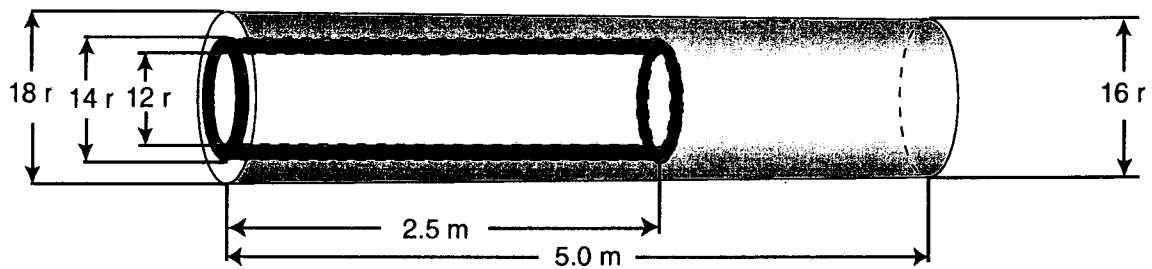


Figure 5.37 A log with partial length ring rot.

5.9.3.4.2 Formal Calculation

Using the same cylinder deduction formulas described in Appendix 5B, the net volume of the log is calculated to be 0.415 m³.

5.9.3.4.3 Field Calculation - Length Deduction

To reduce the gross length of the log to create a log with net dimensions equal to the net volume in the above example:

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

Outside diameter cylinder volume:

Half volume of 020/14	=	62 dm ³
Half volume of 005/14	=	<u>15</u> dm ³
Half volume of 025/14	=	77 dm ³
Full volume of 025/14	=	154 dm ³ (2 x half volume)

Inside diameter cylinder volume:

Half volume of 020/12	=	45 dm ³
Half volume of 005/12	=	<u>11</u> dm ³
Half volume of 025/12	=	56 dm ³
Full volume of 025/12	=	112 dm ³ (2 x half volume)

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

$$\text{Defect volume} = 154 - 112 = 42 \text{ dm}^3$$

A factor may be applied at this point for a partial ring defect (i.e., if the ring arc forms only one half of the circumference, multiply the above volume by 0.5).

Calculate the unit volume for the log by adding the ten metre half volumes of the end measurements of the log and dividing by 10.

$$\text{Half volume of } 100/16 = 402 \text{ dm}^3$$

$$\text{Half volume of } 100/18 = \underline{509} \text{ dm}^3$$

$$\text{Full volume of } 100/27/35 = 911 \text{ dm}^3$$

$$\text{Full volume of } 010/20/24 = 91 \text{ dm}^3$$

Calculate the length deduction by dividing the defect volume by the one metre unit volume of the log:

$$\frac{42}{91} = 0.46 \text{ m}$$

The length deduction is rounded to 0.5 m.

Find the net length by subtracting the length deduction from the gross length of the log.

$$5.0 \text{ m} - 0.5 \text{ m} = 4.5 \text{ m}$$

$$\text{Volume} = .410 \text{ m}^3 \text{ or } 410 \text{ dm}^3$$

Record the net dimensions as 045/16/18.

5.9.3.5 Sap Rot

Example & Illustration - Sap Rot

The log in Figure 5.44 was sawn from a windfallen tree and has been lying on the ground long enough for fungi to have eaten into the sap wood 3 to 4 cm.

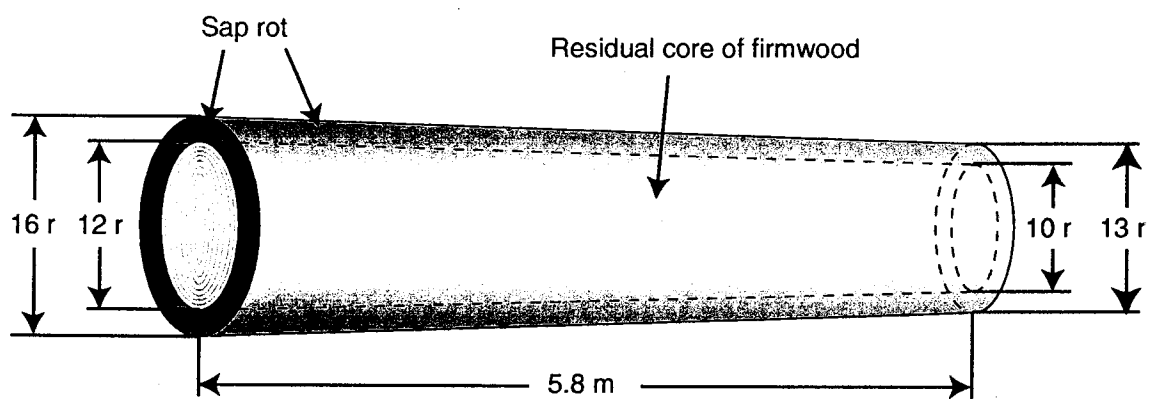


Figure 5.38 A log with sap rot.

5.9.3.5.1 Formal Calculation

Using the cylinder deduction formulas described in Appendix 5B, the net volume of the log is calculated to be 0.222 m³.

5.9.3.6 Field Calculation - Diameter Deduction

This method simply ignores the saprot and uses the diameters of the sound core of wood to find the net volume and recorded net dimensions. Although very simple to apply, it is a "net" method, and does not provide users of scale data with any information about the rot. Scalers using "gross-net" scale will use the length deduction method demonstrated next, to provide additional information on the gross dimensions and volume of the log, the volume of the rot, and the net dimensions and volume.

Using the diameters of the firm core inside the rot:

Calculate the half volume of the top net inner cylinder:

$$\text{Half volume of 050/10} = 79 \text{ dm}^3$$

$$\text{Half volume of 008/10} = \underline{13} \text{ dm}^3$$

$$\text{Half volume of 058/10} = 92 \text{ dm}^3$$

Calculate the half volume of the butt net inner cylinder:

$$\text{Half volume of 050/12} = 113 \text{ dm}^3$$

$$\text{Half volume of 008/12} = \underline{18} \text{ dm}^3$$

$$\text{Half volume of 058/12} = 131 \text{ dm}^3$$

Add the half of the top cylinder to the butt cylinder:

$$92 + 131$$

$$\text{Full volume of 058/10/12} = 223 \text{ dm}^3$$

$$\text{Volume} = .0223 \text{ m}^3 \text{ or } 223 \text{ dm}^3$$

Record the net dimensions as 058/10/12.

5.9.3.7 Field Calculation - Length Deduction

Although more difficult to apply, method is a "gross-net" method, with the advantage of providing users of scale data with more information about the rot. Scalers using "gross-net" scale use this method, rather than the diameter deduction method described above, to provide additional information on the gross dimensions and volume of the log, the volume of the rot, and the net dimensions and volume.

Therefore, the volume of defect equals outer gross cylinder volume minus inner net cylinder volume, and it can be found by:

Calculate the gross top half volume of the cylinder.

$$\text{Half volume of 050/13} = 133 \text{ dm}^3$$

$$\text{Half volume of 008/13} = \underline{21} \text{ dm}^3$$

$$\text{Half volume of 058/13} = 154 \text{ dm}^3$$

Calculate the gross butt half volume of the cylinder.

$$\text{Half volume of 050/16} = 201 \text{ dm}^3$$

$$\text{Half volume of 008/16} = \underline{32} \text{ dm}^3$$

$$\text{Half volume of 058/16} = 233 \text{ dm}^3$$

Add the half volumes to find the full volume:

$$\text{Full volume of 058/13/16} = 387 \text{ dm}^3$$

Subtract the inner cylinder volume:

$$= \underline{223} \text{ dm}^3$$

$$\text{Equals the defect volume} = 164 \text{ dm}^3$$

Find the unit volume of the log using the gross diameters:

$$\text{Unit volume 13} = 53 \text{ dm}^3$$

$$\text{Unit volume 16} = \underline{80} \text{ dm}^3$$

$$\text{Sum} = 133 \text{ dm}^3$$

$$\text{Divide by 2} = 66 \text{ dm}^3$$

Find the length deduction by:

Divide the rot volume by unit volume = $164/66 = 2.484$ rounded to 2.5

Subtract the length deduction from the
gross length = $5.8 - 2.5 = 3.3$ m

Volume = 221 dm^3

Record the net dimensions as: 033/13/16.

5.9.4 Cubical Defects

5.9.4.1 Pocket Defect - Through-running

5.9.4.1.1 Example and Illustration - Pocket Defect, Through-running

The log in Figure 5.45 is infected with a type of rot which forms in pockets rather than following the growth rings. Its shape is closer to being rectangular than circular.

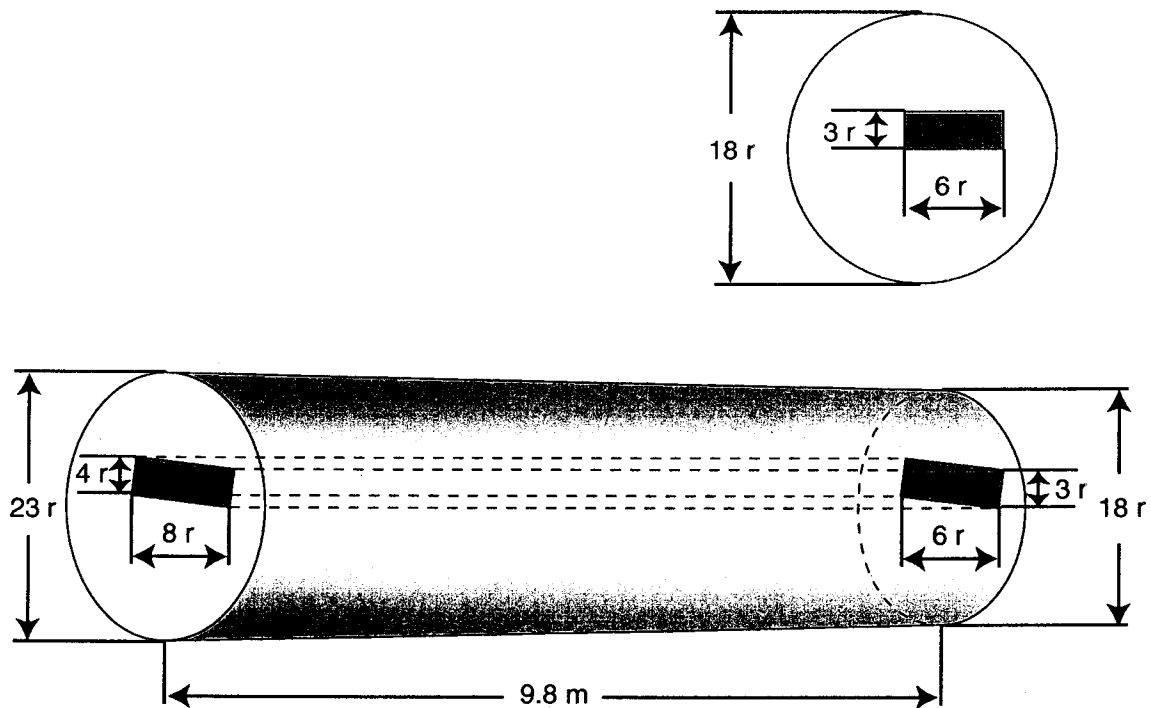


Figure 5.39 A log with through-running pocket rot.

5.9.4.1.2 Formal Calculation

Using the cubical or "rectangular box" deduction formulas described in Appendix 5B, the net volume of the log is calculated to be 1.215 m³.

5.9.4.1.3 Field Calculation - Length Deduction

To reduce the gross length measurement of the log to create a log with net dimensions equal to the net volume in the example, the defect is enclosed in a box representing the area of the defect. Part 1 of this chapter provides detailed information on enclosing irregular defects and determining representative dimensions.

Calculate the unit volumes of the defect ends by multiplying the height by the width by the factor of 0.4 to convert the end area of the defect from square rads to unit volumes:

$$\begin{array}{rcl}
 3 \times 6 \times 0.4 & = & 7 \text{ dm}^3 \\
 4 \times 8 \times 0.4 & = & \underline{13 \text{ dm}^3} \\
 \text{Sum of unit volumes} & = & 20 \text{ dm}^3 \\
 \text{Divided by 2} & = & 10 \text{ dm}^3, \text{ the Average unit volume}
 \end{array}$$

Multiply the average unit volume of the defect by the length of the defect to obtain the defect volume:

$$\text{unit volume } 10 \text{ dm}^3 \times 9.8 \text{ m} = 98 \text{ dm}^3$$

(In the case of multiple pockets or pipes, calculate the volume of each one and add the volumes together at this point. Where there are several small pockets, it is possible to visualize grouping them together into a single box.)

Calculate the one metre volume for the log by adding the ten metre half volumes of the end measurements of the log and dividing by ten or adding the unit volumes and dividing by 2.

$$\begin{array}{rcl}
 \text{Half volume of 100/18} & = & 509 \text{ dm}^3 \\
 \text{Half volume of 100/23} & = & \underline{831 \text{ dm}^3} \\
 \text{Full volume of 100/18/23} & = & 1340 \text{ dm}^3 \\
 \text{Unit volume of 010/18/23} & = & 134 \text{ dm}^3
 \end{array}$$

Calculate the length deduction by dividing the defect volume by the unit volume of the log.

$$\frac{98}{134} = 0.731 \text{ m}$$

The rounded length deduction is 0.7 m

Calculate the net length by subtracting the length deduction from the gross length of the log.

$$9.8 \text{ m} - 0.7 \text{ m} = 9.1 \text{ m}$$

$$\text{Volume} = 1.219 \text{ m}^3 \text{ or } 1219 \text{ dm}^3$$

Record the net dimension as 091/18/23

5.9.4.1.4 Field Calculation - Diameter Deduction

To reduce the gross diameter measurement of the log to create a log with net dimensions equal to the net volume in the example, the diameter deduction is possible, if the defect is through running, or runs exactly half way through the log.

$$\text{Find the unit volume of the 18 rad top:} = 102 \text{ dm}^3$$

Find the unit volume of the top defect:

$$\text{and subtract from top: } 3 \times 6 \times 0.4 = \underline{7} \text{ dm}^3$$

$$\text{to get the net unit volume} = 95 \text{ dm}^3$$

Find the closest equivalent unit volume on the scale stick and record the rad class of 17.

$$\text{Find the unit volume of the 23 rad Butt:} = 166$$

Find the unit volume of the top defect,

$$\text{and subtract from the butt: } 4 \times 8 \times 0.4 = \underline{13} \text{ dm}^3$$

$$\text{to get the Net unit volume} = 153 \text{ dm}^3$$

Find the closest equivalent unit volume on the scale stick and record the rad class of 22.

Record the net dimensions as 098 17 22.

5.9.4.2 Pocket Defect · Partial Length of the Log

5.9.4.2.1 Example and Illustration - Pocket Rot, Partial Length

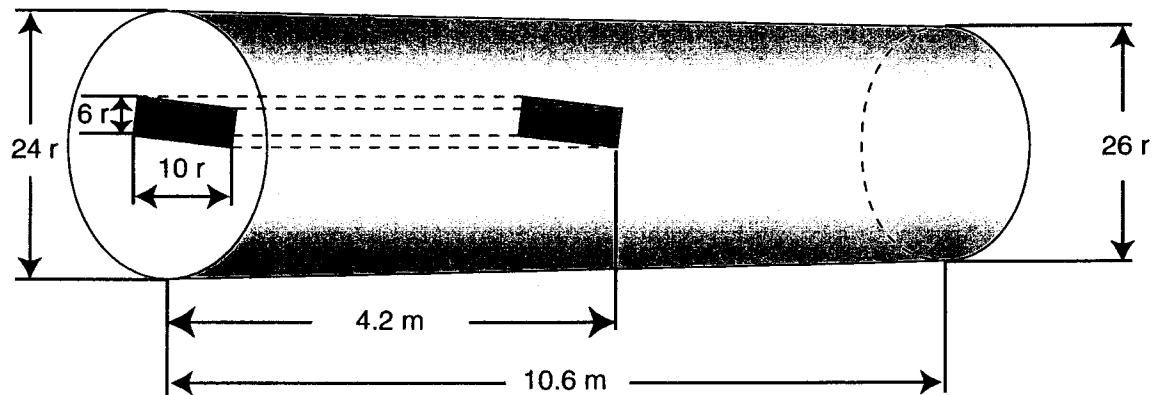


Figure 5.40 A log with partial-length pocket rot.

5.9.4.2.2 Formal Calculation

Using the cubical or "rectangular box" deduction formulas described in Appendix 5B, the net volume of the log is calculated to be 1.984 m³.

5.9.4.2.3 Field Calculation - Length Deduction

To reduce the gross length measurement of the log to create a log with net dimensions equal to the net volume in the example, the defect is enclosed in a box representing the area of the defect. Part 1 of this chapter provides detailed information on enclosing irregular defects and determining representative dimensions.

Calculate the unit volumes of the defect ends by multiplying the height by the width by the factor of 0.4 to convert the end area of the defect from square rads to unit volumes, and multiply by the defect length to obtain the defect volume.

$$\text{Unit volume} = 6 \text{ R} \times 10 \text{ R} \times 0.4 = 24 \text{ dm}^3$$

$$\text{Defect Volume} = 24 \text{ dm}^3 \times 4.2 \text{ m} = 101 \text{ dm}^3$$

In the case of multiple pockets or pipes, calculate the volume of each one and add them together. Where there are several small pockets, it is possible to visually group them together and use one measurement.

Calculate the one metre unit volume for the log by adding the unit volumes and dividing by two or adding the ten metre half volumes of the end measurements of the log and dividing by ten:

$$\text{unit volume of 24} = 181 \text{ dm}^3$$

$$\text{unit volume of 26} = \underline{212} \text{ dm}^3$$

$$\text{Sum of unit volumes} = 393 \text{ dm}^3$$

$$\text{Average unit volume} = 197 \text{ dm}^3$$

Calculate the length deduction by dividing the defect volume by the one metre unit volume of the log.

$$\frac{101}{197} = 0.513 \text{ m}$$

Length deduction is 0.5 m

Calculate the net length by subtracting the length deduction from the gross length of the log.

$$10.6 - 0.5 = 10.1 \text{ m}$$

$$\text{Volume} = 1.987 \text{ m}^3 \text{ or } 1987 \text{ dm}^3$$

Record the net dimensions as 101/24/26.

5.9.5 Other Defects

5.9.5.1 Missing Wood

Missing wood can take many forms. This example demonstrates the use of a percentage factor to represent the missing part, but any of the other methods described previously will serve just as well if they are more representative of the shape of the defect.

5.9.5.1.1 Example and Illustration - Missing Wood

The defect shown in Figure 5.47 on the next page is typical of mechanical damage. Such defects as burnt saddles or charred wood could also apply to this example, and in this case, the missing portion is equal to 50% or 1/2 of the log for 4.8 m.

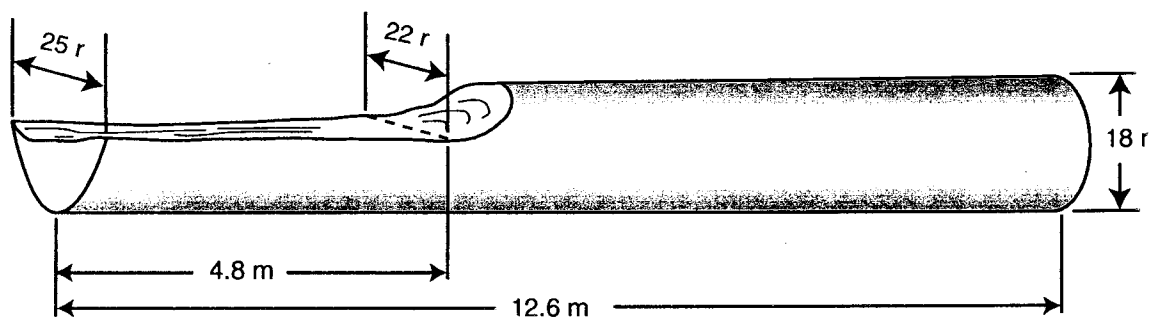


Figure 5.41 A log with missing wood.

5.9.5.1.2 Formal Calculation

Using the cylindrical deduction formula with factor as described in Appendix 5B, the net volume of the log is calculated to be 1.460 m³.

5.9.5.1.3 Field Calculation - Length Deduction

To reduce the recorded length measurement of the log to create a log with net dimensions equal to the net volume in the example, first look up the volume of a cylinder of the Diameter and length of the log affected by the defect.

The half volume at the upper limit of the defect:

$$\text{Half volume of } 040/22 = 304 \text{ dm}^3$$

$$\text{Half volume of } 008/22 = \underline{61} \text{ dm}^3$$

$$\text{Half volume of } 048/22 = 365 \text{ dm}^3$$

Plus the half volume at the lower limit of the defect:

$$\text{Half volume of } 040/25 = 393 \text{ dm}^3$$

$$\text{Half volume of } 008/25 = \underline{79} \text{ dm}^3$$

$$\text{Half volume of } 048/25 = 472 \text{ dm}^3$$

equals the full volume of the portion of the log affected by the defect:

$$\text{Full volume of } 4.8/22/25 = (365 + 472) = 837 \text{ dm}^3$$

multiplied by the percentage missing, is the volume of the defect:

$$\text{Volume of defect} = 837 \times 0.5 = 419 \text{ m}^3$$

Calculate the one metre unit volume for the log by adding the ten metre half volumes of the end measurements of the log and dividing by 10 or by adding the Unit volumes and dividing by 2.

$$\text{Half volume of } 100/18 = 509 \text{ dm}^3$$

$$\text{Half volume of } 100/25 = \underline{982} \text{ dm}^3$$

$$\text{Full volume of } 100/18/25 = 1491 \text{ dm}^3$$

$$\text{Unit volume of } 010/30/38 = 149 \text{ dm}^3$$

Calculate the length deduction by dividing the defect volume by the unit volume:

$$\frac{419}{149} = 2.812 \text{ m}$$

The length deduction rounded is 2.8 m.

Calculate the net length by subtracting the length deduction from the gross length of the log.

$$12.6 - 2.8 = 9.8 \text{ m}$$

$$\text{Volume} = 1.461 \text{ m}^3 \text{ or } 1461 \text{ dm}^3$$

Record the net dimensions as 098/18/25.

5.9.5.2 Segment Defects

5.9.5.2.1 Example and Illustration - Surface Defect

The log in Figure 5.48 has a pie-shaped segment split out of it. This segment is about 15% of the whole piece. Surface defects such as, lightning scars, frost checks or bark seams are typical examples.

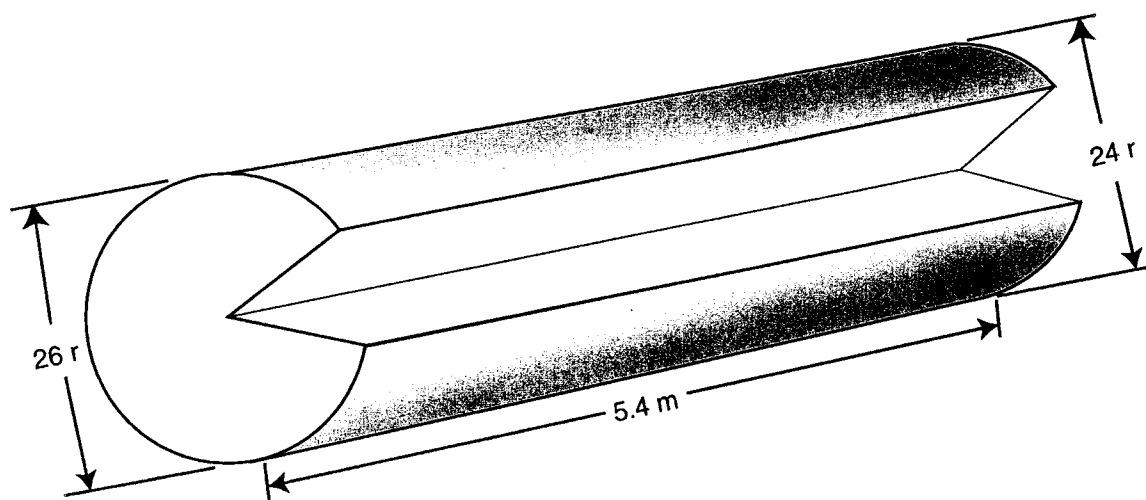


Figure 5.42 A log with segment defect extending to the heart.

5.9.5.2.2 Formal Calculation

Using Smalian's formula with factor as described in Appendix 5B, the net volume of the log is calculated to be 0.903 m³.

5.9.5.2.3 Field Calculation, Length Deduction Using a Factor

This example uses the application of a factor to determine net volume, in the same way as demonstrated in the previous example for missing wood. With pie-shaped defects which do not extend to the pith, however, it is easier to use the prism formula described after this. This is because the application of a factor is more of an approximation, and it is much more difficult to estimate the defect factor if it does not extend to the pith.

To reduce the recorded length measurement of the log to create a log with net dimensions equal to the net volume in the example:

Using the scale stick, find the top end half volume

$$\text{Half volume of } 050/24 = 452 \text{ dm}^3$$

$$\text{Half volume of } 004/24 = \underline{36.2} \text{ dm}^3$$

$$\text{Half volume of } 054/24 = 488.2 \text{ dm}^3$$

Find the butt end half volume

$$\text{Half volume of } 050/26 = 531 \text{ dm}^3$$

$$\text{Half volume of } 004/26 = \underline{42.5} \text{ dm}^3$$

$$\text{Half volume of } 054/26 = 573.5 \text{ dm}^3$$

Add the half volumes:

$$\text{Full volume of } 5.4/24/26 = (488 + 574) = 1062 \text{ dm}^3$$

In this example, if 85% of the log is sound, the remaining 15% is defect. Multiply the gross volume by this factor to obtain the volume of the defect.

$$\text{Volume of defect} = 1062 \times .15 = 159 \text{ m}^3$$

Calculate the average unit volume for the log by adding the ten metre half volumes of the end measurements of the log and dividing by 10:

$$\text{Half volume of } 100/24 = 905 \text{ dm}^3$$

$$\text{Half volume of } 100/26 = \underline{1062} \text{ dm}^3$$

$$\text{Full volume of } 100/24/26 = 1967 \text{ dm}^3$$

$$\text{unit volume (010/24/26)} = 197 \text{ dm}^3$$

or by adding the unit volumes and dividing by two.

$$\text{unit volume of } 24 = 181$$

$$\text{unit volume of } 26 = 212$$

$$\text{The sum of same} = \underline{393}$$

$$\text{Divided by two} = 196.5 \text{ or } 197$$

Calculate the length deduction by dividing the defect volume by the one metre unit volume of the log:

$$\frac{159}{197} = 0.807 \text{ m}$$

The length deduction rounded is 0.8 m.

Calculate the net length by subtracting the length deduction from the gross length of the log.

$$5.4 - 0.8 = 4.6 \text{ m}$$

$$\text{Volume} = 0.905 \text{ m}^3 \text{ or } 905 \text{ dm}^3$$

Record the net dimensions as 046/24/26.

5.9.5.2.4 Field Calculation, Diameter Deduction Using the Prism Formula

This method of making a deduction for pie shaped defects is more appropriate in cases where the segment does not reach to the geometric centre of the log. Where it is necessary to estimate a percentage factor for the method described above, the prism or triangle measurement does not.

To reduce the recorded length measurements of the log to create a log with net dimensions equal to the net volume in the example, determine the volume of the defect using methods described in the measurements section of this chapter.

Whatever form a triangle may take the formula for finding its area is always one half the base times the height.

The formula for scaling purposes is $\frac{BH \times 0.4}{2} = \text{unit volume};$

for the butt end of the log,

$$\begin{aligned} \text{Base} &= 12 \text{ r} \\ \text{Height} &= 13 \text{ r} \\ \text{Unit Volume (UV)} &= \frac{12 \times 13 \times 0.4}{2} = 31.2 \text{ dm}^3; \end{aligned}$$

Locate the closest uv on the scale stick (31) and note the diameter, which is 10 r.

For the top end of the log,

$$\begin{aligned} \text{Base} &= 11 \text{ r} \\ \text{Height} &= 12 \text{ r} \\ \text{Unit Volume (UV)} &= \frac{11 \times 12 \times 0.4}{2} = 26.4 \text{ dm}^3 \end{aligned}$$

Locate the closest uv on the scale stick (25) and note the diameter, which is 9 r.

Using the scale stick, find the top end half volume

$$\begin{aligned} \text{Half volume of 050/09} &= 64 \text{ dm}^3 \\ \text{Half volume of 004/09} &= \underline{5.1} \text{ dm}^3 \\ \text{Half volume of 054/09} &= 71.5 \text{ dm}^3 \end{aligned}$$

Find the butt end half volume

$$\begin{aligned} \text{Half volume of 050/10} &= 79 \text{ dm}^3 \\ \text{Half volume of 004/10} &= \underline{6.3} \text{ dm}^3 \\ \text{Half volume of 054/10} &= 85.3 \text{ dm}^3 \end{aligned}$$

Add the half volumes:

$$\text{Full volume of 5.4/24/26} = (71.5 + 85.3) = 156.8 \text{ dm}^3 \text{ rounded to } 157 \text{ dm}^3$$

Calculate the average unit volume for the log by adding the ten metre half volumes of the end measurements of the log and dividing by 10,

$$\text{Half volume of 100/24} = 905 \text{ dm}^3$$

$$\text{Half volume of 100/26} = \underline{1062} \text{ dm}^3$$

$$\text{Full volume of 100/24/26} = 1967 \text{ dm}^3$$

$$\text{unit volume (010/24/26)} = 197 \text{ dm}^3$$

or by adding the unit volumes and dividing by two.

$$\text{unit volume of 24} = 181$$

$$\text{unit volume of 26} = 212$$

$$\text{The sum of same} = \underline{393}$$

$$\text{Divided by two} = 196.5 \text{ or } 197$$

Calculate the length deduction by dividing the defect volume by the one metre unit volume of the log:

$$\frac{157}{197} = 0.796 \text{ m}$$

The length deduction rounded is 0.8 m.

Calculate the net length by subtracting the length deduction from the gross length of the log.

$$5.4 - 0.8 = 4.6 \text{ m}$$

$$\text{Volume} = 0.905 \text{ m}^3 \text{ or } 905 \text{ dm}^3$$

Record the net dimensions as 046/24/26.

Notes:

- The method of applying a factor is most effective for defects which extend to the geometric centre or pith of the log because it is easier for to estimate the percentage of a log affected, and
- If the defect does not extend to the pith, or if it is difficult to estimate with certainty the percentage of the log affected by the defect, apply methods for the cylinder, cone, rectangular box or prism to find the defect volume.

Appendix 5A Log Scale Stick Specifications as Approved for Official Scaling in British Columbia

- a. Scale sticks shall be of one design but manufactured in three lengths. These lengths will be:

Coast Stick: 2 m from the inside of the tine up to and including the handle.

Interior 1.5 m Stick: 1.51 m from the inside of the tine up to but excluding the handle.

Interior 1 m Stick: 1.01 m from the inside of the tine up to but excluding the handle.
- b. The stick must be of straight-grained hickory, hard maple or other approved wood of equivalent texture and strength and finished in good quality clear varnish or approved coating or, alternatively, of straight-grained spruce or yellow cedar covered with fibreglass. The finish shall be of such quality and so applied that it does not fracture, craze or become opaque under normal conditions of use. The type of wood and finish will be specified on the purchase order.
- c. The stick is to be 23 mm in width; it must, if fibreglass, be built up an additional 2 mm on each edge with fibreglass. It is to be not over 10 mm in thickness.
- d. The total weight of the stick, including tine and handle, is not to be over 540 g.
- e. The handle of the stick is to be of hard cork or similar material 15 cm long and is to be so fashioned that it provides a comfortable grip.
- f. The tine is to be of stainless steel 13 mm wide; 215 mm in length for coast sticks, 130 mm in length for interior sticks; with face plates of a minimum length of 63 mm, outside measurements and a width of that of the stick extending up the broad faces of the stick. Tine and plate must be riveted with steel rivets, not less than four (4) in number, two (2) of which attach the tine to the plate so that the tine is at true right angles to the stick.
- g. All required numbering and lettering must be in waterproof ink or paint, red or black as specified, so that the required items are readily legible and will not be obliterated as a result of normal use. Alternative methods of lettering are acceptable, so long as they provide a durability and legibility equivalent to the aforesaid.
- h. Numerals representing diameter radius classes, to be shown on both edges of the stick, must be approximately 8 mm high, black in colour, and in bolder face than the other numerals on the stick and must be burned, or otherwise impressed into the wood. Where the stick is fibreglassed, the burning is optional.

- i. Black lines marking the limits of the diameter radius classes shall be in bold face and burned into the wood. Where the stick is fibreglassed, the burning is optional. Such lines shall be at 2 cm intervals along the stick at 3 cm, 5 cm, 7 cm, etc. from the inside of the tine with the uppermost line at the handle. Maximum permissible deviations from true measurements indicated shall be 0.8 mm for these markings.
- j. Numerals representing lengths, to be shown on both edges of the stick, must be approximately 5 mm high, red in colour, at right angles to the numerals representing diameters and readable from the handle. The red numerals will be 0.2, 0.4, 0.6, 0.8, 1.0 and for longer sticks 1.2, 1.4, 1.6, 1.8 and will be located in the diameter radius classes of 10, 20, 30, 40, 50, 60, 70, 80, and 90.
- k. Red lines marking the limits of the length classes, shall be in bold face and burned, or otherwise impressed, into the wood. Where the stick is fibreglassed, the burning or impressment is optional. These red lines will be at 0.1 m, 0.3 m, 0.5 m, 0.7 m, 0.9 m, and for longer sticks 1.1 m, 1.3 m, 1.5 m and 1.7 m respectively, from the inside of the tine. Maximum permissible deviations from true measurements indicated shall be 2 mm for these markings.
- l. Numerals representing half volumes of cylinders in cubic decimetres, to be shown on the sides of the stick, must be black in colour and approximately 3 mm high. Half volumes of cylinders for the range of diameter radius classes and lengths used on the stick will be taken from Table 1, Half Volumes of Cylinders in Cubic Decimetres.
- m. The half volume numerals for each diameter radius class will be separated by black lines corresponding to the diameter radius class lines described in i above. Maximum permissible deviations from true measurements indicated shall be 1 mm for these markings.
- n. Characters identifying the lengths of cylinders for which half volumes are shown, to be shown on the side in the diameter radius class next to the handle and next to the plate, must be black in colour and approximately 3 mm high. The cylinder lengths shown shall be 3 m, 4 m, 5 m, 6 m, or 7 m on the face with the tine pointing down, and 8 m, 9 m, 10 m, 11 m, or 12 m on the other face, with the tine pointing up.
- o. Numerals, representing unit volumes in dm^3 for each diameter radius class must be black in colour and approximately 3 mm high. These numerals shall be recorded on each face at right angles to the half volume numerals described in l above and shall be readable from the handle. Unit volumes for the sides of the stick will be taken from Table 2, Volumes of one Metre Cylinders in Cubic Decimetres.

- p. The following shall be lettered, in black letters approximately 3 mm high, on both sides of the stick in the diameter radius class next to the handle.

Unit Vol. dm³	Half
	Vol.
	dm ³

A specification sketch for the British Columbia Metric Log Scale Stick follows on the next page.

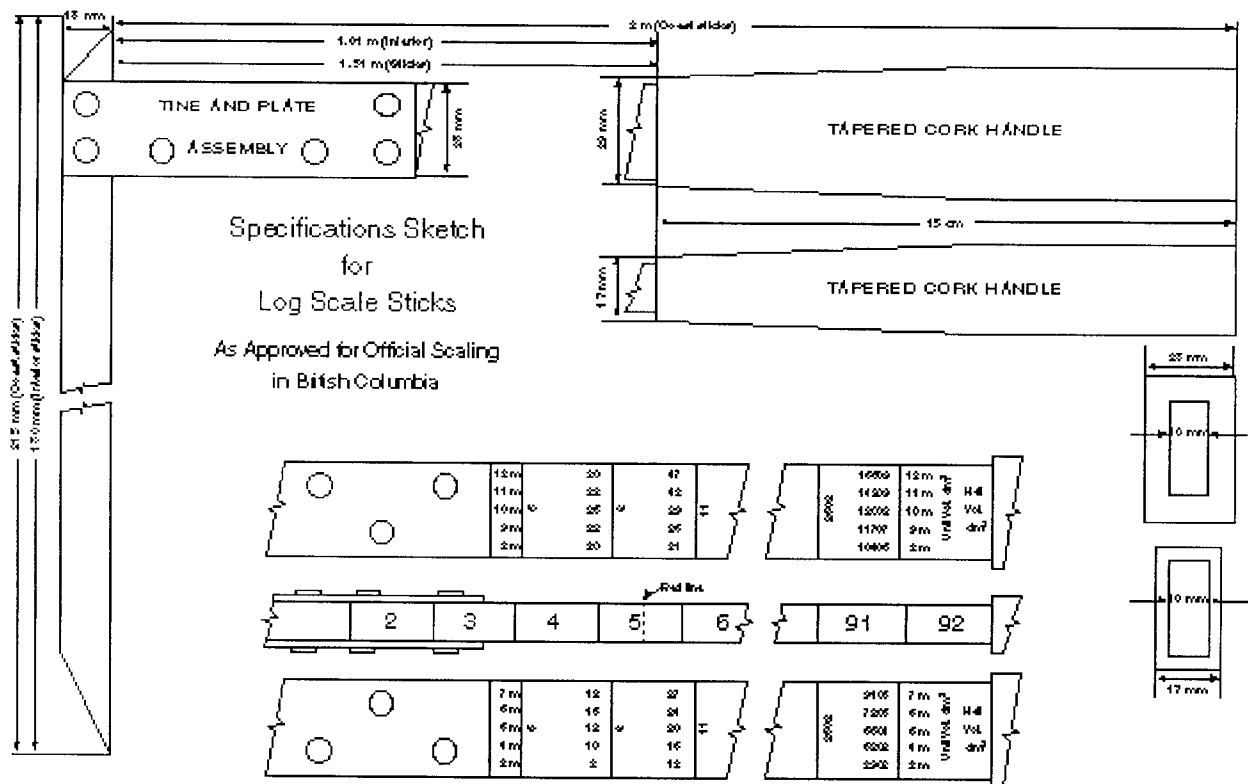


Figure 5A.1 British Columbia Metric Log Scale Stick - Specifications Sketch.

Table 5A.1 Half Volume of Cylinders in Cubic Decimetres

Length (m)	Radius Class (cm)									
	4	5	6	7	8	9	10	11	12	13
Half Volumes (dm ³)										
12	30	47	68	92	121	153	188	228	271	319
11	28	43	62	85	111	140	173	209	249	292
10	25	39	57	77	101	127	157	190	226	265
9	23	35	51	69	90	115	141	171	204	239
8	20	31	45	62	80	102	126	152	181	212
7	18	27	40	54	70	89	110	133	158	186
6	15	24	34	46	60	76	94	114	136	159
5	13	20	28	38	50	64	79	95	113	133
4	10	16	23	31	40	51	63	76	90	106
3	8	12	17	23	30	38	47	57	68	80

Length (m)	Radius Class (cm)									
	14	15	16	17	18	19	20	21	22	23
Half Volumes (dm ³)										
12	369	424	483	545	611	680	754	831	912	997
11	339	389	442	499	560	624	691	762	836	914
10	308	353	402	454	509	567	628	693	760	831
9	277	318	362	409	458	510	565	623	684	748
8	246	283	322	363	407	454	503	554	608	665
7	216	247	281	318	356	397	440	485	532	582
6	185	212	241	272	305	340	377	416	456	499
5	154	177	201	227	254	284	314	346	380	415
4	123	141	161	182	204	227	251	277	304	332
3	92	106	121	136	153	170	188	208	228	249

Table 5A.1 (continued)

Length (m)	Radius Class (cm)									
	24	25	26	27	28	29	30	31	32	33
Half Volumes (dm ³)										
12	1086	1178	1274	1374	1478	1585	1696	1811	1930	2053
11	995	1080	1168	1260	1355	1453	1555	1660	1769	1882
10	905	982	1062	1145	1232	1321	1414	1510	1608	1711
9	814	884	956	1031	1108	1189	1272	1359	1448	1540
8	724	785	849	916	985	1057	1131	1208	1287	1368
7	633	687	743	802	862	925	990	1057	1126	1197
6	543	589	637	687	739	793	848	906	965	1026
5	452	491	531	573	616	661	707	755	804	855
4	362	393	425	458	493	528	565	604	643	684
3	271	295	319	344	369	396	424	453	483	513

Length (m)	Radius Class (cm)									
	34	35	36	37	38	39	40	41	42	43
Half Volumes (dm ³)										
12	2179	2309	2443	2581	2722	2867	3016	3169	3325	3485
11	1997	2117	2239	2365	2495	2628	2765	2905	3048	3195
10	1816	1924	2036	2150	2268	2389	2513	2641	2771	2904
9	1634	1732	1832	1935	2041	2150	2262	2376	2494	2614
8	1453	1539	1629	1720	1815	1911	2011	2112	2217	2324
7	1271	1347	1425	1505	1588	1672	1759	1848	1940	2033
6	1090	1155	1221	1290	1361	1434	1508	1584	1663	1743
5	908	962	1018	1075	1134	1195	1257	1320	1385	1452
4	726	770	814	860	907	956	1005	1056	1108	1162
3	545	577	611	645	680	717	754	792	831	871

Table 5A.1 (continued)

Length (m)	Radius Class (cm)									
	44	45	46	47	48	49	50	51	52	53
Half Volumes (dm ³)										
12	3649	3817	3989	4164	4343	4526	4712	4903	5097	5295
11	3345	3499	3656	3817	3981	4149	4320	4494	4672	4854
10	3041	3181	3324	3470	3619	3771	3927	4086	4247	4412
9	2737	2863	2991	3123	3257	3394	3534	3677	3823	3971
8	2433	2545	2659	2776	2895	3017	3142	3269	3398	3530
7	2129	2227	2327	2429	2533	2640	2749	2860	2973	3089
6	1825	1909	1994	2082	2171	2263	2356	2451	2548	2647
5	1521	1590	1662	1735	1810	1886	1963	2043	2124	2206
4	1216	1272	1330	1388	1448	1509	1571	1634	1699	1765
3	912	954	997	1041	1086	1131	1178	1226	1274	1324

Length (m)	Radius Class (cm)									
	54	55	56	57	58	59	60	61	62	63
Half Volumes (dm ³)										
12	5497	5702	5911	6124	6341	6562	6786	7014	7246	7481
11	5038	5227	5419	5614	5813	6015	6220	6429	6642	6858
10	4580	4752	4926	5104	5284	5468	5655	5845	6038	6234
9	4122	4276	4433	4593	4756	4921	5089	5260	5434	5611
8	3664	3801	3941	4083	4227	4374	4524	4676	4831	4988
7	3206	3326	3448	3572	3699	3828	3958	4091	4227	4364
6	2748	2851	2956	3062	3170	3281	3393	3507	3623	3741
5	2290	2376	2463	2552	2642	2734	2827	2922	3019	3117
4	1832	1901	1970	2041	2114	2187	2262	2338	2415	2494
3	1374	1425	1478	1531	1585	1640	1696	1753	1811	1870

Table 5A.1 (continued)

Length (m)	Radius Class (cm)									
	64	65	66	67	68	69	70	71	72	73
Half Volumes (dm ³)										
12	7721	7964	8211	8462	8716	8974	9236	9502	9772	10043
11	7077	7300	7527	7756	7990	8226	8467	8710	8957	9208
10	6434	6637	6842	7051	7263	7479	7697	7918	8143	8371
9	5791	5973	6158	6346	6537	6731	6927	7127	7329	7534
8	5147	5309	5474	5641	5811	5983	6158	5335	6514	6697
7	4504	4646	4790	4936	5084	5235	5388	5543	5700	5860
6	3860	3982	4105	4231	4358	4487	4618	4751	4886	5022
5	3217	3318	3421	3526	3632	3739	3848	3959	4072	4185
4	2574	2655	2737	2821	2905	2991	3079	3167	3257	3348
3	1930	1991	2053	2115	2179	2244	2309	2376	2443	2511

Length (m)	Radius Class (cm)									
	74	75	76	77	78	79	80	81	82	83
Half Volumes (dm ³)										
12	10322	10603	10888	11176	11468	11764	12064	12367	12674	12985
11	9462	9719	9980	10245	10512	10784	11058	11337	11618	11903
10	8602	8836	9073	9313	9557	9803	10053	10306	10562	10821
9	7742	7952	8166	8382	8601	8823	9048	9275	9506	9739
8	6881	7069	7258	7451	7645	7843	8042	8245	8450	8657
7	6021	6185	6351	6519	6690	6862	7037	7214	7393	7575
6	5161	5301	5444	5588	5734	5882	6032	6184	6337	6493
5	4301	4418	4536	4657	4778	4902	5027	5153	5281	5411
4	3441	3534	3629	3725	3823	3921	4021	4122	4225	4328
3	2581	2651	2722	2794	2867	2941	3016	3092	3169	3246

Table 5A.1 (continued)

Length (m)	Radius Class (cm)							
	84	85	86	87	88	89	90	91
Half Volumes (dm ³)								
12	13300	13619	13941	14267	14597	14931	15268	15609
11	12192	12484	12779	13078	13381	13687	13996	14309
10	11084	11349	11618	11889	12164	12442	12723	13008
9	9975	10214	10456	10700	10948	11198	11451	11707
8	8867	9079	9294	9511	9731	9954	10179	10406
7	7758	7944	8132	8323	8515	8710	8906	9105
6	6650	6809	6971	7134	7299	7465	7634	7805
5	5542	5675	5809	5945	6082	6221	6362	6504
4	4433	4540	4647	4756	4866	4977	5089	5203
3	3325	3405	3485	3567	3649	3733	3817	3902

Table 5A.2 Volumes of One Metre Cylinders in Cubic Decimetres

Radius Class	Unit Volume	Radius Class	Unit Volume	Radius Class	Unit Volume	Radius Class	Unit Volume
4	5	26	212	48	724	70	1539
5	8	27	229	49	754	71	1584
6	11	28	246	50	785	72	1629
7	15	29	264	51	817	73	1674
8	20	30	283	52	849	74	1720
9	25	31	302	53	882	75	1767
10	31	32	322	54	916	76	1815
11	38	33	342	55	950	77	1863
12	45	34	363	56	985	78	1911
13	53	35	385	57	1021	79	1961
14	62	36	407	58	1057	80	2011
15	71	37	430	59	1094	81	2061
16	80	38	454	60	1131	82	2112
17	91	39	478	61	1169	83	2164
18	102	40	503	62	1208	84	2217
19	113	41	528	63	1247	85	2270
20	126	42	554	64	1287	86	2324
21	139	43	581	65	1327	87	2378
22	152	44	608	66	1368	88	2433
23	166	45	636	67	1410	89	2488
24	181	46	665	68	1453	90	2545
25	196	47	694	69	1496	91	2602

Appendix 5B Defect Calculations

5B.1 Formulas and Their Terms

Formulas are expressed in this section in standard algebraic form. A formula is a mathematical rule. It is an algebraic expression that can be solved to find a particular quantity. For example, the formula that is used to find the area of a rectangle is:

Area is equal to the length times the width,

or

$$A = lw$$

In a formula, the value that you are trying to find is usually written to the left of the equal (=) sign. The Algebraic expression you need to solve is usually written to the right. To find the value from a formula, substitute numbers for the words or letters (variables) in the algebraic expression and do the arithmetic. Variables are often enclosed in brackets or nested brackets; these variables are calculated before proceeding to the next steps, starting with the innermost nest.

To present a formula in a compact form, variables are reduced to terms or symbols that represent the variable. For example, in a mathematical calculation, it is much easier to use "x" or "y" to represent a phrase than it is to write out the phrase in every occurrence. *Table 1* describes the terms used in all formulas in this manual.

For the sake of simplicity, all measurements, excluding length measurements, used in the calculations are in rads.

It is important to remember that when measuring the diameter of a circle in rads, the resulting value is equal to the radius in centimetres. This is why the formulas may appear erroneous to those who are used to seeing the area of a circle being expressed as πr^2 .

Table 5B.1 Chart of Terms Used in Scaling Formulas

Term	Definition
<i>L</i>	Length of log measured in metres.
<i>T</i>	Top or small end diameter of a log measured in rads.
<i>B</i>	Butt or large end diameter of the log measured in rads.
<i>DL</i>	Length of defect measured in metres.
<i>DT</i>	Top or small end diameter of a cylindrical defect measured in rads.
<i>DB</i>	Butt or large end diameter of a cylindrical defect measured in rads.
<i>H</i>	Height of a rectangular or triangular shape measured in rads.
<i>W</i>	Width of a rectangular or triangular shape measured in rads.
<i>DHT</i>	Top height of a rectangular or triangular defect measured in rads.
<i>DWT</i>	Top width of a rectangular or triangular defect measured in rads.
<i>DHB</i>	Butt height of a rectangular or triangular defect measured in rads.
<i>DWB</i>	Butt width of a rectangular or triangular defect measured in rads.
<i>IDT</i>	Inside diameter, top, or small end of a ring defect measured in rads.
<i>IDB</i>	Inside diameter, butt, or large end of a ring defect measured in rads.
<i>ODT</i>	Outside diameter, top, or small end of a ring defect measured in rads.
<i>ODB</i>	Outside diameter, butt, or large end of a ring defect measured in rads.
<i>NDT</i>	Net top or small end diameter of a log measured in rads.
<i>NDB</i>	Net butt or large end diameter of a log measured in rads.
<i>F</i>	Factor of 0.0001570796 (The constant used in shortened Smalian formula.)
<i>UV</i>	One metre unit volume. A ten metre volume may be divided by 10 to obtain the one (1) metre unit volume.
<i>V</i>	Volume in cubic metres or cubic decimetres.

5B.1.1 The Cone Formula (Volume of a Cone)

The formula that is used to find the volume of a conical defect is expressed as follows, where the volume of a cone is one third of the volume of a cylinder with the same basal diameter:

$$V = \frac{(DB^2 + DB^2) \times DL \times F}{3}$$

The complete formula for finding the net volume of a log with a conical defect is expressed as follows, where the volume of the cone of defect is subtracted from the volume of the cylinder of firm wood:

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

5B.1.2 The Cylinder Formula (Volume of a cylinder)

The formula that is used to find the volume of a cylindrical defect is expressed as follows, using Smalian's shortened formula:

$$V = (DT^2 + DB^2) \times DL \times F$$

The complete formula for finding the net volume of a log with a cylindrical defect is expressed as follows where the volume of the cylinder of defect is subtracted from the volume of the cylinder of firm wood:

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

A variant of the formula used for finding the net volume of a log with a ring defect and is expressed as follows, where the volume of the inner core of sound wood is subtracted from the volume determined from the outside diameters of the ring before subtracting its volume from the gross volume of the log:

$$V = \left[(T^2 + B^2) \times L \times F \right] - \left[\left[(ODT^2 + ODB^2) \times DL \times F \right] - \left[(IDT^2 + IDB^2) \times DL \times F \right] \right]$$

A variant of the formula used for finding the net volume of a log with a sapwood defect is structured the same as the one used above for a ring defect, except that the variables *ODT* and *ODB* are replaced with *T* and *B*, and the variables *IDT* and *IDB* are replaced with *NDT* and *NDB*.

5B.1.3 The Cubical Formula (Volume of a Rectangular Box)

The formula that is used to find the volume of a rectangular defect is expressed as follows:

$$V = \frac{[(DHT \times DWT) + (DHB \times DWB)] \times DL \times 0.0004}{2}$$

The complete formula for finding the net volume of a log with a rectangular defect is expressed as follows where the volume of the defect is subtracted from the volume of the log cylinder:

$$V = [(T^2 + B^2) \times L \times F] - \left[\frac{[(DHT \times DWT) + (DHB \times DWB)] \times DL \times 0.0004}{2} \right]$$

5B.1.4 The Prism Formula (Volume of a Triangular Shape)

The formula that is used to find the volume of a triangular defect is expressed as follows:

$$V = \left[\frac{(DHT \times \frac{DWT}{2}) + (DHB \times \frac{DWB}{2})}{2} \right] \times DL \times 0.0004$$

The complete formula for finding the net volume of a log with a triangular defect is expressed as follows where the volume of the defect is subtracted from the volume of the log cylinder:

$$V = [(T^2 + B^2) \times L \times F] - \left[\left[\frac{(DHT \times \frac{DWT}{2}) + (DHB \times \frac{DWB}{2})}{2} \right] \times DL \times 0.0004 \right]$$

5B.2 The Butt Rot Calculation in Chapter 5, Figure 5.34

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

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

Where the following values are substituted for the variables:

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

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

$$L = 12.2 \text{ m,}$$

$$F = 0.0001570796,$$

$$DB = 25 \text{ rads,}$$

$$DL = 3.6 \text{ m,}$$

$$V = \left[(30^2 + 38^2) \times 12.2 \times 0.0001570796 \right] - \left[\frac{(25^2 \times 25^2) \times 3.6 \times 0.0001570796}{3} \right],$$

$$V = \left[2344 \times 12.2 \times 0.0001570796 \right] - \left[\frac{1250 \times 3.6 \times 0.0001570796}{3} \right],$$

$$V = 4.492 - 0.236,$$

$$V = 4.256 \text{ m}^3.$$

5B.3 The Catface Calculation in Chapter 5, Figure 5.35

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

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

Where the following values are substituted for the variables:

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

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

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

$$F = 0.0001570796,$$

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

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

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

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

$$V = 1.07317 - \frac{0.295561}{3},$$

$$V = 1.07317 - 0.099,$$

$$V = 0.974 \text{ m}^3.$$

5B.4 The Catface Calculation in Chapter 5, Figure 5.36

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

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

Where the following values are substituted for the variables:

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

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

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

$$F = 0.0001570796,$$

$$DB = 9 \text{ rads,}$$

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

$$V = \left[(20^2 + 24^2) \times 7.0 \times 0.0001570796 \right] - \left[\frac{(9^2 + 9^2) \times 4.8 \times 0.0001570796}{3} \right],$$

$$V = [976 \times 7.0 \times 0.0001570796] - \left[\frac{162 \times 4.8 \times 0.0001570796}{3} \right],$$

$$V = 1.07317 - \frac{0.122}{3},$$

$$V = 1.07317 - 0.041,$$

$$V = 1.032 \text{ m}^3.$$

5B.5 The Heart Defect Calculation in Chapter 5, Figure 5.37

Using the formula for finding the net volume of a log with a cylindrical defect which projects through a log:

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

Where the following values are substituted for the variables:

$$T = 16 \text{ rads,}$$

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

$$L = 7.4 \text{ m,}$$

$$F = 0.0001570796,$$

$$DT = 8 \text{ rads,}$$

$$DB = 10 \text{ rads,}$$

$$DL = 7.4 \text{ m,}$$

$$V = \left[(16^2 + 20^2) \times 7.4 \times 0.0001570796 \right] - \left[(8^2 + 10^2) \times 7.4 \times 0.0001570796 \right],$$

$$V = \left[656 \times 7.4 \times 0.0001570796 \right] - \left[164 \times 7.4 \times 0.0001570796 \right],$$

$$V = 0.763 - 0.191,$$

$$V = 0.572 \text{ m}^3.$$

5B.6 The Heart Defect Calculation in Chapter 5, Figure 5.38

Using the formula for finding the net volume of a log with a cylindrical defect which does not project completely through the log:

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

Where the following values are substituted for the variables:

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

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

$$L = 8.8 \text{ m,}$$

$$F = 0.0001570796,$$

$$DT = 10 \text{ rads,}$$

$$DL = 4.4 \text{ m,}$$

$$V = [(20^2 + 24^2) \times 8.8 \times 0.0001570796] - [(10^2 + 10^2) \times 4.4 \times 0.0001570796],$$

$$V = [976 \times 8.8 \times 0.0001570796] - [200 \times 4.4 \times 0.0001570796],$$

$$V = 1.349 - 0.138,$$

$$V = 1.211 \text{ m}^3.$$

5B.7 The Ring Defect Calculation in Chapter 5, Figure 5.39

Using the formula used for finding the net volume of a log with a ring defect which projects through a log:

$$V = [(T^2 + B^2) \times L \times F] - [(ODT^2 + ODB^2) \times DL \times F] - [(IDT^2 + IDB^2) \times DL \times F]$$

Where the following values are substituted for the variables:

$$T = 27 \text{ rads,}$$

$$B = 35 \text{ rads,}$$

$$L = 12 \text{ m,}$$

$$F = 0.0001570796,$$

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

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

$$IDT = 16 \text{ rads,}$$

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

$$DL = 12 \text{ m,}$$

$$V = [(27^2 + 35^2) \times 12.0 \times F] - [(20^2 + 24^2) \times 12.0 \times F] - [(16^2 + 20^2) \times 12.0 \times F],$$

$$V = [1954 \times 12.0 \times 0.0001570796] - [976 \times 12.0 \times 0.0001570796] - [656 \times 12.0 \times 0.0001570796],$$

$$V = 3.683 - [1.840 - 1.237],$$

$$V = 3.683 - 0.603,$$

$$V = 3.080 \text{ m}^3.$$

5B.8 The Ring Defect Calculation in Chapter 5, Figure 5.40

Using the formula used for finding the net volume of a log with a ring defect which does not project through a log:

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

Where the following values are substituted for the variables:

$$T = 16 \text{ rads,}$$

$$B = 18 \text{ rads,}$$

$$L = 5 \text{ m,}$$

$$F = 0.0001570796,$$

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

$$IDB = 12 \text{ rads,}$$

$$DL = 2.5 \text{ m,}$$

$$V = [(16^2 + 18^2) \times 5.0 \times F] - [(14^2 + 14^2) \times 2.5 \times F] - [(12^2 + 12^2) \times 2.5 \times F],$$

$$V = [580 \times 5.0 \times 0.0001570796] - [392 \times 2.5 \times 0.0001570796] - [288 \times 2.5 \times 0.0001570796],$$

$$V = 0.456 - [0.154 - 0.113],$$

$$V = 0.456 - 0.041,$$

$$V = 0.415 \text{ m}^3.$$

5B.9 The Sap Rot Calculation in Chapter 5, Figure 5.41

Using the formula used for finding the net volume of a log with a sapwood defect which projects through a log:

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

Where the following values are substituted for the variables:

$$T = 13 \text{ rads,}$$

$$B = 16 \text{ rads,}$$

$$L = 5.8 \text{ m,}$$

$$F = 0.0001570796,$$

$$NDT = 10 \text{ rads,}$$

$$NDB = 12 \text{ rads,}$$

$$DL = 5.8 \text{ m,}$$

$$V = [(13^2 + 16^2) \times 5.8 \times F] - [(13^2 + 16^2) \times 5.8 \times F] - [(10^2 + 12^2) \times 5.8 \times F],$$

$$V = [425 \times 5.8 \times 0.0001570796] - [425 \times 5.8 \times 0.0001570796] - [244 \times 5.8 \times 0.0001570796],$$

$$V = 0.387 - [0.387 - 0.222],$$

$$0.387 - 0.165,$$

$$0.222 \text{ m}^3.$$

5B.10 The Cubical Rot Calculation in Chapter 5, Figure 5.42

Using the formula for finding the net volume of a log with a rectangular defect which projects the full length of a log:

$$V = \left[(T^2 + B^2) \times L \times F \right] - \left[\frac{[(DHT \times DWT) + (DHB \times DWB)] \times DL \times 0.0004}{2} \right]$$

Where the following values are substituted for the variables:

$$T = 18 \text{ rads,}$$

$$B = 23 \text{ rads,}$$

$$L = 9.8 \text{ m,}$$

$$F = 0.0001570796,$$

$$DHT = 3 \text{ rads,}$$

$$DWT = 6 \text{ rads,}$$

$$DHB = 4 \text{ rads,}$$

$$DWB = 8 \text{ rads,}$$

$$DL = 9.8 \text{ m,}$$

$$V = \left[(18^2 + 23^2) \times 9.8 \times 0.0001570796 \right] - \left[\frac{[(03 \times 06) + (04 \times 08)] \times DL \times 0.0004}{2} \right],$$

$$V = [853 \times 9.8 \times 0.0001570796] - \left[\frac{50 \times 9.8 \times 0.0004}{2} \right],$$

$$V = 1.313 - \left[\frac{0.196}{2} \right],$$

$$V = 1.313 - 0.098,$$

$$V = 1.215 \text{ m}^3.$$

5B.11 The Cubical Rot Calculation in Chapter 5, Figure 5.43

Using the formula for finding the net volume of a log with a rectangular defect which does not project the full length of a log:

$$V = [(T^2 + B^2) \times L \times F] - [(DHT \times DWT) \times DL \times 0.0004]$$

Where the following values are substituted for the variables:

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

$$B = 26 \text{ rads,}$$

$$L = 10.6 \text{ m,}$$

$$F = 0.0001570796,$$

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

$$DWT = 10 \text{ rads,}$$

$$DL = 4.2 \text{ m,}$$

$$V = [(24^2 + 26^2) \times 10.6 \times 0.0001570796] - [(06 \times 10) \times 4.2 \times 0.0004],$$

$$V = [1252 \times 10.6 \times 0.0001570796] - [60 \times 4.2 \times 0.0004],$$

$$V = 2.085 - 0.101,$$

$$V = 1.984 \text{ m}^3.$$

5B.12 The Missing Wood Calculation in Chapter 5, Figure 5.44

Using the formula for finding the net volume of a log with a cylindrical defect and applying a percentage factor:

$$V = \left[(T^2 + B^2) \times L \times F \right] - \left[\left[(DT^2 + DB^2) \times DL \times F \right] \times \frac{\%f}{100} \right]$$

Where the following values are substituted for the variables:

$$T = 18 \text{ rads,}$$

$$B = 25 \text{ rads,}$$

$$L = 12.6 \text{ m,}$$

$$F = 0.0001570796,$$

$$DT = 22 \text{ rads,}$$

$$DB = 25 \text{ rads,}$$

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

$$\%f = 50 \text{ percent,}$$

$$V = \left[(18^2 + 25^2) \times 12.6 \times 0.0001570796 \right] - \left[\left[(22^2 + 25^2) \times 4.8 \times 0.0001570796 \right] \times \frac{50}{100} \right],$$

$$V = [949 \times 12.6 \times 0.0001570796] - [1109 \times 4.8 \times 0.0001570796] \times 0.5],$$

$$V = 1.878 - 0.418,$$

$$V = 1.460 \text{ m}^3.$$

5B.13 The Pie-shaped Defect Calculation in Chapter 5, Figure 5.45**5B.13.1 Finding Net Volume by Application of a Percentage Factor**

Using Smalian's formula for finding the gross volume of a log with a pie-shaped defect and applying a percentage factor:

$$V = \left[(T^2 + B^2) \times L \times F \right] \times \left[\frac{(100 - \%f)}{100} \right]$$

Where the following values are substituted for the variables:

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

$$B = 26 \text{ rads},$$

$$L = 5.4 \text{ m},$$

$$F = 0.0001570796,$$

$$\%f = 15 \text{ percent},$$

$$V = \left[(24^2 + 26^2) \times 5.4 \times 0.0001570796 \right] \times \left[\frac{(100 - 15)}{100} \right],$$

$$V = \left[1252 \times 5.4 \times 0.0001570796 \right] \times \left[\frac{85}{100} \right],$$

$$V = 1.062 \times 0.85,$$

$$V = 0.903 \text{ m}^3.$$

5B.13.2 Finding Net Volume Using the Prism Formula

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

$$V = \left[(T^2 + B^2) \times L \times F \right] - \left[\left[\frac{\left(DHT \times \frac{DWT}{2} \right) + \left(DHB \times \frac{DWB}{2} \right)}{2} \right] \times DL \times 0.0004 \right]$$

Where the following values are substituted for the variables:

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

$$B = 26 \text{ rads,}$$

$$L = 5.4 \text{ m,}$$

$$F = 0.0001570796,$$

$$DHT = 12 \text{ rads,}$$

$$DWT = 11 \text{ rads,}$$

$$DHB = 13 \text{ rads,}$$

$$DWB = 12 \text{ rads,}$$

$$DL = 5.4 \text{ m,}$$

$$V = \left[(24^2 + 26^2) \times 5.4 \times 0.0001570796 \right] - \left[\left[\frac{\left(12 \times \frac{11}{2} \right) + \left(13 \times \frac{12}{2} \right)}{2} \right] \times 5.4 \times 0.0004 \right],$$

$$V = [1252 \times 5.4 \times 0.0001570796] - \left[\left[\frac{66 + 78}{2} \right] \times 5.4 \times 0.0001570796 \right],$$

$$V = 1.062 - [72 \times 5.4 \times 0.0004],$$

$$V = 1.062 - 0.156,$$

$$V = 0.906 \text{ m}^3.$$

Timber Grading

6

The legal definition of scaling extracted from the *Forest Act* is "to determine the volume or quantity of timber, and to classify the quality of that timber." Classifying the quality of timber is known as timber grading.

Timber grading does *not* hold any direct relationship to lumber grading. Lumber grading is carried out on the end products manufactured from the timber. Scalers are viewing the raw stock "in the round." While they may try to visualize potential boards and are interested in knots and spiral grain, the methods and assumptions are distinctly separate.

Timber is graded to make the volumetric information of the scale more meaningful and useful to the purchasers and sellers of the timber and to the managers of the forest resource. The quality and potential end use of logs can significantly influence their worth and a scale without grade does not provide enough information to accurately reflect timber values. In addition to the monetary value of the logs, their grade can determine whether or not the logs are accounted for cut control purposes under the Provincial Utilization Policy.

6.1 History of Timber Grading in B.C.

As outlined in Chapter 1, British Columbian timber has been measured in one way or another since the mid-1800s. Over this period five official scales or log rules have been used to regulate the harvest and collect revenue:

- Prior to 1894 Foley and Doyle Log Rules,
- 1894 British Columbia Board Foot Scale (FBM),
- 1944 British Columbia Cubic Scale (lumber cubic),
- 1965 British Columbia Firmwood Cubic Scale, and
- 1979 British Columbia Metric Scale.

Over this same period dual, scales have often been used whereby timber is officially scaled and then rescaled using another log rule. The presence of these dual scales clearly demonstrates both the need for data to serve different and specialized purposes and the inability of any one log rule and/or grade schedule to cover all these various challenges. It is anticipated that the methods and standards employed in timber measurement will continue to evolve along with the changing needs and approaches to resource management.

Timber grading was introduced into British Columbia in 1902 with the *Timber Measurement Act*, which contained the province's first statutory schedule of log grades. These grades applied only to timber harvested in the coastal region.

With its valuable old growth forests, marine transport and historic settlement patterns, logging and lumbering first flourished along the B.C. coast. In the interior, significant growth in the forest sector did not occur until the mid-1960s. Interest in timber grading did not evolve until the mid-1980s.

Coastal grading finds its roots in the FBM conventions that served prior to the adoption of cubic based log scales. While the schedule of coastal grades has evolved and expanded in response to changing needs, many of the principles of grading have changed very little.

The 1970s found users of coastal grades questioning the relevance of the statutory grades then in place as they had become insensitive to changes in the harvest profile, log handling practices, and product manufacturing capabilities. By 1981, a new statutory grade schedule, designed by a joint industry/ministry committee, was implemented. These grades are referred to as the letter grades and are recorded as alphabetical characters whereas their predecessors had been numerical. To date there have been only minor changes to the 1981 schedule.

A formalized interior grading system was adopted in 1988. Prior to 1988, only the firmwood reject logs were differentiated throughout the interior although the pricing policy did provide the possibility of a reduced stumpage rate for "category 04 logs." These category 04 logs were primarily derived from decadent and damaged stands and identified using regional guidelines. As interest in category 04 logs increased, due largely to catastrophic bark beetle losses and changing management strategies, the significance of the regional differences increased. These inequities were removed with the 1988 implementation of an interior grade schedule.

Today, two grade schedules, one for the interior and one for the coast, are appended to the *Scaling Regulation*. Differences between the coast and the interior in terms of timber profile, method of stumpage appraisal, utilization policy, and manufacturing method, coupled with the needs of the wood consuming industry, have lead to often subtle differences in how these two grade schedules are interpreted. Some of these differences are investigated in Sections 6.5 and 6.6.

6.2 Timber Grading Requirement

In British Columbia, all timber that is harvested from private or Crown lands or that is salvaged from the foreshore and that will be manufactured into products, sold, or transported must be scaled. As previously mentioned, grading is a legally required and integral component of the scale.

The *Scaling Regulation* requires that timber cut in areas of the province where a log based stumpage appraisal is used (predominantly the coast), be classified with reference to the Schedule Of Coast Timber Grades, appended to the *Scaling Regulation*. Timber originating in areas of the province where a lumber-based appraisal is used (predominantly the interior) is to be classified with reference to the Schedule of Interior Timber Grades, also appended to the *Scaling Regulation*.

This chapter details and further explains the acceptable timber grading procedures used in British Columbia. It is the officially approved procedural supplement to the *Scaling Regulation* for use in determining and interpreting the prescribed timber grades.

In some instances, a district manager may permit harvested or salvaged timber to be scaled as a special forest product. In the scaling of special forest products the normal grading conventions and rules do not apply. The exceptions to this rule are **poles**, **pilings**, and **building logs**. These three specific special forest products are scaled and graded exactly the same as other logs. The classification of quality for the other special forest products is implied from their respective descriptions and end uses. (For a detailed discussion of special forest products, please see Chapter 8).

6.3 Principles of Timber Grading

As stated, grading is the assessment of the quality of a log. By its very nature, grading brings forth aspects of relativity and subjectivity and taxes the scaler's judgement. Generally speaking there is a relationship between log quality and log value. That is to say, a very large diameter, clear, close grained, straight, slow and evenly tapering log (i.e., a high quality lumber or veneer log), will generally command a premium price.

However, if a manufacturing plant is specifically designed to produce finger-jointed mouldings from undersized stock, then such a log would be both an economic and a technological challenge. A basic principle of timber grading is to assess the log quality in terms of the end products for which it is best suited.

6.3.1 Common End Products

The most common manufactured end products are lumber, chips, veneer, and shingles. The most prevalent of these in today's industry is still lumber. The minimum acceptable lumber product is a nominal 2 by 4 stud with an assumed National Lumber Grade Authority (NLGA) lumber grade of better than utility.

On the coast, logs are assessed with respect to their assumed potential for all four of the common end products. In the interior, the timber appraisal system is geared to lumber manufacture and, therefore, logs are evaluated only with respect to their assumed lumber potential.

6.3.2 Product "Recoveries"

Some log scales employed in other jurisdictions and occasionally used in B.C. for unofficial purposes attempt to estimate lumber recovery or outrun. They typically consider a log on the basis of the lumber producing cylinder as dictated by its top diameter. They often make liberal allowances for slabbing, edging and saw kerf. The more common ones relate to a one inch board. Relatively little one inch nominal stock is sawn in B.C.

The official British Columbia Metric Scale does not follow these conventions. In fact, as stated in the preceding Section 6.1, this type of log assessment was disenfranchised in British Columbia in 1972.

The principle method of grade assessment employed throughout the majority of B.C. provides for the gross log contents (as determined by Smalian's formula) to be volumetrically reduced for allowable grade defects (the total firmwood content is, however, still reported). Another field method that is commonly used in the coastal piece scale system reduces the gross dimensions (primarily the length) in response to the presence of these same grade defects. This "lineal method" is acceptable on short, larger diameter logs with slight to moderate tapers. (For a description of the lineal method please see Appendix 6A.)

The defects for which these grade deductions may be made include the firmwood defects, fractures (including splits, shakes, checks, shatter), bark seams, sweep, crook, non-recoverable segments, thin collars and saw trim.

In addition to assessing the percentage of the log that can be manufactured, the B.C. Metric Log Scale also assesses the quality of the potential product outturn. This assessment is based upon knots, grain characteristics, and for some premium grades, the presence of stain.

In the traditional sawmill, actual lumber recoveries are highly variable and are largely dependant upon top diameter, amount and type of defect, taper and log form (i.e., a neiloid, paraboloid, conoid), mill efficiency/technology, and the sawyer's skill. State of the art sawmills employ laser guided, computer controlled sawing technology. They employ thin kerfs and are capable of sawing along each log's taper, thereby optimizing outturn.

6.3.3 Defects that Reduce Recovery

The defects discussed in this section reduce the proportion of the gross log suitable for the production of lumber, veneer, or shingles. The firmwood defects described in Section 6.3.3.4 (rot, hole, and char) will additionally 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 deduction and is explained fully under Section 6.4.1.

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

6.3.3.1 Fractures and Fibre Separation

Wood fibres may separate or split across the annual rings (i.e., checks) or between the annual rings (i.e., shakes). Once this separation has occurred, any lumber manufactured across the separation will likely fall apart. The volumes of firmwood that cannot be cut into lumber, veneer, or shingles because of these fractures must be determined.

Checks may appear on the outside surface or in the heartwood of the log. Where checks occur in conjunction with twist, the impact on lumber recovery is considerably increased. Other factors being the same, outside or surface checks have a proportionately greater effect on small log recoveries than on large log recoveries.

Unnecessary delays in presenting logs for scaling, such as leaving logs in the woods or in cold decks, often results in a type of surface check known as weather checks (also known as wind or sun checks). These checks are usually about twice the depth at the ends of the log than elsewhere and are not allowed for in scale deductions.

Logging is not a gentle pursuit and additional damage often ensues by way of breakage during felling, skidding, yarding, loading, and unloading.

6.3.3.2 Bark Seams

Bark seams are formed as a result of there being no wood growth at one point on the circumference of a tree so that over time a seam of bark is left extending inward from the edge of the tree. Lumber and veneer cannot be recovered from the area of the seam. The volume of firmwood that cannot be manufactured because of bark seams must be determined by blocking out the end area of the wood lost for product recovery and multiplying the cross sectional area by the length of the seam.

6.3.3.3 Sweep, Crook and Pistol Grip

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

6.3.3.4 Rot, Hole, and Char

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

The rot fungus typically enters the tree through a root, a broken branch, a damaged leader or a scar on the stem. The remains of an old scar, a damaged leader, a crook or fork in a log often means rot is present. Scalers are advised to carefully inspect all visible log surfaces for firmwood defect indicators. Logs cut from older trees are more likely to contain rot, especially logs cut from tree species such as cedar, hemlock and balsam which are more susceptible to attack by fungi.

If in doubt, cut into the log with an axe or saw. No deductions are made for stain which is rot in the incipient stages, 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 a deduction is made (see Chapters 4 and 5).

In the grading of timber, a scaler must estimate to what extent 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. A trim allowance is usually added around the defect to account for this additional loss.

6.3.3.5 Trim Allowance

Trim allowance is included in the grade deduction and refers to the sound wood surrounding rot and other defects lost to lumber recovery because the sawyer must square out around defects (normally 2 cm (1 rad) on each side of the defect).

6.3.3.6 Thin Collars or Shells

Collars or shells refer to the defect-free "tube" of wood surrounding heart defects in logs. Collars must be thick enough to enable economical product recovery. They must also be thick enough to hold the log together during the manufacturing process.

For the purposes of the grading specifications, collar thickness is not considered unless the defect is greater than 20% of the diameter of the log end in which it appears. Product can not be recovered from shells that are thinner than 5 rads or 10 cm (1 rad = 2 cm).

6.3.3.7 Logs and Log Segments too Short to Manufacture

A log or log segment must be at least 2.5 m long to produce 8 foot lumber. Logs, slabs and chunks shorter than 2.5 m included in conventional loads delivered to the scale site are considered 100% grade deduction. Veneer peeler bolts or blocks must be at least 2.6 m long.

Where logs are bucked into lengths less than 2.5 m in the interior, or 5.2 m on the coast, in order to facilitate the removal or transportation of the timber, or for the purpose of scaling, or for the purpose of manufacturing a forest product; their respective lengths (for purposes of grade classification) are deemed to be 2.5 m in the interior and 5.2 m on the coast. **However, only the actual net length of the log, slab or chunk is recorded.**

Log segments (or portions) refer to the residual lineal log sections after the defective sections of a log are visually segregated out. This practice is termed "pencil bucking." Where these segments are less than 2.5 m in length, they must be included as grade deduction in the overall assessment of the log. It is important to note that each physical log only receives one grade. The only exception to this rule is where a log contains a segment that is less than 5 rads (10 cm) in diameter or a slab contains a segment that is less than 5 rads (10 cm) in thickness. In these two cases the undersized portion qualifies as a firmwood reject and is to be recorded as such. The remainder of the log is recorded with the grade code applicable to its quality. The sum of the volumes of the two recorded "pieces" will equal the volume of the log or slab.

6.3.4 Quality Considerations

In addition to the defects that reduce the potential product recovery volume, certain log features may reduce the quality of the potentially recoverable product. That is, these features may render the lumber or a significant proportion of the lumber unmerchantable.

6.3.4.1 Twist (Spiral Grain)

As trees grow they often spiral about their central axes. 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.

Twist is to be measured over a representative 30 cm (15 rads) 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 is to be selected. Areas around large knots, clusters of knots or other irregularities such as crooks, forks, and burls should be avoided.

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

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

For example, a 5 m log with a 24 radius class top showing 3 rads of grain deflection is considered to have 12.5% twist.

The maximum twist allowances permitted for specific, respective log grades are detailed in Sections 6.5 and 6.6.

6.3.4.2 Knots

The size, type, and distribution of knots may have a significant impact on lumber quality. As such, knots are a key consideration in classifying timber.

6.3.4.2.1 Size of Knots

Knots larger than 2 cm will lower the strength of lumber and hence the grade and value of the lumber cut. The larger the knot size, the greater the loss of strength. Extremely large knots will make the cutting of merchantable lumber impossible. Knot size is measured in centimetres or rads of diameter.

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

6.3.4.2.2 Type of Knots

Knots are referred to as loose, tight, rotten, or sound. Broken branches are an entry point for fungus spores and the knot and the wood behind the knot may be rotten. A loose knot is found in lumber cut from the outer part of a large log that has had the remains of a dead branch in the wood. Branches when still living are connected to the main stem and knots in lumber cut from that section of the log in which the branch was alive are usually tight. Sound, tight knots are intended when referred to in the requirements (i.e., Sections 6.5 and 6.6), unless otherwise stated.

6.3.4.2.3 Knot Distribution

After the first few years coniferous trees grow 0.2 to 1 m per year depending on the species and suitability of the growing site. When a mature height of 24 to 45 m is reached apical or upward growth decreases significantly. Balsam, fir, pine, and spruce grow a whorl of branches at the start of each year and normal branch distribution in small diameter stems consists of whorls spaced 0.3 to 0.5 m apart. Red cedar, yellow cedar, and hemlock branches are not produced in regular whorls. Instead, their branches are spaced on the stems of young trees 0.3 to 0.5 m apart.

When a tree reaches mature height, additional branch whorls are still added each year but the branches are much closer together. Sometimes a tree will 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) will reduce the strength of the lumber cut from the portion of the log containing the cluster or bunch.

In general, a cluster or bunch knot situation exists 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.

6.3.4.3 Grain Density (Ring Count)

The growth rate of a tree is dependant upon species, genotype, climate, and other site specific conditions. The faster a tree grows (i.e., the greater the rate of increment) the greater the distance between the seasonal or so called "annual" growth rings.

Finer-grained logs will yield higher quality lumber and veneer and are generally more valuable. Most high quality lumber logs or veneer blocks or bolts should have a minimum of six "annual" rings for each 1 rad (2 cm) of diameter. A premium lumber log should have at least 12 rings per rad.

Minimum ring counts for specific coast grades are found in Section 6.5.

6.4 Determining the Grade of Timber

6.4.1 Grade Deduction

As mentioned in Section 6.3, timber often contains defects that will reduce the amount of lumber, veneer, shingles, or pulp that can be recovered from a manufactured log or slab. These defects include the firmwood defects (rot, hole, char, and missing wood) described in Chapter 5 as well as other defects that do not reduce the firmwood content of the log. Included among the non-firmwood defects are: shake, checks, frost cracks, shatter, splits, forks, catface, deadside, lightning scar, bark seams, goitre, pistol grip, sweep, and crook.

Additional defect-free log volume is often lost for lumber and veneer recovery purposes because of manufacturing considerations such as trim allowance around defects, sound collars that are too thin to cut lumber, segments of slabs that are too thin to cut lumber, sound hearts that are less than 5 rads (10 cm) diameter, and remaining defect-free segments of logs or slabs that are too short to cut lumber.

Scalers must calculate the volume unavailable for lumber or other products as a result of the above. The volume represented by the firmwood defects, the grade defects and the other manufacturing considerations named is collectively known as **grade deduction**.

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

When determining eligibility for inclusion in a given statutory grade category, scalers must, therefore, subtract the total grade deduction volume from the gross log volume and express the result as a percentage of the gross volume.

Thus:

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

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

Measuring the grade deduction volume and calculating the percentage suitable for product recovery, while not too difficult, does take a little bit of time. As a scaler gains experience through completing numerous grade deduction calculations, he or she will become proficient at estimating product recovery losses. Such practiced and experienced scalers may find it only necessary to perform periodic full calculations to confirm their estimates and to determine the grades of borderline logs. While this log sense is never really lost, it can be weakened by periods of inactivity and even highly experienced scalers will mathematically reconfirm their skills after periods of layoff.

Experienced scalers also learn to look for the obvious grade considerations before getting bogged down in needless arithmetic. For instance, on logs that are obviously excessively spiralled or have very large knots, scalers may save some effort by determining the quality considerations before completing a full blown calculation of the grade deduction. Obviously, if none of the lumber produced will be merchantable because of knots or twist, the grade potential of the log is considerably narrowed.

Similarly, a defect that may be very significant on one class of logs may be less so on another. For instance, other factors being the same, outside or surface checks have a proportionately greater affect on small log recoveries than on large log recoveries. Thus a scaler may carefully calculate the impact of extensive 2 rad surface checking on a 10 rad log but not be very concerned where this is the only defect on a 90 rad log.

These types of judgements become second nature to experienced scalers. Initially, scalers are strongly advised to calculate all grade deductions. It is only through such a background of disciplined practice that the aforementioned "log sense" will evolve.

6.4.2 Calculation of Grade Deduction

The two grade schedules appended to the *Scaling Regulation* specify, among other things, that certain percentages of the gross log volume must be suitable for manufacture. As stated in Section 6.3 (Principles of Grading), the gross Smalian log volume is to be reduced for the allowable defects. The net log volume that is suitable for manufacture is then calculated as a percentage of the gross log volume. For certain grade categories the schedules also require that set percentages of the manufactured product must be merchantable and/or clear (free of knots and stain). The schedules also reference other quality considerations such as minimum top diameter, minimum gross length, and tightness of grain.

The correct methods for calculating grade deduction are the same as those used for determining firmwood deduction. Scalers should carefully study Chapter 5 and practice these methods on logs until they are thoroughly understood.

It will be noted that the grade deduction loss will almost always be larger than the firmwood deduction loss. There are three main reasons for this:

- first, there are a number of defects such as fractures, bark seems, goitre, sweep, and crook that reduce product recovery but do not cause firmwood loss,
- second, additional defect free volume around the allowable defects (i.e., the trim) is lost in the manufacturing process, and
- third, while the firmwood loss is related only to the size of the defect, the grade deduction loss is also dependant 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.

6.4.2.1 Trim Allowance

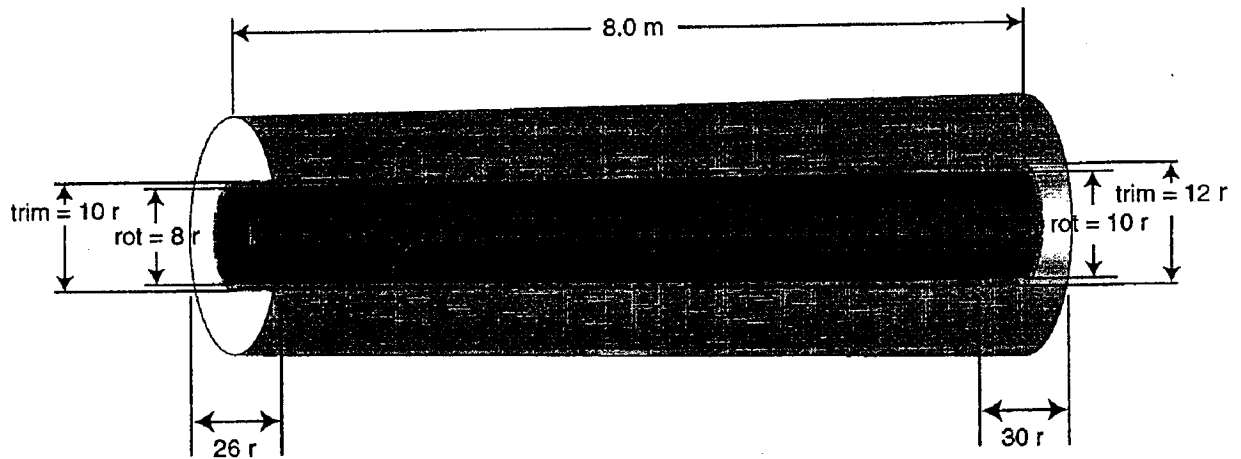
A trim allowance must be added to most defects to compensate for product loss in squaring out the defect. For most defects the standard trim allowance is 2 cm (1 radius class) on all sides of the defect. The standard trim allowance does not allow enough loss around conical butt defects such as butt rot and water shake. In these cases a 1.5 rad trim is usually applied. Also if the defect is irregularly shaped an additional allowance may be made to permit squaring out the defect.

Once the trim has been added, the total defect plus trim dimensions should be inserted into the appropriate formulae from Chapter 5 and the individual grade losses for the measured defects calculated. The individual losses are then summed to derive the total grade deduction.

It is not necessary to add trim allowance inside sap rot or charred wood since these have the same effect on recovery as does the bark.

Where a sound collar does not meet the minimum thickness required to produce lumber, do not add trim allowance when calculating the residual heart recovery. In these cases the collar or portion of collar below the minimum thickness is included as grade deduction and it is assumed that the entire residual core is available for manufacture (that is, where the residual core is larger than 5 rads or 10 cm).

The examples in Figures 6.1 through 6.8 demonstrate the principles of trim allowance in calculating grade deductions.



Here, the diameter of the rot is 8 rads at the top and 10 at the butt. The grade deduction, however, will be for a 10 rad top defect and a 12 rad butt defect after the 1 radius unit trim allowance has been added.

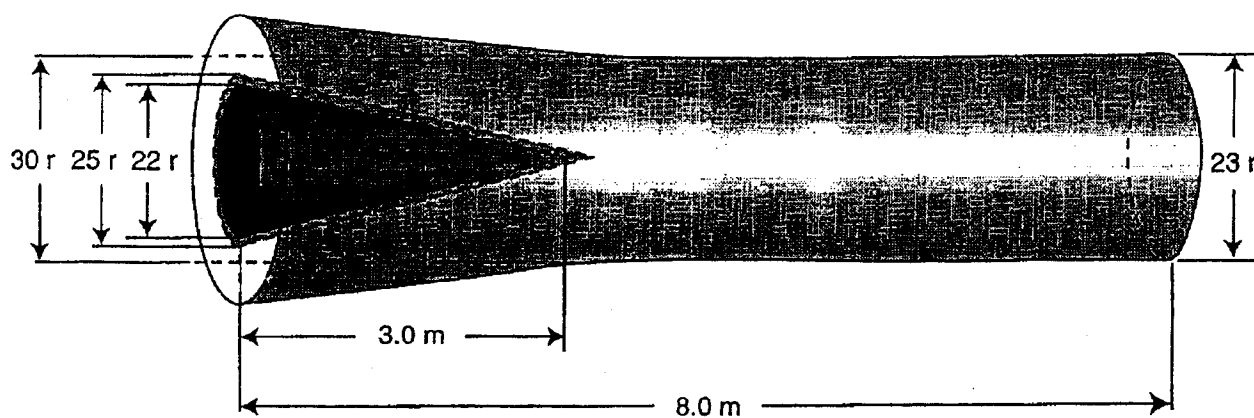
Gross Volume = 26 rads by 30 rads by 8 m = $(849 + 1131) = 1980 \text{ dm}^3$.

Grade Deduction = 10 rads by 12 rads by 8 m = $(126 + 181) = 307 \text{ dm}^3$.

Percent of gross volume suitable for manufacture = $\frac{1980 - 307}{1980} \times 100\% = 84.5\%$

Please note, if the collar had not met the minimum thickness required for manufacture, then it also would have been grade deduction.

Figure 6.1 Trim around heart rot and hole.



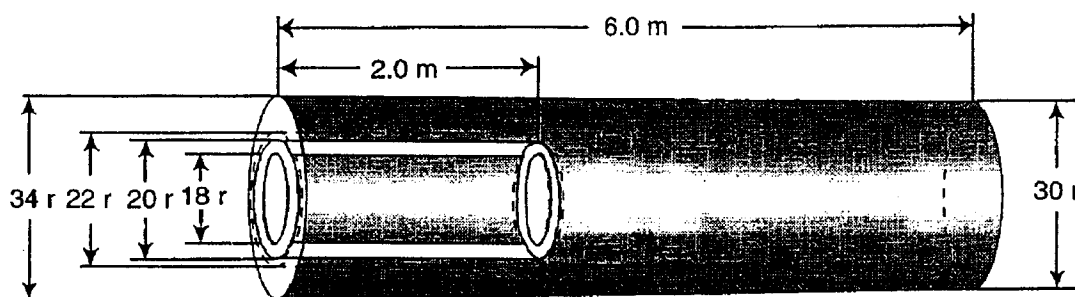
Add 1.5 rads on each side (total of 3 rads) and treat as a conical defect.

Gross Volume = 23 rads by 30 rads by 8 m = $(665+1131) = 1796 \text{ dm}^3$.

Grade Deduction = 25 rad cone by 3 m = $\frac{589}{3} = 196 \text{ dm}^3$.

% suitable for manufacture = $\frac{1796-196}{1796} \times 400\% = 89.1\%$.

Figure 6.2 Trim around conical butt rot and water shake.



Add 1 rad trim allowance on either side of the shake and deduct the 2 rad ring.

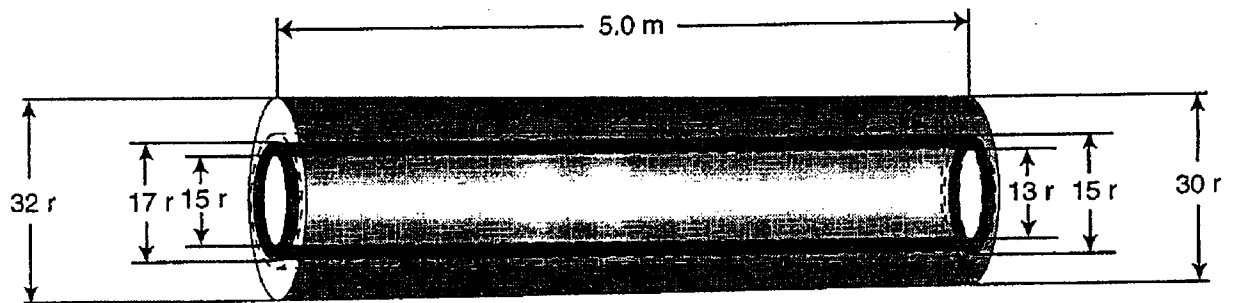
Gross Volume = 30 rads by 34 rads by 6 m = $(848+1090) = \underline{1938} \text{ dm}^3$.

Grade Deduction = uv 22 - u v 18 for 2 m = $(152 - 102) \times 2 = \underline{100} \text{ dm}^3$.

% suitable for manufacture = $\frac{1938 \times 100}{1938} \times 100\% = 94.8\%$

This method applies where the collar outside the defect meets the minimum thickness to cut lumber (5 rads). See Section 6.4.2.3 for the grade deduction method where the collar is too narrow to produce lumber.

Figure 6.3 Trim allowances around ring shake.



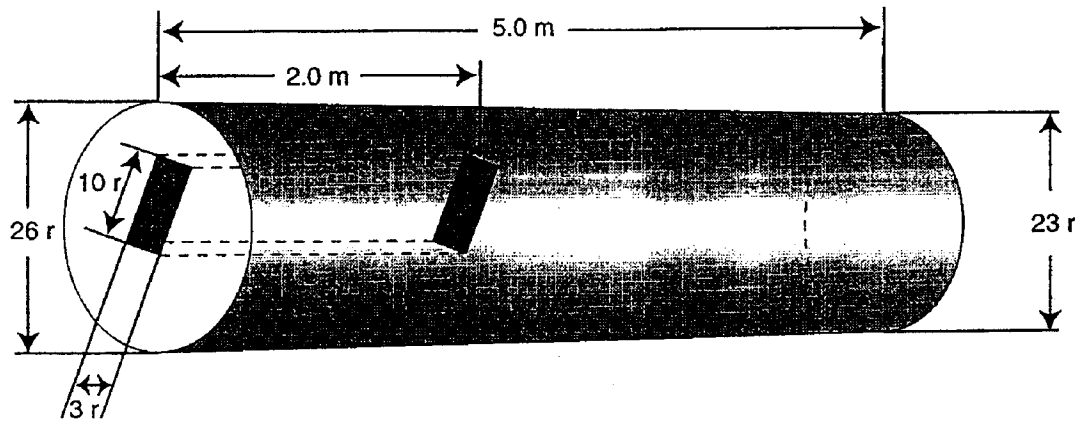
Use the same principle as for ring shake. Here the ring rot is 2 rads thick so a 4 rad ring must be taken as grade deduction after trim allowance has been added both inside and outside the rot.

Gross Volume = 30 rads by 32 rads by 5 m = 1511 dm³.

Grade Deduction = 511 - 228 = 283 dm³.

% available for manufacture = $\frac{1511-286}{1511} = 81.3\%$

Figure 6.4 Trim allowance around ring rot with recoverable heart.



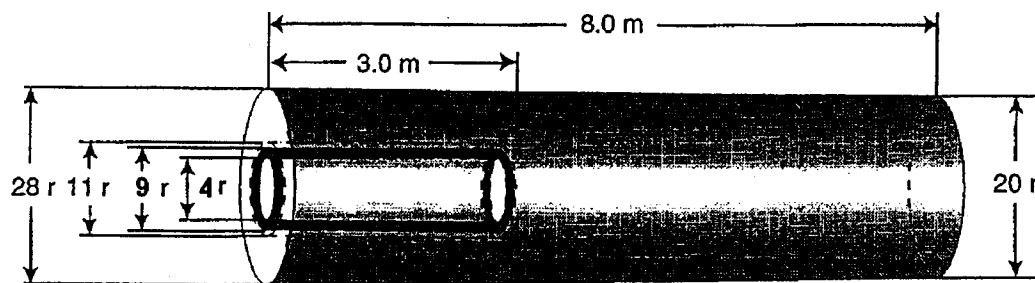
Add trim and calculate the volume of the grade deduction. In this case 3 cm or 1.5 rads is required on either side due to the irregular shape of the check. Therefore, the grade deduction is for a block 3 rads (6 cm) by 10 rads (20 cm) by 2 m long.

Gross Volume = 23 rads by 26 rads by 5 m = (413 - 531) = 944 dm³.

$$\text{Grade Deduction} = \frac{6}{10} \text{ dm} \times \frac{10}{10} \text{ dm} \times 20 \text{ dm} = \underline{12} \text{ dm}^3.$$

$$\% \text{ suitable for manufacture} = \frac{944 - 12}{944} \times 100\% = 98.7\%$$

Figure 6.5 *Trim allowance around heart checks.*



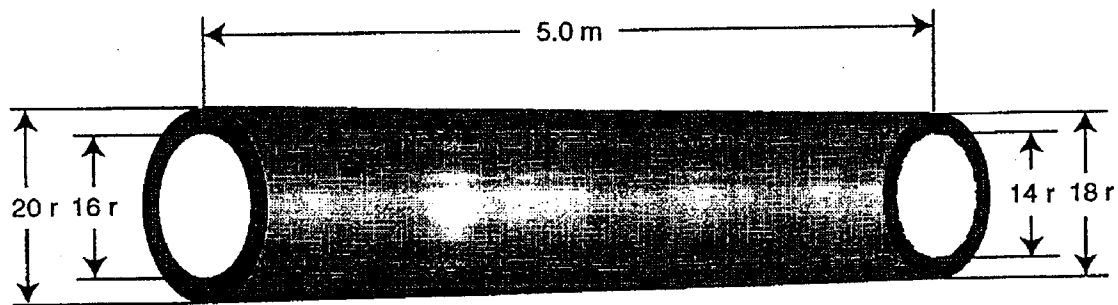
In this case the sound heart is 4 rads which less than the 5 rads or 10 cm required to cut lumber. It must be included in the grade deduction. Thus, the grade deduction becomes the entire 11 rad circle or 38 dm³ for each metre the rot extends into the log.

Gross Volume = 20 rads by 28 rads by 8 m = (503 + 985) = 1488 dm³.

Grade Deduction = 11 rads x 3 m = 114 dm³.

$$\% \text{ suitable for manufacture} = \frac{1488 - 114}{1488} \times 100\% = 92.3\%$$

Figure 6.6 Trim allowance around ring rot with undersized heart.



Trim allowance is not added. The sap rot is effectively like the bark and the measurement inside the defect is the portion of the log that is suitable for manufacture.

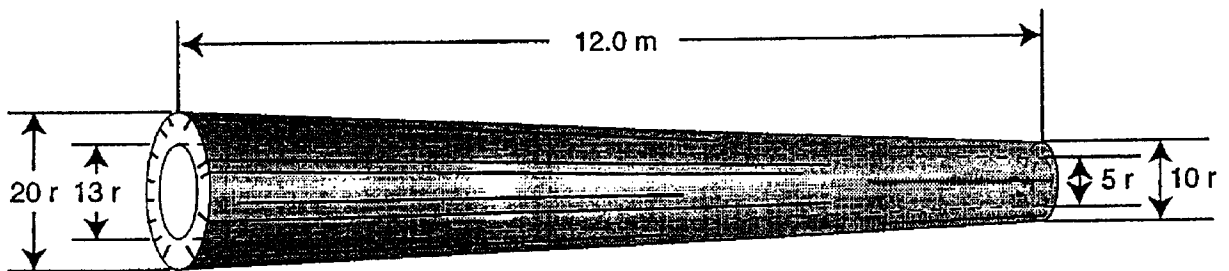
Gross Volume = 18 rads by 20 rads by 5 m = $(254 - 314) = 563 \text{ dm}^3$.

Volume suitable for manufacture = 14 rads by 16 rads by 5 m = 355 dm^3 .

Grade Deduction = $(568 - 355) = 213 \text{ dm}^3$.

% suitable for manufacture = $\frac{568 - 213}{568} = 62.5\%$.

Figure 6.7 Trim allowance around sap rot.



Here it is estimated that the recoverable core of the log is equal to a 13 rad by 5 rad log 12 m long.

Gross Volume = 10 rads by 20 rads by 12 m = $(188 + 754) = \underline{942} \text{ dm}^3$.

Defect Volume = Gross volume - recoverable core.

Recoverable core = (5 rads by 13 rads by 12 m).

Defect Volume = $(942 - 366) \text{ dm}^3 = \underline{576} \text{ dm}^3$.

% available for manufacture = $366 \times 100\% = 38.9\%$.

Figure 6.8 Trim allowance around extensive outside (surface) checking.

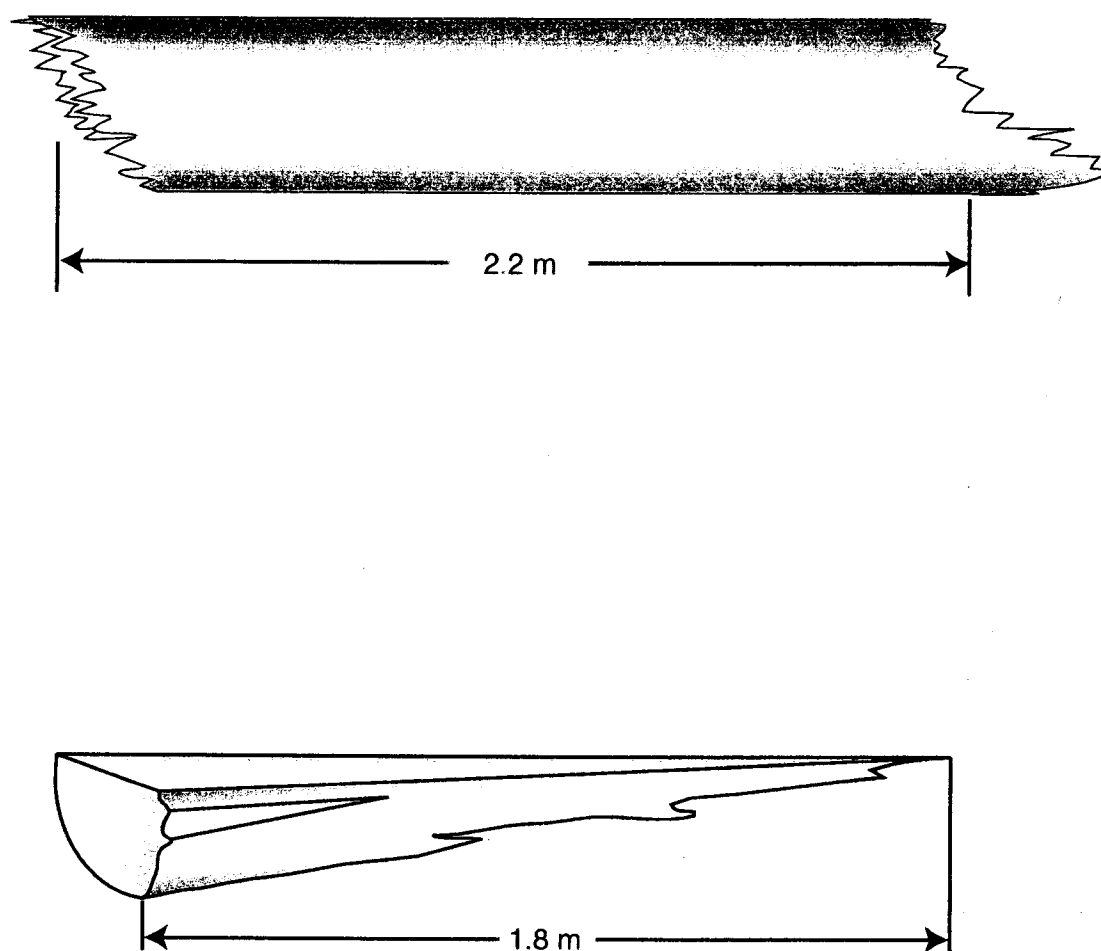
6.4.2.2 Logs and Log Segments

Logs and slabs must be at least 2.5 m long to produce lumber. Logs, slabs, and chunks shorter than 2.5 m that are included in conventional loads delivered to the scale site are considered 100% grade deduction and are classified appropriately. In the interior these will likely grade out as lumber reject and on the coast they are likely to be grade Y.

Where logs are bucked into lengths less than 2.5 m in the interior (or to lengths less than 5.2 m on the coast), to facilitate removal or transportation of the timber, or for the purpose of scaling, or for the purpose of manufacturing a forest product (i.e., when the Forest Service has not permitted the timber to be scaled as special forest products), their lengths for purposes of grade classification are 2.5 m, in the interior and 5.2 m, on the coast. For reporting purposes, the actual net length of the log is recorded on the tally sheet.

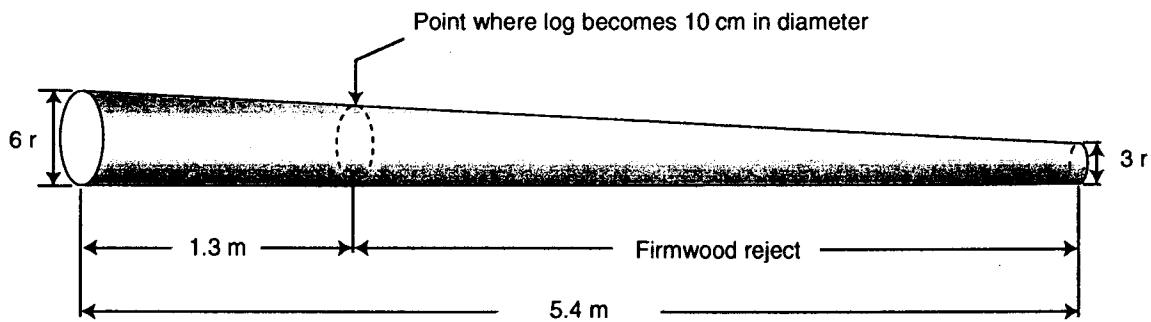
Log segments (or portions) refer to the residual log sections after defective sections of a log are visually segregated or pencil bucked. Where these segments are less than 2.5 m in length, they must be included as grade deduction in the overall assessment of the log.

Examples of short logs and log segments are shown in Figures 6.9 through 6.16.



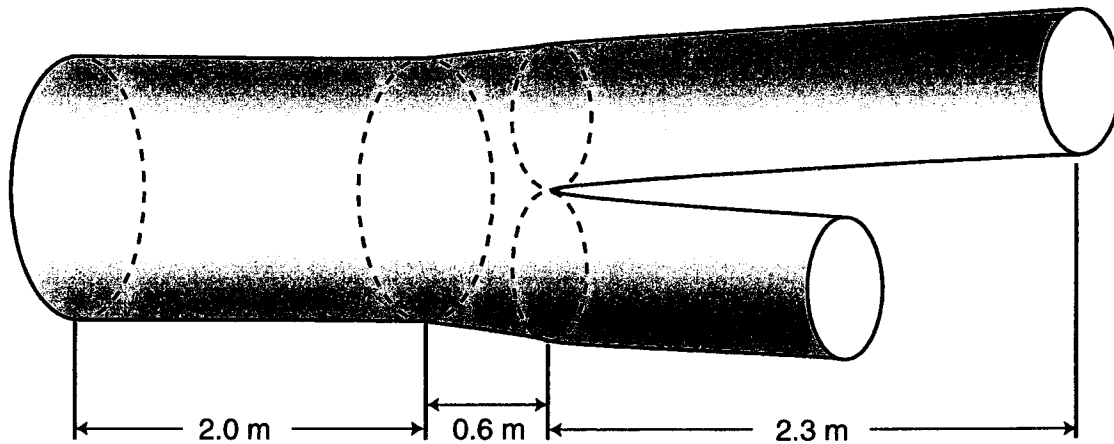
These examples represent breakage and are both graded on the basis that the log length available to cut lumber is less than 2.5 m.

Figure 6.9 Short breakage pieces contained in conventional load.



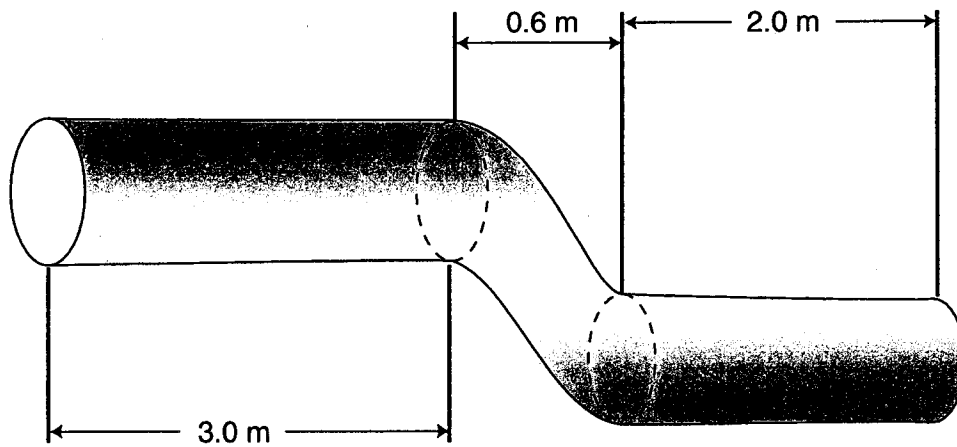
This undersized top or "rat tail" contains a 1.3 m segment that is over the firmwood reject diameter limit; however, it is too short for manufacture. Since the log was delivered this way, the 1.3 m portion is grade deduction. Had it been bucked at the site, it would be deemed to be 2.5 m long in the interior or 5.2 m long on the coast for grading purposes only.

Figure 6.10 Rat tail top delivered with a short segment over the 10 cm Z radius limit.



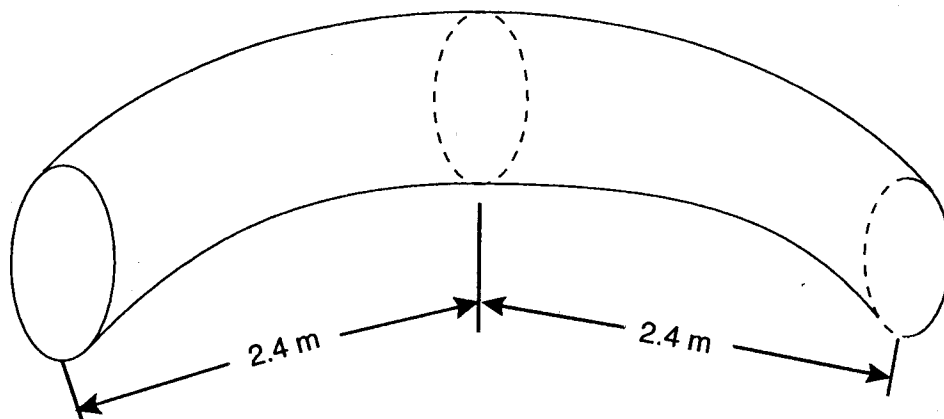
For this defect the grade deduction would normally be the volume attributable to the 0.6 m required to eliminate the fork. However, since the residual segments are each less than 2.5 m, they are also unsuitable for manufacture. Due to poor bucking practices, no portion of this log is recoverable. If it is delivered this way, it is 100% grade deduction. If bucked at the scale site, only the 0.6 m portion is grade deduction.

Figure 6.11 Short, forked log.



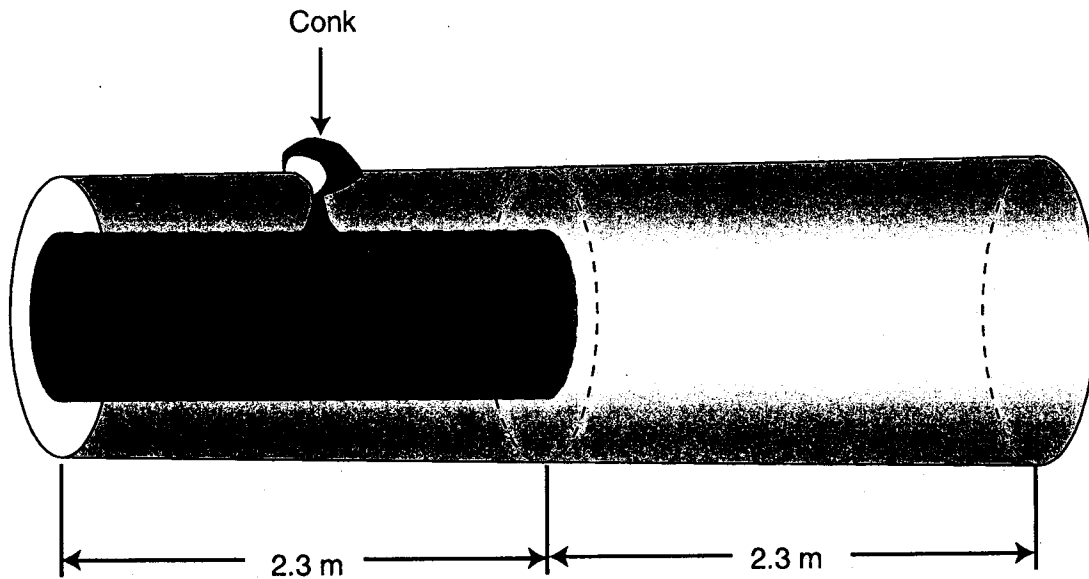
The 0.6 m crooked portion is obviously grade deduction. The 2 m segment above the crook is too short to cut lumber and it is also grade deduction if the log is bucked this way after delivery to the scale site.

Figure 6.12 Log with crook.



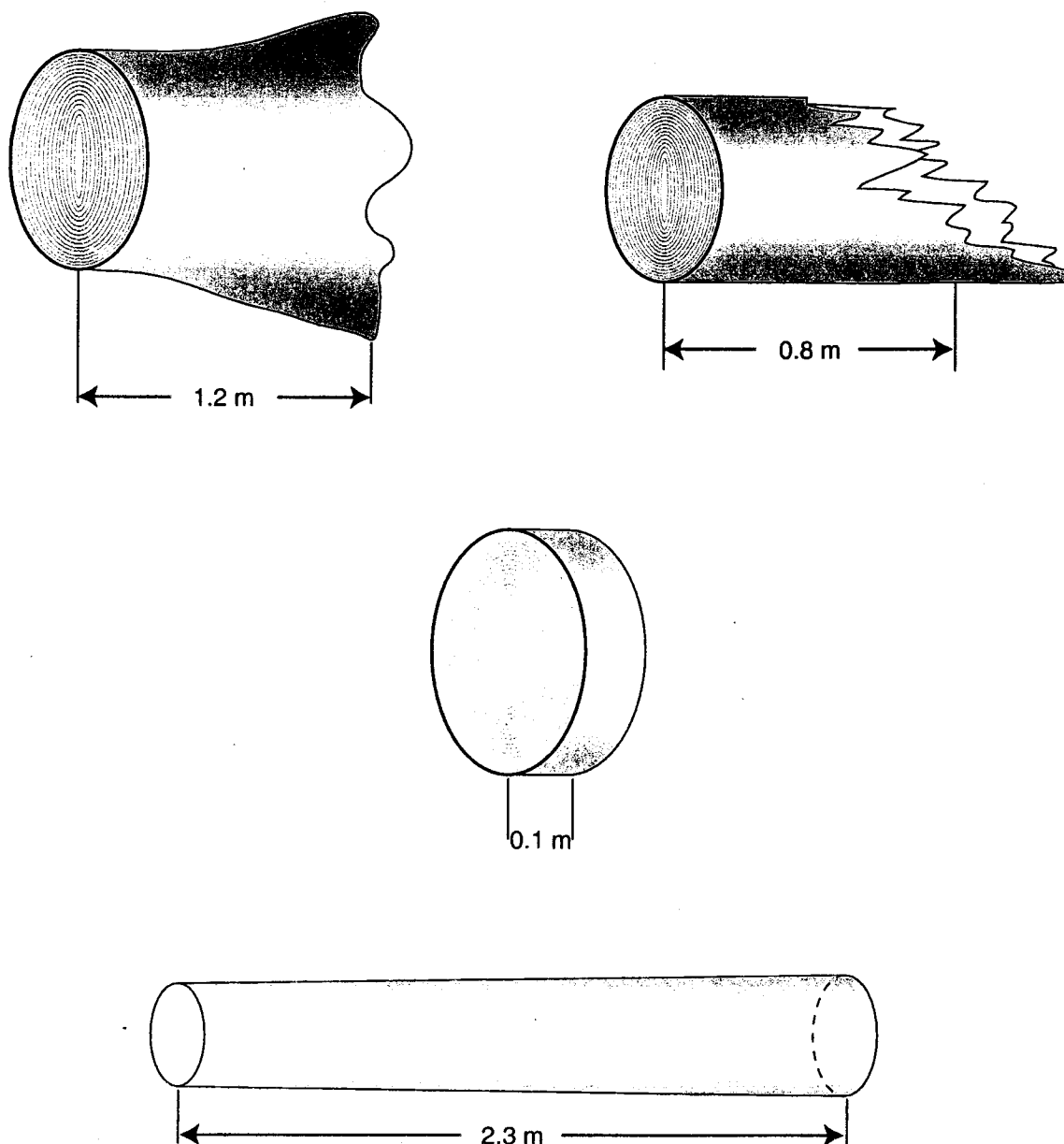
If this log were longer or the sweep less severe, it could be bucked into two logs prior to manufacture, thereby reducing the lumber loss caused by the sweep. Likewise, a scaler, when grading, will "pencil buck" the log to assess the maximum theoretical recovery. In this case the log has excessive sweep and bucking will not upgrade the log.

Figure 6.13 Log with heavy sweep.



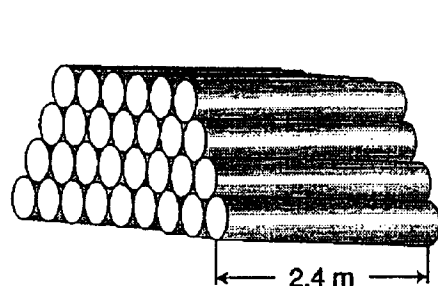
The normal grade deduction here would be the rotten heartwood plus the sound collar, which is too thin to cut lumber. That is, the volume attributable to the 2.3 m rotted end. In this example, however, the sound log segment is shorter than the 2.5 m required for manufacture and must be included as grade deduction. As a result this log is 100 % grade deduction.

Figure 6.14 Log with severe heart rot.

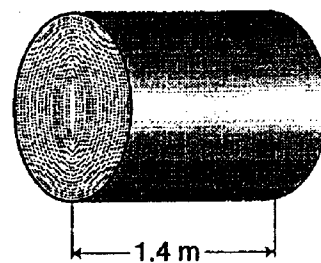


(These examples, for purposes of grade, are all scaled as if 2.5 m. in the interior and as if 5.2 m. on the coast)

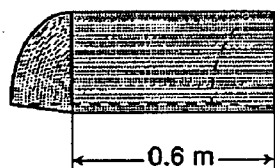
Figure 6.15 Short logs left after bucking at scale site.



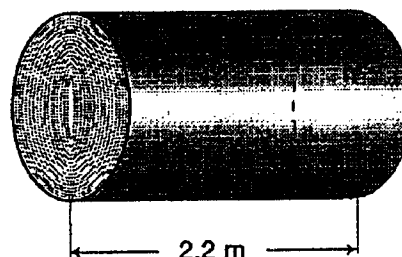
Fence posts



Shingle bolt



Shake block



Mining timber

Where timber is delivered to a scale site for the purpose of manufacturing a special forest product or as a special forest product and the District Manager has not granted permission to scale the special forest product, the timber is to be scaled as logs. See Chapter 8 for more detail.

For Grading, such logs are deemed to be 2.5 m in the interior and 5.2 m on the coast

Figure 6.16 Unauthorized manufacture of Special Forest Products.

6.4.2.3 Collars (Shells)

A log with heart type defects needs to have a minimum collar or shell of wood suitable for manufacture if it is going to be economically processed. No meaningful recovery is possible on shells less than 5 rads (10 cm) in thickness. Therefore, the minimum shell requirement is set at 5 rads with the following restrictions.

In the interior, a 7.5 rad (15 cm) thick shell or collar is required around heart defects of both red cedar and hemlock. The 5 rad (10 cm) shell holds for all other interior species (see Section 6.6).

Where hole, heart rot, true star check, ring rot, or shake affecting the heartwood has a diameter that is 20% or less of the diameter of the log end in which it appears, trim allowance is added to the defect and the grade deduction is calculated. However, the log is assessed without considering the thickness of the firmwood collar surrounding the defect.

Where a defect greater than 20% of the end diameter is off centred (e.g., pocket rot) or only affects a quadrant or portion of the log (e.g., partial rings), that portion of the collar or shell between the defect and the surface of the log may be considered for the minimum 5 rad shell.

Collar thickness is considered only when the diameter of the defect is greater than 20% of the diameter of the log end in which it appears. For logs where the collar thickness meets the minimum required to cut lumber, the trim allowance is added and the grade deduction is calculated in the usual manner. Where the collar does not meet the minimum thickness required to produce lumber, the collar must be included as grade deduction.

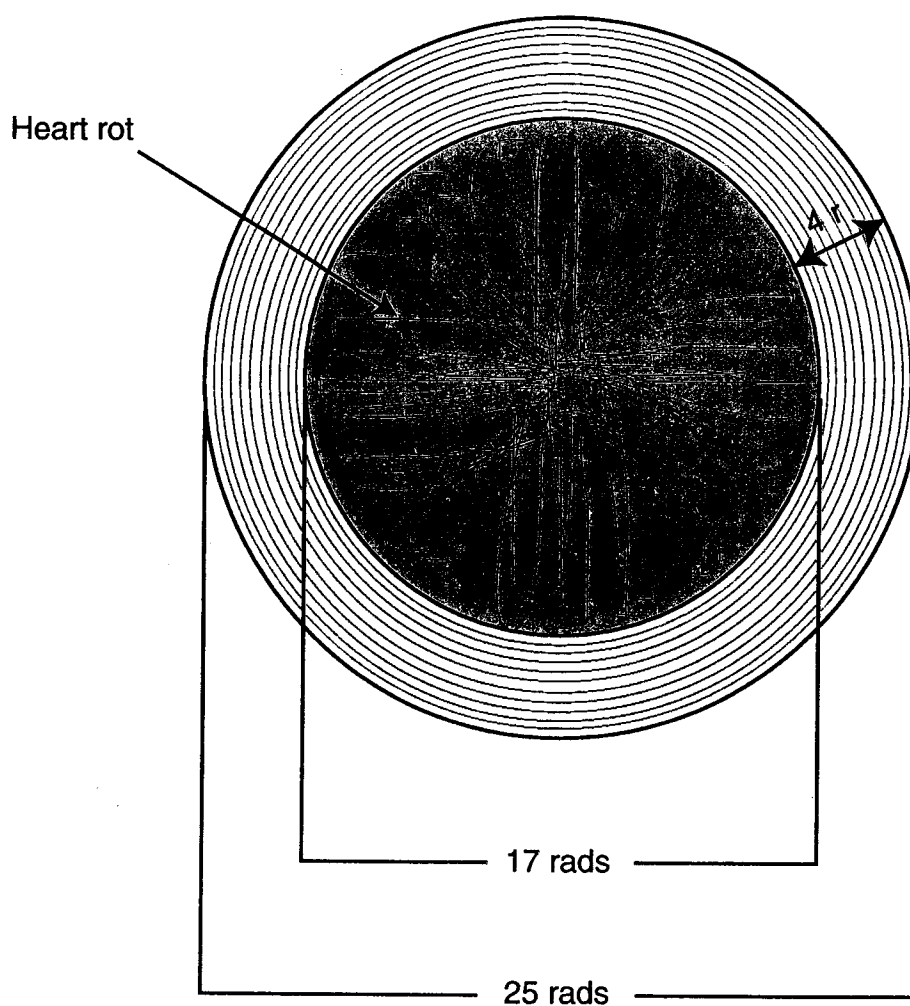
The minimum collar thickness specified is the actual average unrounded measurement taken before trim allowance has been added to the defect.

Scalers must exercise care when measuring or estimating collar thickness. On logs with excessive butt flair it is tempting to simply subtract the recorded rot from the recorded butt diameter and divide the difference by two. This will often considerably underestimate the true collar thickness since the recorded butt has already been reduced to compensate for the flair. Experience has shown that defects usually follow the growth rings. Therefore, a truer indication of the collar thickness can be obtained by direct measurement of the collar with the scale stick. If adequate collar is found on the cut surface, there will be adequate collar where the butt was calipered.

As with all defects that reduce product recovery, the minimum collar thickness specifications should not be over-simplified and misinterpreted so logs having collar portions measuring less than the minimum are automatically downgraded. Rather, the portions of the collar that will not cut yield product due to thickness must be added to the grade deduction and the percentage available for product recovery calculated.

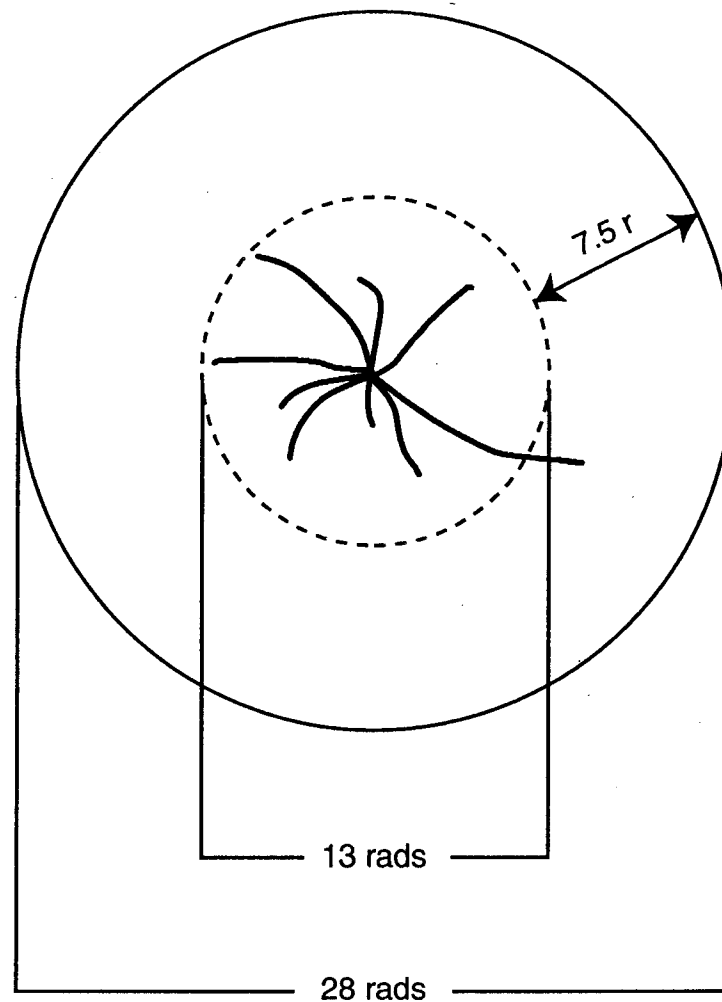
Similarly, consideration must be given to how far the defect runs and to where adequate collar resumes.

Examples of the collar thickness principles are provided in Figures 6.17 through 6.22.



The minimum collar thickness to cut lumber around heart rot is 5 rads (7.5 rads for interior hemlock and red cedar). Where the collar does not meet this thickness it must be included as grade deduction. In this example no lumber can be cut from this end of the log and the entire end is grade deduction.

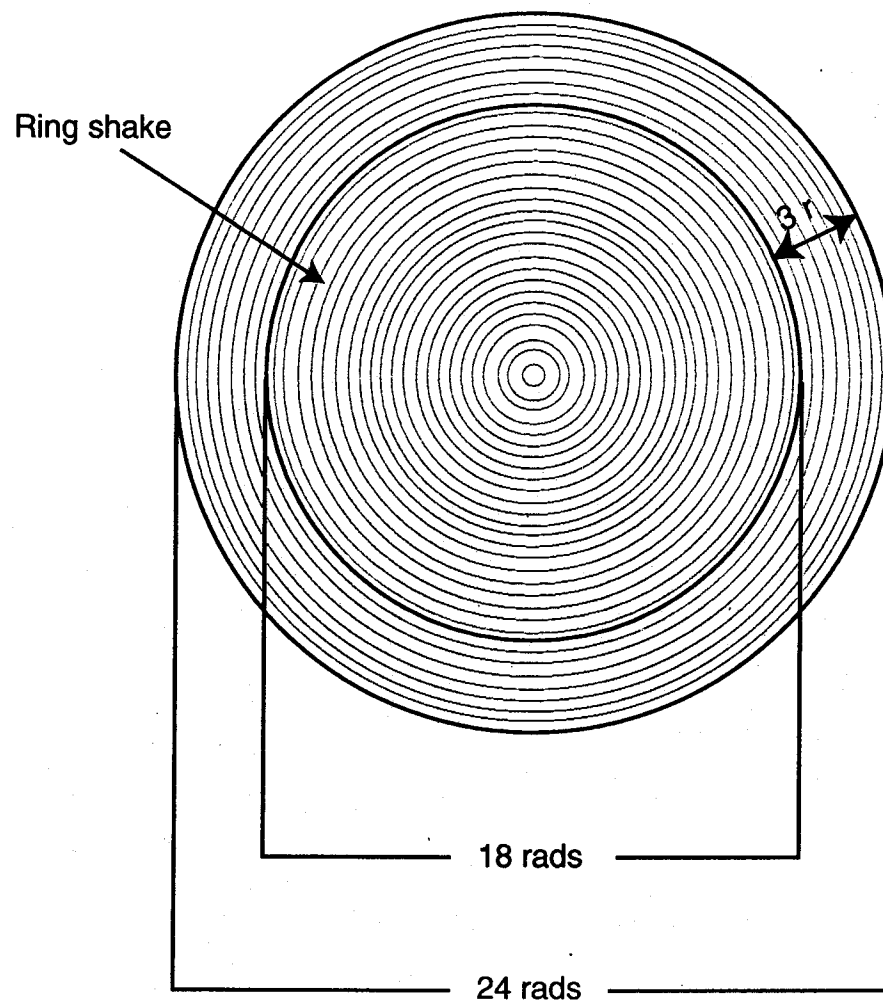
Figure 6.17 Collars around heart rot and hole.



Scalers must estimate the size of the circle that will include enough volume to compensate for the star check. Some of the "rays" of the star check will lie outside the bounds of the circle and some portions of the circle may contain no defect.

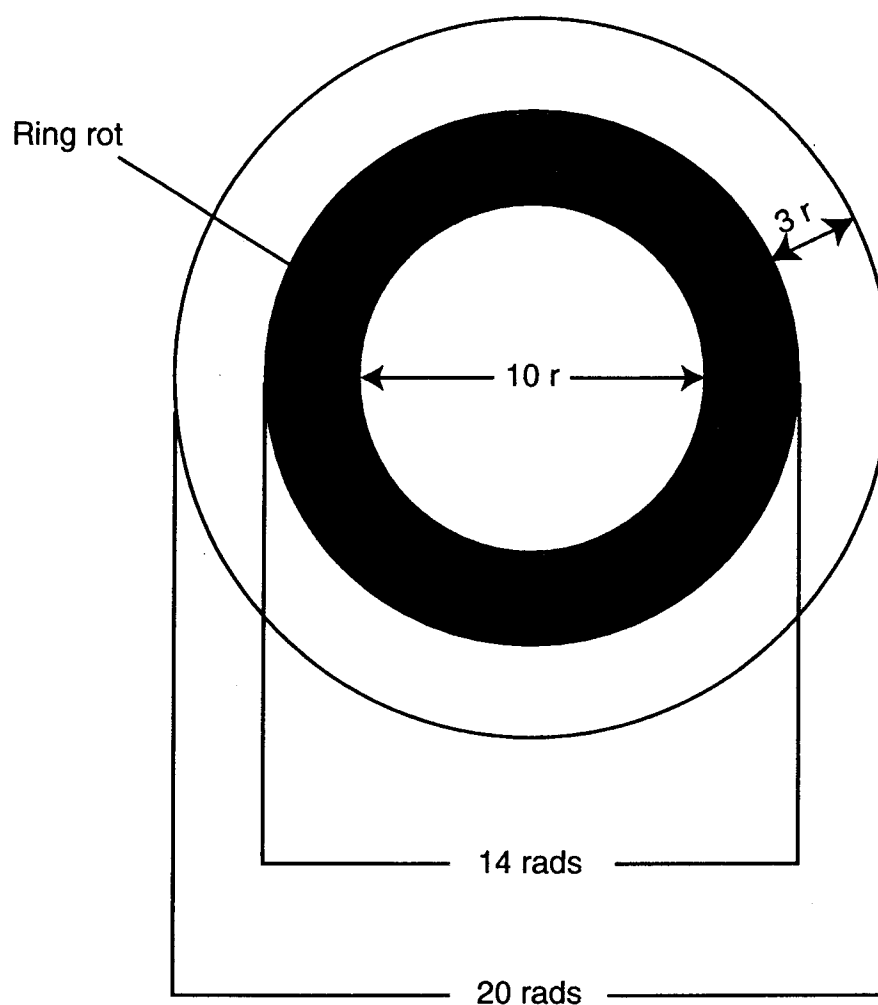
In This example, it is estimated that a 13 rad circle will include sufficient grade deduction volume and that a 7.5 rad collar is recoverable.

Figure 6.18 Star check.



Where the collar outside a ring shake is less than the minimum thickness required for manufacture (5 rads) the entire collar is grade deduction. Here, the collar is 3 rads. Trim allowance is not added inside the shake, as the entire sound heart is considered suitable for manufacture. (Of course, if the diameter of the sound heart were less than 5 rads, it would also be grade deduction.)

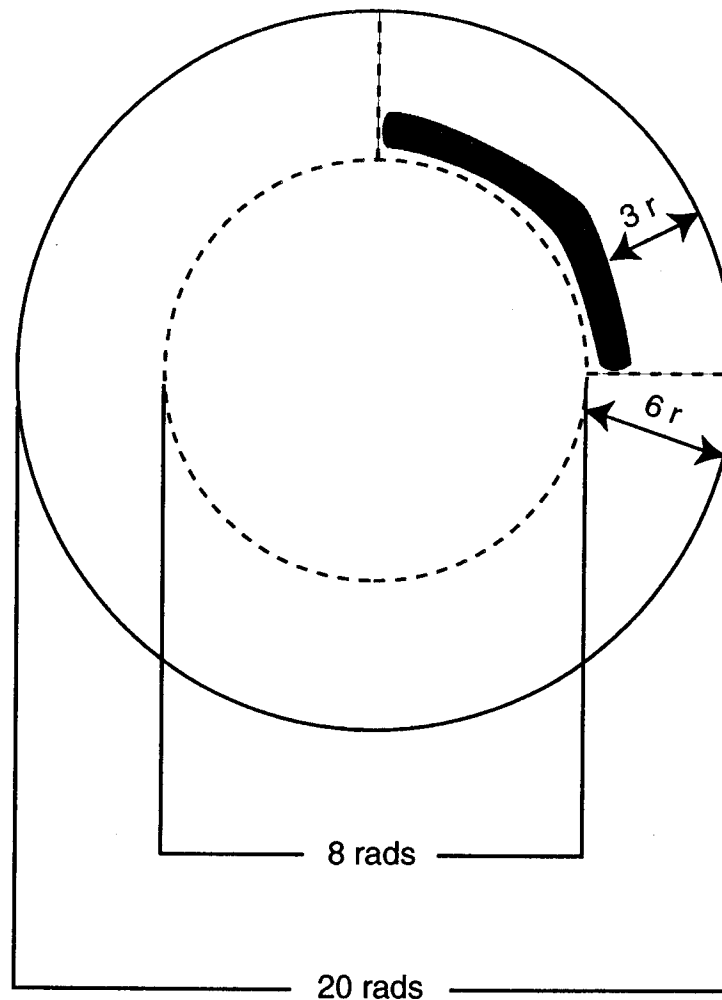
Figure 6.19 Ring shake.



In this example, the collar outside the ring rot is 3 rads thick (5 rads is required to cut lumber). The grade deduction is everything outside the 10 rad sound heart. No trim is added inside the rot.

Grade Deduction - unit volume of 20 - unit volume of 10 or $126 - 31 = 95\text{ dm}^3$ for each metre the rot runs into the log.

Figure 6.20 Ring rot with unrecoverable collar.

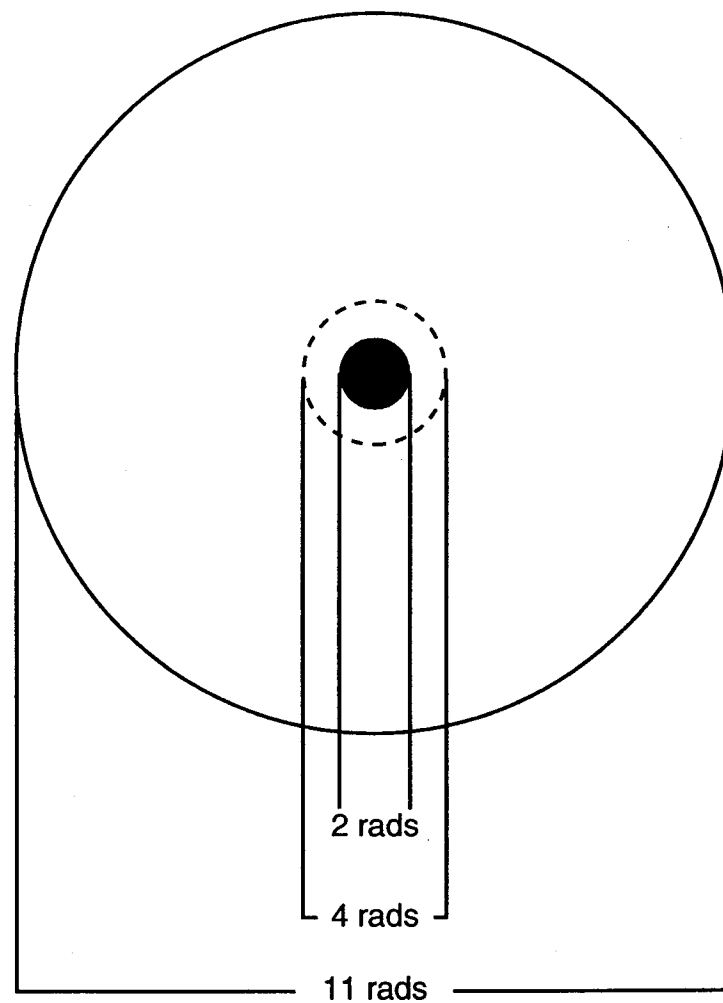


Here the collar outside the partial ring rot does not meet the 5 rad minimum required to cut lumber and must be included as grade deduction.

The partial ring extends around about a quarter of the log circumference, therefore, the grade deduction here is about a quarter of a 6 rad collar or 26 dm³ per metre of length.

i.e., Unit volume 20 - unit volume 8 or $126 - 20 = 106 \times .25$ (since only a quarter of the collar is affected) = 26 dm³.

Figure 6.21 Portions of collars.



In this example, the diameter of the defect is less than 20% of the diameter of the log end, and collar thickness is not a factor in determining whether it will cut lumber. If the diameter of the rot were over 20% of the log end, the collar would have to meet the minimum thickness to cut lumber. Thus, the grade deduction is for the 2 rad rot plus the trim allowance (i.e., 4 rad defect).

Figure 6.22 Defects less than 20% of the end.

6.4.2.4 Multiple Defects with Less than 5 rads Separation

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 deduction would understate the product recovery loss. In such cases the available material separating the defects is also deemed as unsuitable for manufacture and is added to the Grade Deduction.

This principle is demonstrated in Figure 6.23, which depicts a log end with heart and multiple rings of rot. In this example, no recovery is possible (i.e., 100% grade deduction).

6.4.2.5 Slabs

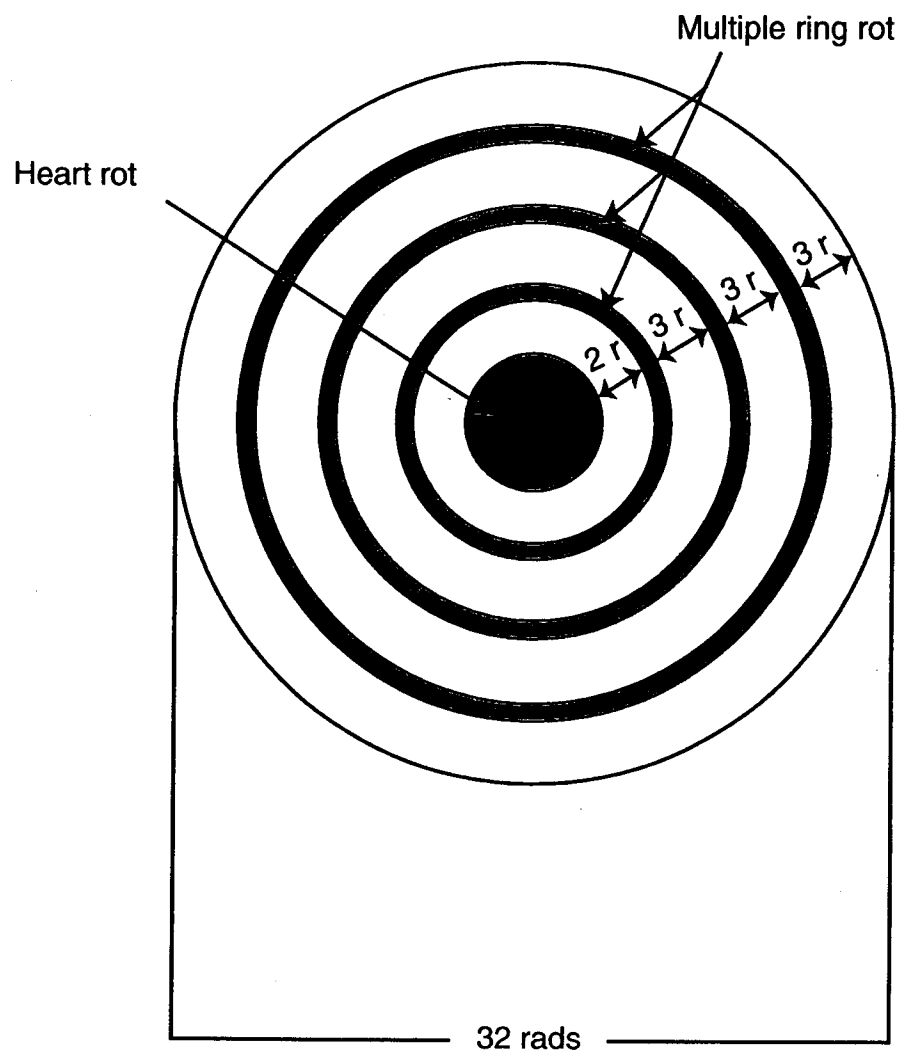
In the interior, slabs must be 7½ rads (15 cm) thick in order to be considered suitable for manufacture; while on the coast, they must be at least 5 rads (10 cm) thick. In the interior, linear portions (i.e., segments) of slabs which do not meet the minimum thickness are considered grade deduction. The referenced slab thickness is the maximum depth of the slab and is to be measured as described in Chapter 5 of this manual (refer back to Figure 5.17 where the thickness is denoted as the letter "B").

6.4.2.6 Sound Hearts (Residual Cores)

Sound hearts inside defects such as ring rot and ring shake are considered suitable for lumber production if they are 5 rads (i.e., 10 cm) or more in diameter. Hearts less than 5 rads are included in the grade deduction.

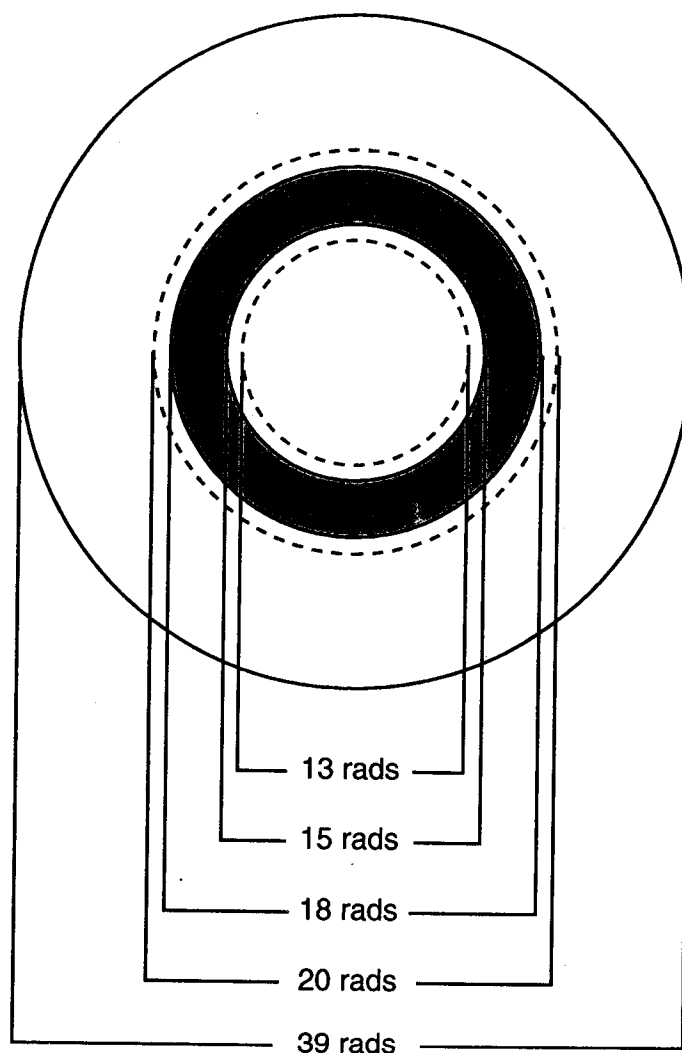
Normally, where the collar outside a ring defect is thick enough to produce lumber a trim allowance must be added both inside and outside of the defect in calculating the grade deduction. However, where the collar outside the defect is not thick enough to produce lumber, no trim allowance is added as the entire sound heart is considered available to cut lumber and the entire volume outside the heart is considered grade deduction.

Figures 6.24 and 6.25 provides examples of the treatment of sound hearts.



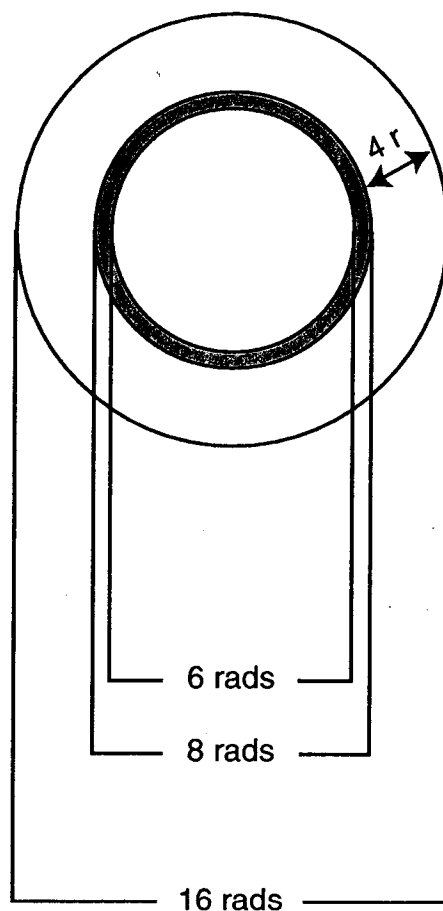
In this log end no recovery is possible.

Figure 6.23 Losses around poorly separated multiple defects.



In the above example (Figure 6.24) both the core inside and the collar surrounding the ring rot are suitable for manufacture. Therefore, the grade deduction consists of the ring and a 1 rad trim allowance on either side (i.e., unit volume 20 - unit volume 13 = $126 - 53 = 73 \text{ dm}^3$ for each metre that the defect travels into the log).

Figure 6.24 Log end with recoverable core and collar.



In this example, the core is suitable for manufacture, but the collar is too thin (4 rads). No trim is added and the grade deduction is everything outside the 6 rad core (i.e., unit volume 16 - unit volume 6 or $80 - 11 = \text{dm}^3$ for each metre the defect penetrates).

Figure 6.25 Sound core with unrecoverable collar.

6.4.3 Quality Considerations

So far we have looked the grade deductions 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 product out turn. The rules in the two timber grading schedules appended to the *Scaling Regulation* state that certain set percentages of the product produced must be merchantable and or clear.

The merchantability determination is based on the size and placement of knots and the degree of spiral or twist observed on the log. Merchantable lumber is considered to be that which will grade out better than utility. However, as stated in Section 6.0 there is no direct relationship between log grading and lumber grading. For instance, the slope of grain permitted in the NLGA Lumber Grade Rules and the twist allowed in the schedules can and do differ. Lumber graders are looking at the final breakdown product and scalers are classifying the "raw stock" from which it was derived.

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

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

6.4.3.1 Knots

Knots larger than 2 rads (4 cm) can reduce lumber quality because the grain deflection around the knots weaken the recovered lumber even though the actual knot wood may be denser and stronger than its supporting tissue.

Maximum allowable knot sizes increase with the diameter of the log and are expressed in radius units (RADS) of diameter. (*One rad equals 2 cm*) When taking this measurement only the actual knot should be measured and not the shoulder surrounding it. See Figure 6.26.

Only the heartwood portion of the knot is measured.

For specific knot requirements by grade classification, please refer to the respective section for the appropriate grade schedule (i.e., Section 6.5 for the Coast and Section 6.6 for the Interior). This is particularly important for the coast grades, since many grade calls hinge on knot criteria.

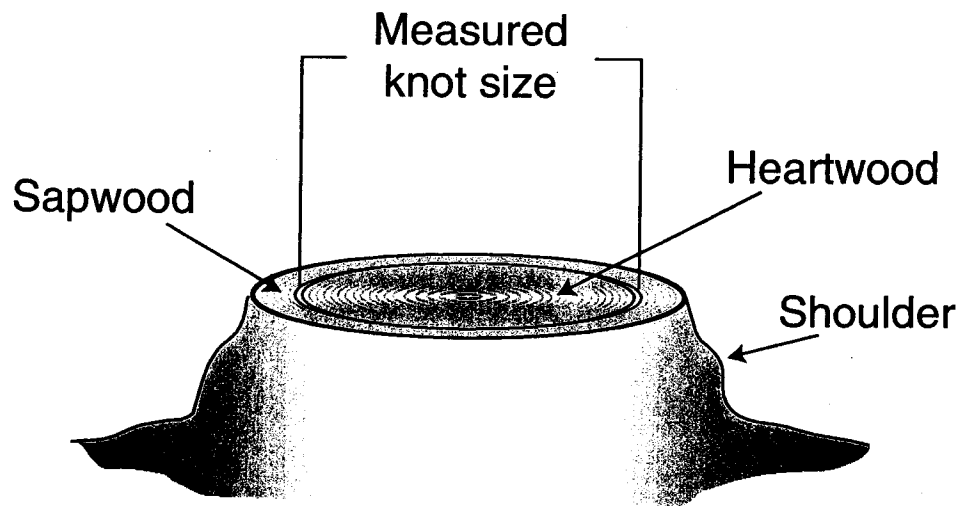
In addition to knot size, the scaler must carefully consider the location and distribution of knots. As stated in Section 6.3.3, log segments must be 2.5 m long to produce lumber. Therefore occasional oversized knots are permitted. In general, one oversized knot is permitted every 3 m. This allows for product recovery between the knots.

Also, where the oversized knots are concentrated in either one quadrant, side or end of the log, the remaining portions will yield merchantable lumber.

For interior logs up to and including 8 m in length and for all coastal logs, knots are assessed against the top diameter of the log.

For interior logs greater than 8 m in length, a midpoint diameter must be taken. Knots on the butt half are assessed against the maximums specified for the midpoint diameter. Knots on the top half of the log are assessed against the maximums specified for the top diameter.

Knot sizes specified pertain to single sound knots. Bunch knots or knots very close together should be assessed the same as oversize knots. Bunch knots or cluster knots are defined as those situations where the majority of the log's grain deflects around, rather than through or between the grouping. The scaler is to measure the smallest circle or oval that will surround the cluster. This is taken as the "knot diameter".



Only the heartwood portion is measured.

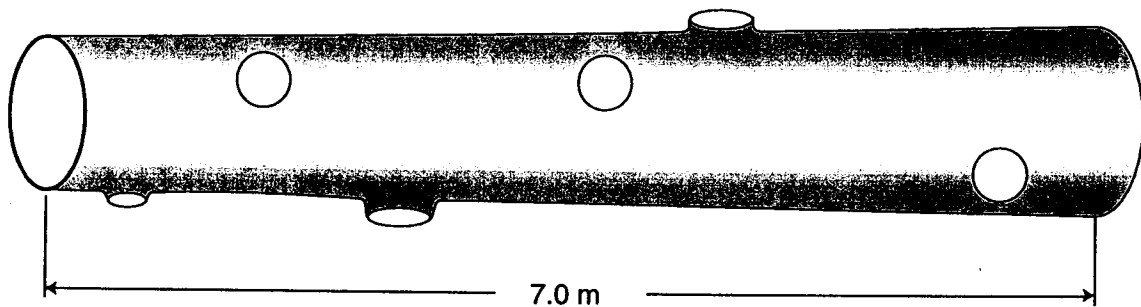
Figure 6.26 Measuring knots.

Undersized knots that indicate the presence of conk or other rots should be assessed in terms of reducing the percentage of the log available to cut lumber, rather than in terms of lowering lumber quality. Remember, it is the grain deflection around the knot or grouping that weakens and lowers the value of the manufactured products.

Certain species such as Douglas-fir and larch, when stressed, produce adventitious branches which, after a period of time, may come to take the appearance of oversized knots or knot clusters. These adventitious branches (sucker limbs) do not, however, penetrate very far into the log since they form much later in the trees 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, particularly in the dry belt regions, should come to recognize this characteristic.

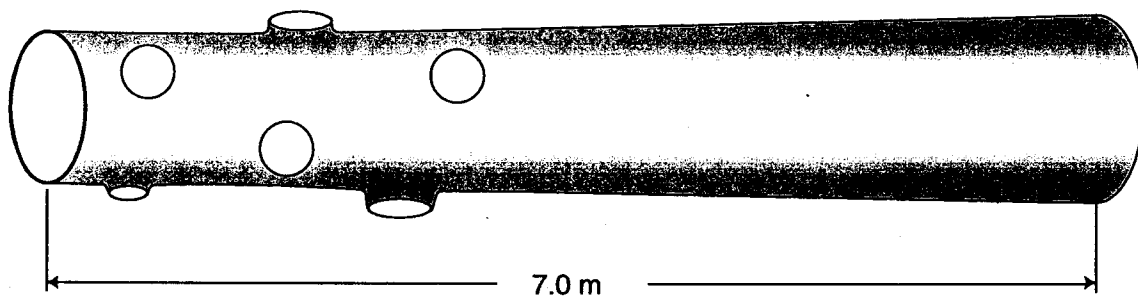
Figures 6.27 through 6.29 demonstrate the assessment of knots.

The first two logs diagrammed have identical gross dimensions. The oversized knots are indicated. Recall, the general rule regarding the oversize knots is that one is allowed for each 3 m of log length; and, as previously mentioned, the orientation and distribution of the knots is critical to grade assessment.



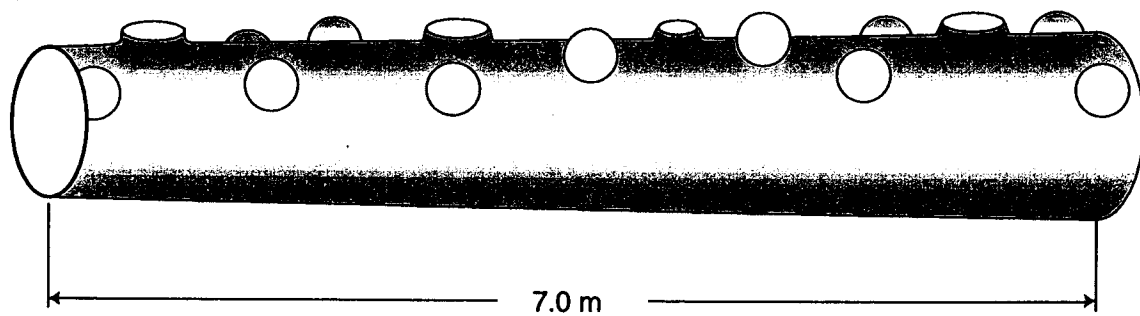
This log has six oversized knots on a 7 m length, and the large knots are distributed over the entire log. At this length, only two oversized knots are allowed. This log is unlikely to yield merchantable lumber or veneer.

Figure 6.27 Oversized knots (spread out).



This log has the same number of oversize knots as Figure 6.27, but they are confined to the top portion of the log. Since the rest of the log is relatively knot free, it is reasoned that merchantable lumber can be obtained from the bottom half.

Figure 6.28 Oversized knots (concentrated at top).



This log also has more oversize knots than would normally be allowed for a quality sawlog. In this case, however, the knots are confined to one side of the log while the other side is clear. Fifty percent of the recovered lumber will be merchantable. However, this log poses difficulty for veneer production by a rotary lathe. Such logs often come from trees growing on the edge of openings.

Figure 6.29 Oversized knots concentrated on one side.

6.4.3.2 Twist (Spiral Grain)

Twist is measured over a 30 cm (15 rad) section of log length where it is representative of the average for the log.

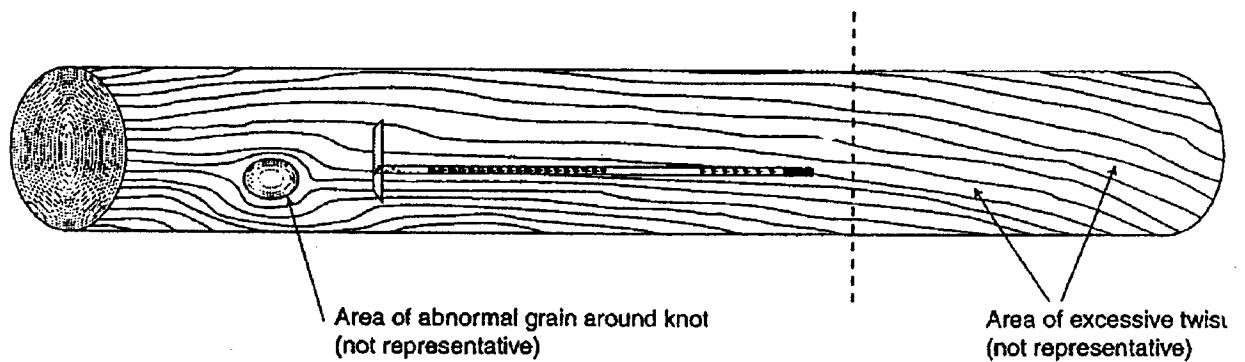
The maximum twist permitted for a particular grade is expressed as a percentage. On coastal logs this is a percentage of the top radius. On interior logs, up to and including 8 m in length, the percentage refers to the top diameter. On interior logs over 8 m, the percentage is compared against the measured mid-point diameter.

Twist measurements of less than 2 rads (4 cm) do not affect product merchantability. On the other hand, where the measured twist exceeds $4\frac{1}{2}$ rads (9 cm) for any diameter, very little merchantable lumber is likely to be recovered. Specific twist requirements by grade for the two respective schedules can be found in Section 6.5 (coast) and Section 6.6 (interior).

Where twist occurs in conjunction with other grade defects which follow the grain of the log (e.g., checks), the loss in terms of product recovery is greatly increased.

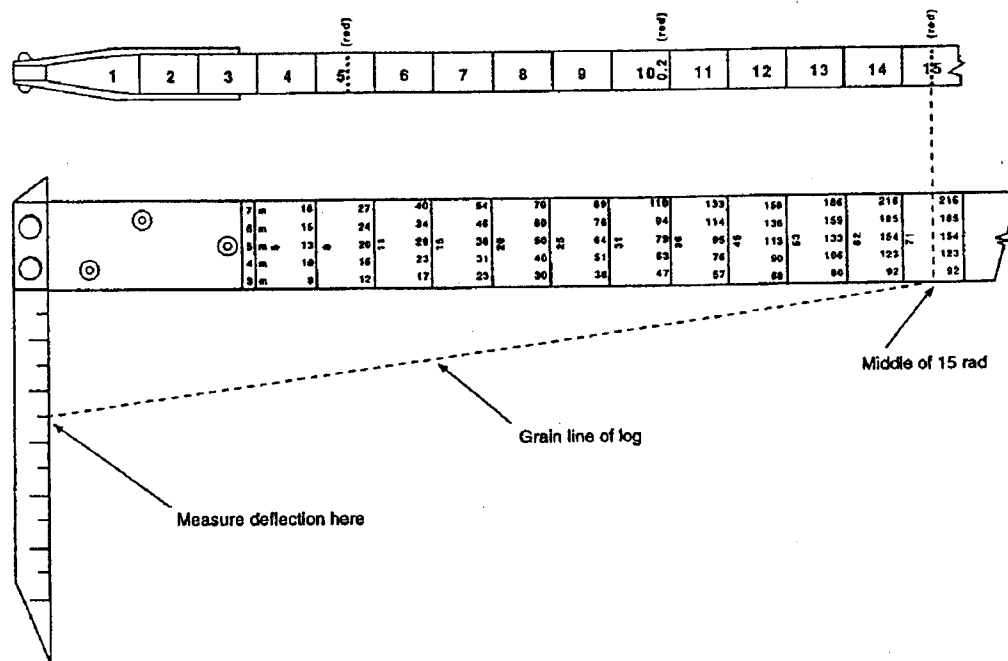
Twist must be measured where it is representative of the average for the log. In Figure 6.30, the extreme twist at the butt end (below the dotted line) is not representative of the log as a whole. Similarly, the area around the knot has abnormal grain and should be avoided.

Figure 6.31 demonstrates how the scale stick is used for measuring twist.



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, but it is too close to the abnormal grain deflection around the knot.

Figure 6.30 Measuring twist - placing the stick.



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 stick is the deflection. The deflection is then read where the grain line intersects the stick. Here, it reads as 5 cm or 2.5 rads.

Figurr 6.31 Measuring twist - reading the deflection.

6.4.3.3 Grain Density (Ring Count)

As stated in Section 6.3.4.3, the ring count of a log can greatly affect its value. The reason for this is that the narrower the separation between the rings, the denser the woody tissue. Denser woody tissue has more cellulose and lignin and is, therefore, stronger. In addition to this strength factor, fine grained logs are easier to peel into veneer on a rotary lathe and yield higher quality and stronger veneer.

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

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

Growth rings are counted at a point 1/6 of the diameter in from the logs outer circumference at the small end. The rings are then to be counted in the one rad (2 cm) area from this point towards the outer circumference of the log. Where a log has an off centre heart, the rings are to be counted where their separation is widest.

6.4.3.4 Stain

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

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

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

6.4.4 The Determination of Dead/dry Status

6.4.4.1 Background

When the Province's forests were inventoried, those trees that were standing dead were measured but their volumes were not added into the overall inventory calculation.

The Interior Utilization Policy excludes these volumes from cut control where the stands from which they are taken are deemed as "endemic." On stands considered "catastrophic," only the underlying background endemic proportion is excluded.

In order that the rules related to cut control may be applied to scaled volumes, scalers must determine whether each log being scaled was cut from a live or a dead tree.

6.4.4.2 Characteristics of Dead/Dry Logs

It is apparent that no one distinguishable characteristic is always present on logs bucked from dead trees. Rather, there are a number of characteristic features that may be present in various combinations. Similarly, there are a number of contraindicative features that let the experienced scaler know that the log was green when harvested but has subsequently taken on the appearance of having come from a dead tree.

Logs cut from dead trees often display a deteriorated cambium layer (inner bark). As a result of this they also frequently have loose or shedding bark. If the tree has been standing dead for a period of time, its butt may have circumferential or encircling sap rot. Often wood boring insects will be evident. Logs from dead trees will also often show significant deep checking.

On the other hand, where green logs have not been promptly scaled, they will often display bark that has curled away from the wood as a result of rapid drying of the inner layer. If there are any attached branches with green needles then the tree is, by the inventory definition, live. Green logs that have been decked for extended periods will often have evidence of mould and/or mildew on exposed wood surfaces. This feature may also occasionally be evident upon logs from dead, windthrown trees.

Where trees have died as a result of recent fire activity (e.g., sanitation logging of fringe damage and slash burn escapes) they do not qualify as dead/dry. Older fire damage such as lightning kills do, however, qualify. Decked, green logs will often display darkened, weathered ends. Some species of trees, notably the pines, are quite resinous in life and will continue to exude pitch for some time after harvesting. Thus, pitchy log ends are taken as an indicator of a log cut from a live, green tree.

Those features that indicate that the log was cut from a dead tree (the **indicators**) and those features that indicate that the log was cut from a live tree (the **contraindicators**) have been catalogued and separately grouped below.

6.4.4.2.1 Indicators

To be classified as dead/dry the log must have one or more of the following characteristics:

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

6.4.4.2.2 Contraindicators

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

- curling bark,
- green needles,
- fresh cambium (sticky),
- mildew or mould on wood surface (except on windthrow),
- charred wood (recent fire kill),
- dark weathered ends (indicative of decked timber), or
- pitching log ends.

Logs that display both *indicators* and one or more *contra-indicators* are deemed to have come from a live, green tree.

Where the logs being scaled have been subjected to prolonged decking prior to scaling, they do **not** qualify for consideration in the dead/dry grades.

Felled and baited beetle trap trees do not qualify for grade 3 or grade 5.

Additionally, if there is any doubt whether or not the tree was dead/dry when harvested the log must not be classified as grade 3 or grade 5.

6.4.4.3 Identifying Undersized Logs

The Ministry of Forests has established a policy governing the minimum utilization standards for Crown timber. One of the specifications named in this policy is the minimum diameter at stump height (DSH) for those trees that must be utilized. Typically this figure is 15 cm for lodgepole pine and 20 cm for other coniferous species. However, the guidelines are sometimes more stringent and may occasionally cover deciduous species.

The DSH is to be measured at a point 30 cm above the highest ground adjacent to the tree (on the "high side"). Scalers do not see the tree, but deal with logs cut from it. Therefore the scaler must first be satisfied that what is being measured is a small tree and not merely the top cut from a larger tree. There must be clear evidence of butt flare, undercut, and/or bark characteristics to distinguish as a butt cut. The scaler is then to come up 15 cm or 7.5 rads and determine the average diameter outside the bark.

In the interior of the province (i.e., east of the Cascades) those logs that have a smaller DSH than the minimum established in the licence document are to be identified and classified as grade code 6. On the coast, these types of logs are not differentiated (for additional information please refer to Section 6.6.6.).

6.5 Interpreting the Schedule of Coast Timber Grades

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

6.5.1 Grade Applicability

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

6.5.1.1 Grade Precedence

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

6.5.1.2 Physical Characteristics Affecting Log Quality

Characteristics are described individually but the scaler must look at the whole log when making his judgement call on log grade. Generally speaking, a scaler must estimate how much of a log is clear, merchantable, utility, chippable, or rotten and whether or not the wood can be cut into veneer, lumber, shakes, shingles, or pulp chips.

6.5.1.2.1 Fractures

Wood may separate at right angles to the annual rings (check) or along the annual rings (shake) or may be damaged in logging (shatter). Once separation has occurred, lumber or plywood cannot be manufactured across the separation and the volumes of firmwood that cannot be cut into lumber or plywood because of the fracture must be estimated.

6.5.1.2.2 Slabs

Slabs are excluded from the sawlog J grade.

All slabs must be 38 cm or greater in thickness for classification in the sawlog H or I grades.

Cedar slabs less than 38 cm in thickness can be considered for classification in the shingle grades.

Slabs qualifying for 'U' utility grades shall be at least 16 cm thick with a minimum mean diameter of 16 cm and a shape suitable to cut efficiently on a sawmill carriage.

Slabs qualifying for 'X' utility grades shall be at least 10 cm thick with a minimum mean diameter of 10 cm and a shape suitable to cut efficiently on a sawmill carriage.

6.5.2.2 Growth Factors

6.5.2.2.1 Bark Seams

Bark seams are formed as a result of there being no wood growth at one point on the circumference of a tree so that over time a seam of bark is left extending inward from the edge of the tree. Lumber or plywood cannot be recovered from the area of the seam. The volume of firmwood, which cannot be cut into lumber or plywood because of bark seams, must be estimated.

6.5.2.2.2 Growth Rate

The growth rate determines the distance between annual rings. Finer grained logs, which cut out high quality lumber and plywood, must have at least six annual rings across each 2 cm of diameter (12 rings for premium lumber). When counting annual rings on any log, the count is to be made at a point 1/6 of the diameter in from the outer circumference at the small end of the log. The annual rings are then counted in the 2 cm area from this point towards the outer circumference of the log. Where logs have off centre hearts, the ring count is made where the rings are the widest.

6.5.2.2.3 Sweep, Crook and Pistol Grip

Sweep is a bow like bend in the trunk of a tree. Crook is a definite kink at one point in the stem as a result of a tree losing its leader and decay may have entered the stem through the broken leader. Pistol grip is a sharp bend in the trunk near the large end of a butt log. These defects reduce the amount of usable lumber. The volume of wood that cannot be cut into lumber or plywood because of sweep, crook, or pistol grip must be estimated.

Where sweep, crook, or pistol grip is present in logs less than 8 m in length, "mental bucking" is not allowed and a length consideration sufficient to compensate for the lumber lost in sawing the log full length is required. In logs 8 m and over in length, one or more mental bucks is allowed. The lengths produced are to be 4 m or more. There will be no loss consideration for the mental bucking itself.

For sweep, crook, or pistol grip in broadleaf species, logs may be mental bucked in two or more 2.6 m or greater lengths to reduce loss in sawmilling. Broadleaf logs less than 5.2 m in length may not be mental bucked.

Deductions for sweep, crook, and pistol grip are for grading purposes only, not for firmwood deductions.

6.5.2.2.4 Twist

A tree as it grows may twist around on its axis. A result of the twisting is that the grain is no longer straight and lumber cut has a slope to the grain, lowering its quality. When twist is excessive, no usable lumber can be cut from a log.

Twist is to be measured over 30 cm of log length and is expressed as a percentage of the log radius. For example 20% twist on a log 32 cm in radius is 6.4 cm. Side displacement of the grain over 30 cm is 6.4 cm, or 3.2 radius class units of 2 cm on the scale stick.

Twist is to be measured where representative of average displacement.

Grade determination of logs having twist is to be made on the surface characteristics only and indications or presumptions that the grain may straighten are not to be considered.

6.5.2.2.5 Wood Distribution

Each annual ring may be of equal thickness around the stem or growth may be greater on one side than on the other. When growth is not equal all round, the heart of a log is displaced from the centre. Such displacement, if excessive, may mean a log cannot be peeled on a lathe.

Trees grow in size by adding a ring of wood under the bark each year. Initially there are side branches on the stem and the remains of these will be found in the centre of any log. As a tree grows in height, the lower branches will die and over time a number will drop off or be knocked off. Clear knot free wood will only be found on the outside of logs. The core will usually contain the remains of branches for at least the first 24 cm. A large diameter log is much more likely to cut out clear lumber than a small diameter log because more wood has been added beyond the branch stubs.

6.5.2.3 Knots

6.5.2.3.1 Size of Knots

Clear knot free timber is highly valued. Knots less than 2 cm in radius detract from the appearance and lessen the value of lumber. The larger the knot size the greater the loss in lumber strength, with extremely large knots making the cutting of merchantable lumber impossible. In the sawlog grades, where knots are out of round, knot size is determined by averaging the maximum and minimum measurements. Peeler grades use the maximum measurement for out of round knots. The size of the knot does not include the shoulder.

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

6.5.2.3.2 Type of Knots

Knots are referred to as loose, tight, rotten, or sound. Broken branches are an entry for fungus spores and the knot and the wood behind the knot may be rotten. A loose knot is found in lumber cut from the outer part of a large log, which has had the remains of a dead branch in the wood. Branches when still living are connected to the main stem and knots in lumber cut from that section of the log in which the branch was alive are tight. When knots are referred to in the requirements, sound tight knots are meant unless otherwise stated.

6.5.2.3.3 Knot Distribution

After the first few years coniferous trees grow 0.2 to 1 m per year depending on the species and suitability of the growing site until a mature height of 24 to 45 m is reached, then height growth decreases significantly.

Balsam, fir, pine and spruce grow a whorl of branches at the start of each year and normal branch distribution in small diameter stems consists of whorls spaced 0.3 to 0.5 m apart. Cedar, cypress and hemlock branches are not produced in regular whorls but branches are spaced on the stems of young trees 0.3 to 0.5 m apart.

When a tree reaches mature height, additional branch whorls are still added each year but the branches are much closer together. The portion of the stem with branches very close together will not cut out merchantable lumber. Sometimes a tree will produce a number of branches in a bunch which results in a bunch of knots (bunch knot) in the wood. A close grouping of knots will seriously detract from the strength of lumber and if the knots are of any size no lumber can be cut through the bunch of knots.

6.5.2.3.4 Occasional Larger Knots

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

Interpretation:

If a grade requirement allows 4 cm knots over the entire log, occasional larger knots can be anywhere on the log. Where the requirement states 8 cm knots are allowed on the upper half of a log, the occasional larger knots must be confined to this area as well, with knots no larger than 2 cm permitted on the lower half of the log.

6.5.2.4 Pitch

Pitch may show at the ends of logs in pockets or within an area of shake. The presence of pitch will lower the value of a log.

6.5.2.5 Insect or Worm Holes

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

Small holes made by the ambrosia beetle are common. The borings will not affect the grade of logs other than lumber quality logs where the borings are extreme, and there is deep penetration beyond the sapwood. In this instance, a grade deduction should be made. It is not a serious defect in the sawlog grades.

Cedar is affected by the borings of larvae of the western cedar borer. It is referred to as powder worm, and it is a serious defect, not allowed in specific grades of cedar. There is no volume loss.

Where logs have been left in salt water too long, they could be infested with the borings of the teredo mollusc. Teredo damage can be so extreme that lumber and pulp recovery may be minimal. This damage, regardless of severity, is not a deductible defect and has no effect on grades in metric scaling.

6.5.2.6 Log Size

6.5.2.6.1 Radius

Radius in the grade rule refers to half the average diameter, inside bark, at the small end of a log or slab. A grade includes logs with radii that round up to the minimum radius quoted.

Radius deductions should not be made to a log that would require it to be recorded with a radius less than the minimum specified for that grade.

No. 4 Sawlog, Grade Code J is a defined category of logs. The gross radius measurement for logs in this grade is the range 8 to 18 cm of radius. It is not permitted to make radius deductions for defect into this grade from another grade classification.

6.5.2.6.2 Length

Length measurements referred to in the grade rule are the actual unrounded measurements. Long lengths of lumber are more valuable and can only be cut from long logs, hence a 5 m log will have a greater value than a 3 m log.

A long log will have a greater large end radius than a short log of identical small end radius, and since the greater volume of the log is at the large end, a long log is likely to contain more clear wood than a short log of identical small end radius.

The minimum length requirements for the grades are for handling logs in converting plants. If, in the opinion of the scaler, a log belongs in a grade higher than utility but requires a deduction reducing the log length below the minimum requirement for the grades, but not reducing the percentage of lumber recovery below minimum, the scaler may record the length of the log below the minimum and maintain the grade.

6.5.2.7 Rot

Rot is caused by a variety of fungi that break down and feed off the lignin or cellulose in the wood. The fungus enters the tree through a root, broken branch, a damaged leader, or a scarring of the stem. The remains of an old scar, a damaged leader, or crook in a log usually means rot is present. Logs cut from older trees are more likely to contain rot, especially logs from species such as red cedar and hemlock, which are more susceptible to attack by fungi.

Rot is classified in scaling according to the way it occurs in the tree. Hence there is butt rot, heart rot, pipe rot, pocket rot, and ring rot. Of the many varieties of rot, only the common conk rot is identified by name. A scaler should examine each end of the log and the sides of the log where there is open wood (scars and knots) to see if rot is present.

If in doubt, cut into the log with an axe. No deductions are made for stain, which is rot in the incipient stages so long as the wood is still firm. However, the presence of stain may affect the log grade. If bits or fragments of wood can be picked out easily with the tine of the scale stick the wood is rotten, not firm, and a deduction is made.

In the grading of timber, a scaler must estimate to what extent the rot will reduce the quality and quantity of product that can be manufactured.

Standard methods to determine the estimated loss of lumber have been developed to assist a scaler and to ensure that all scalers can similarly determine a log's quality and quantity of product. A scaler must remember that sound wood around the rot (or other defect) is lost from product recovery because a sawyer must "square out" around the rot or defect.

Deductions for rot can be made in two ways to compensate for firmwood loss. One method is a radius reduction, the other is a length deduction. Each method is explained in Chapter 2 of the Scaling Manual.

There are basic guidelines to be adhered to:

Radius Reduction

1. Can be used on any log where rot shows in both ends or in butt logs with through and through rot where rot in the top is over 5 cm in radius.

2. Can be used on any logs where rot shows in the top only or where rot shows in the butt only of a second cut log. In each case there must be no indicators present that would determine that the rot travels less than half the log length or further than half the log length. Given no indicators, it will be presumed that the rot is cylindrical in form and travels 1/2 the log length.

For logs 12.8 m and longer, it will be presumed the rot is cylindrical in form and travels 1/3 of the log length, therefore only a length deduction can be made.

Length Reduction

This method can be used on any length using methods described in Chapter 2 of the Scaling Manual.

Length Reduction for Butt Rot

Presented here is a guide for determining distance butt rot may travel into a log.

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

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

6.5.2.7.1 Conk

This defect is touched on in Section 5.8.3.1 of the Scaling Manual, but needs additional clarification to effect a standard method for dealing with conk. Conk will appear in several different ways in logs and the method for making deductions differs in each instance.

Where conk is present in a log, it is to be presumed that no lumber will be recovered in the length of the log affected by the conk, regardless of the size of the conk knots or the size of the conk indications at the log ends. The firmwood loss will be determined by the indicators using methods and standards described in this manual.

Where there is a single conk knot and no conk showing in the ends, use the following deduction. Presume that the conk travels 2.4 m above and 3.6 m below the point of entry. This equals a 6 m linear loss from the log for lumber recovery. The metric volume loss is 1/2 the linear loss, or in this instance 3 m of log length.

Where two or more conk knots are present and no conk showing in the ends, the same method as above is used, including the distance between the conk knots. The total distance affected is considered lost to lumber production and one half the linear distance affected is lost as a metric volume length deduction.

Where conk shows in one end of a log and there is one or more conk knots associated:

1. Conk at top of log - a length deduction is required using method described in lessons. The length of the rot would be from end of log to a point 3.6 m below the last conk knot.
2. Conk at butt of log - same method as above except presume conk runs to a point 2.4 m above the last conk knot.

Where conk shows in both ends of a log, with or without conk knots present, a radius deduction can be made at each end. When conk shows in a log end and no other indicators are present, presume the conk travels 2.4 m up from the butt or 3.6 m down from the top. Where conk shows in the top only or butt only and the showing is half or more of the measured end, run the conk half of the log's length or if the log is 12.8 m or longer, run the conk 1/3 of the log's length.

Where a log has a conk knot less than or equal to the standard distances (2.4 m and 3.6 m) from the end of the log and conk does not show in the log end, presume the conk travels half the distance between the conk knot and the log end.

Where very large conk knots are present an additional length deduction may be required to compensate for the funnel effect of the rot intruding from the outside of the log into the central cylinder of rot (usually 0.2 m for each very large knot).

6.5.3 Definition of Descriptive Terms Used in Section 6.5

6.5.3.1 Clear

Clear means free of knots and stain.

6.5.3.2 Gross Scale

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

6.5.3.3 Merchantable

Merchantable with respect to lumber means good, strong, general purpose lumber graded as better than utility or number 3, and not less than 2.6 m long. Collars must be at least 10 cm thick to produce merchantable lumber.

6.5.3.4 Shopgrade

Shopgrade refers to clear lumber at least 2.6 m long.

6.5.3.5 Downgraded Logs

Logs that otherwise would qualify for a specific grade but have a lumber loss deduction exceeding the requirements of that grade will qualify for a lower grade.

In the grade schedule, the key phrases that identify the grade of a log (prior to grade consideration deduction) are:

1. At least 50% of that lumber will be clear" means 'D and F' lumber quality.
2. At least 25% of that lumber will be clear" means 'F' lumber or 'E and G' spruce lumber or better quality.
3. At least 65% of that lumber will be merchantable or better" means 'H' sawlog or better quality.
4. At least 50% of that lumber will be merchantable or better" means 'I or J' sawlog or better quality.

Certain defects do not permit a log to be a particular grade. When a log is to be downgraded because of a loss to lumber production, the scaler must know what grade the log is before taking the lumber loss into consideration. The following requirements must be considered when grading the log before applying the lumber loss deduction to determine the final grade:

- Conk,
- Knots,
- Twist,
- Annual rings,
- Pitch pockets,
- Insect or worm holes, and
- Powder worm.

Example: A surface clear hemlock 10 m x 40 cm r x 46 cm r has conk showing in the top. There is a grade consideration deduction of 3.6 m. This log is an otherwise H grade with a 36% deduction that will downgrade the log to an I grade.

6.5.3.6 Side

Regardless of whether on land or in the water, the surface of a log has two visible sides, one on each side of a vertical plane that passes through the centre of each end of the log.

6.5.3.7 Thickness

Thickness measurements referred to include thicknesses that round up to the minimum measurement quoted.

6.5.3.8 Upper

Upper means closest to the small end of a log.

6.5.3.9 List of Permissible Defects

In the following sections, the end of each "Requirements to Make the Grade" are listed permissible defects. The defects indicated are those common to the species and a defect may not appear as it is not a common defect or does not affect that species.

6.5.3.10 Check

A separation of the wood, at a right angle to the annual rings, which runs through the heart of the log.

6.5.3.11 Tight Check

As described above, the tine of the scale stick will not penetrate the separation.

6.5.3.12 Open Check

As described above, the tine of the scale stick will easily penetrate the separation.

6.5.3.13 Ring Shake

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

6.5.3.14 Tight and Open Ring Shakes

Tight and open ring shakes are as defined for tight or open checks.

6.5.3.15 Silk Shake (or Silk)

Silk shake is an accumulation of pitch or resin in full or partially around the circumference of an annual ring:

1. Where a silk shake appears at only one end of a log, no loss for lumber or plywood is considered.
2. Where a silk shake appears at both ends of a log it is to be treated as a "tight ring shake" and graded accordingly.

6.5.3.16 Peeler Block

Peeler block is a segment (usually 2.6 m) of a log's length suitable for the manufacture of veneer on a rotary lathe.

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

A firmwood reject log is not considered to be merchantable for cut control purposes although the log may in fact be used by a manufacturing plant. In calculating the allowable cut of a public sustained yield unit, the volume of firmwood in trees more than 50% defective is excluded on the grounds that it is not economically practical to log and use such trees. The economics in fact changes from day to day and a scaler may find firmwood reject logs being brought in to be utilized. When a firmwood reject log is scaled, it must be segregated from other logs.

6.5.4.1 Grade Rule

- 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.

6.5.4.2 Coniferous Species Other than Yew

Each coniferous grade is identified by a unique character code on the scale sheet. Some grades are common to all genera, some are common to a few genera and some are unique to one genus or species.

For each grade of each species there are three primary criteria that must be met. They are:

1. Dimensions.
2. A minimum percentage of lumber recovery.
3. Knot specifications and location.

If each and all of these criteria are met, then the stated lumber quality required for the grade should be recoverable.

6.5.4.3 Balsam and Hemlock Grades

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

6.5.4.3.1 Grade Rule

This grade rule requires a log 5 m or more in length and 33 cm or more in radius where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 50% of that lumber will be clear.

6.5.4.3.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No conk, or conk stain is permitted.
2. There must be no fewer than six annual rings in each 2 cm of diameter.
3. Logs 33 to 37 cm in radius must have at least 90% of the visible surface clear with only a few well spaced knots or knot indications permitted on the upper 10% of two sides or the upper 20% of one side.
4. Logs 38 cm or over in radius must have at least 80% of the visible surface clear with only a few well spaced knots or knot indications permitted on the upper 20% of both sides or the upper 40% of one side.
5. Maximum twist permitted over 30 cm of length is 8% of the radius up to a maximum deviation of 6 cm.
6. Pocket rot is allowed. In balsam the pocket rot must be confined to the centre of the log and must not exceed 10% of the log diameter.
7. Ambrosia, burls, butt rot, butt shake, checks, crook, goitre, heart rot, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

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

6.5.4.4.1 Grade Rule

This grade rule requires a log 5 m or more in length and 25 cm or more in radius where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 25% of that lumber will be clear.

6.5.4.4.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No conk, or conk stain is permitted.
2. There must be no fewer than 6 annual rings in each 2 cm of diameter.
3. Logs 25 to 32 cm in radius must have at least 75% of the visible surface clear, with knots or knot indications permitted on the upper 25% of two sides or the upper 50% of one side.
4. Logs 33 cm or over in radius must have at least 50% of the visible surface clear, with knots or knot indications permitted on the upper 50% of two sides or the upper 75% of one side.
5. Maximum twist permitted over 30 cm of length is 8% of the radius up to a maximum deviation of 6 cm.
6. Pocket rot is allowed. In balsam the pocket rot must be confined to the centre of the log and must not exceed 10% of the log diameter.
7. Ambrosia, burls, butt rot, butt shake, checks, crook, goitre, heart rot, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

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

6.5.4.5.1 Grade Rule

This grade rule requires a log 5 m or more in length and:

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

6.5.4.5.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. There must be no fewer than five annual rings in each 2 cm of diameter.
2. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50% of the visible surface, or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50% of the visible surface, or reasonably well-spaced knots up to 5 cm in diameter on the upper 66 2/3% of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
4. Maximum twist permitted over 30 cm in length is 14% of the radius up to a maximum deviation of 8 cm.
5. Ambrosia, burls, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient.

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

6.5.4.6.1 Grade Rule

This grade rule requires a log:

1. 3.8 m or more in length and 19 cm or more in radius where at least 75% of the gross scale can be manufactured into lumber, and at least 50% of that lumber will be merchantable, or
2. otherwise Grade Code H, 5 m or more in length and 19 cm or more in radius, where less than 75 % but at least 50% of the gross scale can be manufactured into lumber and at least 65% of that lumber will be merchantable.

6.5.4.6.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm of length is 20% of the radius up to a maximum deviation of 9 cm.
3. Ambrosia, burls, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversize knots, pocket rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.4.7 No. 4 Sawlog Balsam and Hemlock, Grade Code J**6.5.4.7.1 Grade Rule**

This grade rule requires a log 5 m or more in length and 8 to 18 cm in radius where at least 75% of the gross scale can be manufactured into lumber and at least 50% of that lumber will be merchantable.

6.5.4.7.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

Log radius	Knot size diameter
8 - 13 cm	4 cm
14 - 18 cm	6 cm

2. Maximum twist permitted over 30 cm of length is 20% of the radius.
3. Ambrosia, burls, butt rot, butt shakes, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

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

6.5.4.8.1 Grade Rule

This grade rule requires a log:

1. 5 m or more in length and,
 - a. 5 to 7 cm in radius where at least 75% of the gross scale can be manufactured into lumber, or
 - b. 8 to 18 cm in radius where at least 66 2/3% of the gross scale can be manufactured into lumber, or
2. 3.8 m or more in length and 19 cm or more in radius where at least 50% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.4.8.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and the other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.4.9 No. 6 Utility Balsam and Hemlock, Grade Code X**6.5.4.9.1 Grade Rule**

This grade rule requires a log 3 m or more in length and 5 cm or more in radius where at least 33 1/3% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.4.9.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.4.10 No. 7 Chipper Balsam and Hemlock, Grade Code Y**6.5.4.10.1 Grade Rule**

This grade rule requires a log lower in grade than utility and higher in grade than firmwood reject.

6.5.5 Cedar Grades

These grades apply only to red cedar.

6.5.6 Lumber Grades

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

1. The surface areas of clear required in the grading rules refer to small knots or knot indications only, which by their nature are an indication of shallowness, and does not preclude the grading of a log with one or two large knots lower down the log, particularly on large diameter logs.
2. Knot specifications for lumber quality slabs will be those appropriate to the original round log.

6.5.6.1 No. 1 Lumber Cedar, Grade Code D

6.5.6.1.1 Grade Rule

1. This grade rule requires a log 5 m or more in length and 30 cm or more in radius, or a slab 5 m or more in length, 25 cm or more in radius and 38 cm or more in thickness, where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 50 % of that lumber will be clear, or
2. a log 5 m or more in length and 60 cm or more in radius where at least 66 2/3% of the gross scale can be manufactured into merchantable lumber and at least 50% of that lumber will be clear.

6.5.6.1.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No powder worm damage is permitted.
2. Logs 30 to 37 cm in radius must have at least 75% of the visible surface clear with knots or knot indications permitted in the upper 25% of two sides or the upper 50% of one side.
3. Logs 38 cm or over in radius must have at least 66 2/3% of the visible surface clear with knots or knot indications permitted on the upper 33 1/3% of two sides or the upper 66 2/3% of one side.
4. Maximum twist permitted over 30 cm of length is 8% of the radius up to a maximum deviation of 6 cm.
5. Bark seams, burls, butt rot, catface, checks, crook, heart rot, pocket rot, oversized knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.6.2 No. 2 Lumber Cedar, Grade Code F

6.5.6.2.1 Grade Rule

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

6.5.6.2.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No powder worm damage is permitted.
2. Logs 25 to 29 cm in radius must have the visible surface clear of knots.
3. Logs 30 to 37 cm in radius must have at least $66\frac{2}{3}\%$ of the visible surface clear with knots or knot indications permitted on the upper $33\frac{1}{3}\%$ of two sides or the upper $66\frac{2}{3}\%$ of one side.
4. Logs 38 cm or over in radius must have at least 50% of the visible surface clear with knots or knot indications permitted on the upper 50% of two sides or the upper 75% of one side.
5. Maximum twist permitted over 30 cm of length is 8% of the radius up to a maximum deviation of 6 cm.
6. Bark seams, burls, butt rot, catface, checks, crook, heart rot, oversized knots, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7 Sawlog Grades

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

6.5.7.1 No. 2 Sawlog Cedar, Grade Code H

6.5.7.1.1 Grade Rule

This grade rule requires a log 5 m or more in length and 19 cm or more in radius where at least 75% of the gross scale can be manufactured into lumber and at least 65% of that lumber will be merchantable.

6.5.7.1.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No powder worm damage is permitted.
2. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50% of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50% of the visible surface, or well-spaced knots up to 5 cm in diameter on the upper 66 2/3% of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
4. Maximum twist permitted over 30 cm of length is 14% of the radius up to a maximum deviation of 8 cm.
5. Bark seams, burls, butt rot, catface, checks, heart rot, oversized knots, pocket rot, sap rot, shatter, splits, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.2 No. 3 Sawlog Cedar, Grade Code I

6.5.7.2.1 Grade Rule

This grade rule requires a log:

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

6.5.7.2.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm in length is 20% of the radius up to a maximum deviation of 9 cm.
3. Ambrosia, burls, butt rot, catface, checks, crook, dryside, heart rot, insect holes, loose knots, oversized knots, pocket rot, powder worm, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.3 No. 4 Sawlog Cedar, Grade Code J**6.5.7.3.1 Grade Rule**

This following grade rule requires a log 5 m or more in length and 8 to 18 cm in radius where at least 75% of the gross scale can be manufactured into lumber and at least 50% of that lumber will be merchantable.

6.5.7.3.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm of length is 20% of the radius.

3. Ambrosia, burls, butt rot, catface, checks, crook, dry side, heart rot, insect holes, loose knots, oversized knots, pocket rot, powder worm, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.4 Shingle Grade

Shingle grade logs will have fewer but possible larger knots than sawlogs and so spaced to permit the production of shingle blocks. Shingle logs are generally unsuitable for the manufacture of lumber because of the nature of the knots or because they are irregular in shape, have excessive butt or heart rot, bark seams, open checks, rotten knots, shatter, or combinations of the above defects.

1. The shingle grade rules make no reference to the recovery of lumber. Scalpers will judge the recovery percentage required to produce shingles or shakes.
2. Some very defective red cedar logs should go into shingle grades.
3. 'D' quality logs with less than 75% lumber become 'K' grade, except D's 60 rads or larger.
4. 'F' quality logs with less than 75% lumber become 'L' grade, except that those between 25 and 29 rads which become K's.

6.5.7.5 Other Sawlog or Shingle Grades

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

1. Logs less than 7.8 m in length, broken at one end.
2. Logs less than 9.8 m in length, broken at both ends.
3. Those 'H' or 'I' quality logs over 9.8 m in length containing 50 - 74% lumber, that are more suitable for quality shingle recovery and can meet grade 'L' requirements.
4. Logs less than 12.8 m in length and less than 75% lumber with a serious defect at both ends.
5. 'D' and 'F' quality logs cut 3.8 to 4.8 m in length.

6.5.7.6 No. 1 Shingle Cedar, Grade Code K

6.5.7.6.1 Grade Rule

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

6.5.7.6.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No powder worm damage is permitted.
2. Logs 25 to 29 cm in radius must have the visible surface clear of knots.
3. Logs 30 to 37 cm in radius must have at least 75% of the visible surface clear with knots or knot indications permitted on the upper 25% of two sides or the upper 50% of one side.
4. Logs 38 cm or over in radius must have at least 66 2/3% of the visible surface clear with knots or knot indications permitted on the upper 33 1/3% of two sides or the upper 66 2/3% of one side.
5. Maximum twist permitted over 30 cm in length is 8% of the radius up to a maximum deviation of 6 cm.
6. Bark seams, burls, butt rot, catface, checks, crook, heart rot, oversized knots, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing that the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.7 No. 2 Shingle Cedar, Grade Code L

6.5.7.7.1 Grade Rule

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

6.5.7.7.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No powder worm damage is permitted.
2. Logs must have at least 50% of the visible surface clear with knots permitted on the upper 50% of two sides, or on all of one side.
3. Maximum twist permitted over 30 cm of length is 14% of the radius up to a maximum deviation of 8 cm.
4. Bark seams, burls, butt rot, catface, checks, crook, heart rot, oversized knots, pocket rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.8 No. 3 Shingle Cedar, Grade Code M**6.5.7.8.1 Grade Rule**

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

6.5.7.8.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No powder worm is permitted.
2. Logs must have at least 25% of the visible surface free of knots or knots of reasonable size and spacing are permitted providing the required amount of clear shingles can be obtained.
3. Maximum twist permitted over 30 cm of length is 14% of the radius up to a maximum deviation of 8 cm.
4. Bark seams, burls, butt rot, catface, checks, crook, heart rot, pocket rot, sap rot, shatter, splits, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.9 No. 5 Utility Cedar, Grade Code U

6.5.7.9.1 Grade Rule

The following grade rule requires a log:

1. 5 m or more in length and
 - a. 5 to 7 cm in radius where at least 75% of the gross scale can be manufactured into lumber, or
 - b. 8 to 18 cm in radius where at least 66 2/3% of the gross scale can be manufactured into lumber, or
2. 3.8 m or more in length and 19 cm or more in radius where at least 50% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.7.9.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.10 No. 6 Utility Cedar, Grade Code X

6.5.7.10.1 Grade Rule

The following grade rule requires a log 3 m or more in length and 5 cm or more in radius where at least 33 1/3% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.7.10.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.7.11 No. 7 Chipper Cedar, Grade Code Y

6.5.7.11.1 Grade Rule

The following grade rule requires a log lower in grade than utility and higher in grade than firmwood reject.

6.5.8 Cypress Grades

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

6.5.8.1 No. 1 Lumber Cypress, Grade Code D

6.5.8.1.1 Grade Rule

The following grade rule requires a log 4 m or more in length and 30 cm or more in radius where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 50% of that lumber will be clear.

6.5.8.1.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. Logs 30 to 37 cm in radius must have at least 75% of the visible surface clear with knots or knot indications permitted on the upper 25% of two sides or the upper 50% of one side.
2. Logs 38 cm or over in radius must have at least 66 2/3% of the visible surface clear with knots or knot indications permitted on the upper 33 1/3% of two sides or the upper 66 2/3% of one side.
3. Maximum twist permitted over 30 cm of length is 8% of the radius up to a maximum deviation of 6 cm.
4. Burls, butt rot, catface, checks, crook, frost checks, heart rot, oversized knots, pocket rot, ring rot, sap rot, shatter, splits, stain, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.2 No. 2 Lumber Cypress, Grade Code F

6.5.8.2.1 Grade Rule

The following grade rule requires a log:

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

6.5.8.2.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. Logs 25 to 29 cm in radius must have at least 75% of the visible surface clear with knots or knot indications permitted on the upper 25% of two sides or the upper 50% of one side.
2. Logs 30 cm or over in radius must have at least 50% of the visible surface clear with knots or knot indications permitted on the upper 50% of two sides or the upper 75% of one side.
3. Maximum twist permitted over 30 cm of length is 8% of the radius up to a maximum deviation of 6 cm.
4. Burls, butt rot, catface, checks, crook, frost checks, heart rot, oversized knots, pocket rot, ring rot, sap rot, shatter, splits, stain, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.3 No. 2 Sawlog Cypress, Grade Code H

6.5.8.3.1 Grade Rule

The following grade rule requires a log 4 m or more in length and 19 cm or more in radius where at least 50% of the gross scale can be manufactured into lumber and at least 65% of that lumber will be merchantable.

6.5.8.3.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50% of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
2. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50% of the visible surface, or well-spaced knots up to 5 cm in diameter on the upper 66 2/3% of the visible surface or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. Maximum twist permitted over 30 cm of length is 14% of the radius up to a maximum deviation of 8 cm.
4. Burls, butt rot, catface, checks, frost checks, heart rot, oversized knots, pocket rot, ring rot, sap rot, shatter, splits, stain, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.4 No. 3 Sawlog Cypress, Grade Code I

6.5.8.4.1 Grade Rule

The following grade rule requires a log 4 m or more in length and 19 cm or more in radius where at least 50% of the gross scale can be manufactured into lumber and at least 50% of that lumber will be merchantable.

6.5.8.4.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm in length is 20% of the radius up to a maximum deviation of 9 cm.
3. Ambrosia, burls, butt rot, catface, checks, crook, dry side, frost checks, heart rot, insect holes, loose knots, oversized knots, pocket rot, ring rot, rotten knots, sap rot, shatter, splits, stain, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.5 No. 4 Sawlog Cypress, Grade Code J

6.5.8.5.1 Grade Rule

The following grade rule requires a log 4 m or more in length and 8 to 18 cm in radius where at least 75% of the gross scale can be manufactured into lumber and at least 50% of that lumber will be merchantable.

6.5.8.5.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

Log radius	Knot size diameter
8 - 13 cm	4 cm
14 - 18 cm	6 cm

2. Maximum twist permitted over 30 cm in length is 20% of the radius.
3. Ambrosia, burls, butt rot, catface, checks, crook, dry side, frost checks, heart rot, insect holes, loose knots, oversized knots, pocket rot, ring rot, rotten knots, sap rot, shatter, splits, stain, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.6 No. 5 Utility Cypress, Grade Code U

6.5.8.6.1 Grade Rule

The following grade rule requires a log:

1. 5 m or more in length and
 - a. 5 to 7 cm in radius where at least 75% of the gross scale can be manufactured into lumber, or
 - b. 8 to 18 cm in radius where at least 66 2/3% of the gross scale can be manufactured into lumber, or
2. 3.8 m or more in length and 19 cm or more in radius where at least 50% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.8.6.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.

3. Ambrosia, burls, butt rot, catface, checks, crook, dry side, frost checks, heart rot, insect holes, loose knots, oversized knots, pocket rot, rotten knots, sap rot, shatter, splits, stain, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.7 No. 6 Utility Cypress, Grade Code X

6.5.8.7.1 Grade Rule

The following grade rule requires a log 3 m or more in length and 5 cm or more in radius where at least 33 1/3% of the gross scale can be manufactured into lumber and at least 35% of the lumber will be merchantable.

6.5.8.7.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.8.8 No. 7 Chipper Cypress, Grade Code Y

6.5.8.8.1 Grade Rule

The following grade rule requires a log lower in grade than utility and higher in grade than firmwood reject.

6.5.9 Fir and Pine Grades

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

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

6.5.9.1.1 Grade Rule

The following grade rule requires a log 5 m or more in length and 38 cm or more in radius where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 50% of that lumber will be clear.

6.5.9.1.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

6.5.9.2 No. 2 Lumber Fir and Pine, Grade Code F**6.5.9.2.1 Grade Rule**

The following grade rule requires a log 5 m or more in length and 30 cm or more in radius where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 25% of that lumber will be clear.

6.5.9.2.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No conk, conk stain, or pocket rot is permitted.
2. There must be no fewer than six annual rings in each 2 cm of diameter.
3. Logs 30 to 37 cm of radius must have at least 75% of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 25% of two sides or the upper 50% of one side.
4. Logs 38 cm and over in a radius must have at least 50% of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 50% of two sides or upper 75% of one side.
5. Maximum twist permitted over 30 cm in length is 8% of the radius at the top of the log to a maximum deviation of 6 cm.
6. Only small pitch pockets ranging in number per end from two for logs 30 cm in radius up to six for logs 76 cm or over in radius are permitted.
7. A ring shake that encircles half or more of the circumference of the ring is not permitted in that portion of the log between 8 cm and 20 cm of the bark. A ring shake within 8 cm of the bark is only permitted if within that part of the log inside the shake there is sufficient wood free of knots or other defects to make the grade rule.
8. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
9. Ambrosia, butt rot, burls, checks, crook, heart rot, ring shake, sap rot, shatter, splits, sweeps, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.3 No. 2 Peeler Fir, Grade Code B

6.5.9.3.1 Grade Rule

The following grade rule requires a log 5.2 m or more in length and 30 cm or more in radius where at least 80% of the gross scale can be manufactured on a rotary lathe into veneer.

6.5.9.3.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No conk, conk stain, or pocket rot is permitted.
2. There must be no fewer than six annual rings in each 2 cm of diameter.
3. Logs 30 to 37 cm in radius must have one 2.6 m butt block free of knots or knot indications.
4. Logs 38 cm or over in radius must have one 2.6 m butt block free of knots, - indications permitted.
5. No knots over 4 cm are permitted and knots or knot indications 4 cm or less in diameter must be well-spaced. Bunch knots that can be encircled in a 4 cm diameter are permitted.
6. Maximum twist permitted over 30 cm of length is 14% of the radius up to a maximum deviation of 8 cm.
7. Butt rot must not be present in logs less than 8 m in length.
8. The diameter of butt rot in logs 8 m to less than 10.4 m in length must not exceed 33 1/3% of the measured butt diameter after excluding flare.
9. The diameter of butt rot in logs 10.4 m or over in length must not exceed 50% of the measured butt diameter after excluding flare.
10. Butt star checks must not be longer than half the top diameter of the log.
11. No more than one heart check or split which must not affect the outer 25% of the radius is permitted at either end of log. A check appearing in both ends of the log must be considered to be the same check to be allowed.
12. Heart checks must not penetrate within 12.5% of the surface of the log at either end of the check. To obtain 12.5% measurement divide diameter by 8.
13. An angular heart check will be allowed if it does not vary more than 45 degrees from a straight line but must not affect the outer 25% of the radius.

14. Only small pitch pockets ranging in numbers per end from three for logs 30 cm in radius to seven for logs 76 cm or over in radius are permitted.
15. One tight partial ring shake which does not extend around half the circumference of the ring and does not have checks at right angles to the shake, or a full ring shake with a diameter not exceeding $33 \frac{1}{3}\%$ of the diameter of the log is permitted. An allowable shake in the outer $66 \frac{2}{3}\%$ of the diameter is permitted in one end only. An allowable shake in the inner $33 \frac{1}{3}\%$ of the diameter is permitted in both ends.
16. Ring shake with a check is permitted if both can be contained in the centre of a log by a circle not exceeding $\frac{1}{3}$ the diameter of the log.
17. Any full or partial ring shake which has a clear separation of the annual rings and is located in the outer $\frac{2}{3}$ of the diameter of the log, will be rejected as a peeler.
18. Logs can exhibit sap rot or sun checks to a depth of 4% of the top diameter of the log. The maximum depth of a sap rot or sun checks shall not exceed 5 cm.
19. At the top end of a log, off centre heart is permitted only where distance from true centre does not exceed 10% of the top diameter of the log.
20. Sweep is permitted to the following extent:
 - a. logs 5.2 m to less than 8 m in length allow up to a 0.6 m consideration for sweep,
 - b. logs 8 m to less than 10.4 m in length allow up to a 1.2 m consideration for sweep,
 - c. logs 10.4 m and over in length allow up to a 2 m consideration for sweep.
21. Crook (a definite kink) and pistol grip (a sharp bend near the large end of a butt log) is permitted to the following extent:
 - a. logs 5.2 m to less than 8 m in length, no loss is allowed,
 - b. logs 8 m to less than 10.4 m in length, up to a 1.2 m consideration is allowed,
 - c. logs 10.4 m and over in length, up to a 2 m consideration is allowed.
22. On logs 10.4 m and over in length bucking breaks, splits and broken ends are allowed provided the defect can be eliminated in a length equal to the top diameter.
23. Burls are permitted to the extent of one medium or large size burl for every 2.6 m of log length.

6.5.9.4 No. 3 Peeler Fir, Grade Code C

6.5.9.4.1 Grade Rule

The following grade rule requires a log 5.2 m or more in length and 19 cm or more in radius where at least 80% of the gross scale can be manufactured on a rotary lathe into veneer.

6.5.9.4.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No conk, conk stain, or pocket rot is permitted.
2. There must be no fewer than six annual rings in each 2 cm of diameter.
3. No knots over 4 cm in diameter are permitted and knots 4 cm or less in diameter must be well spaced. Bunch knots that can be encircled in a 4 cm diameter are permitted.
4. Maximum twist permitted over 30 cm of length is 14% of the radius up to a maximum deviation of 8 cm.
5. Butt rot must not be present in logs less than 8 cm in length.
6. The diameter of butt rot in logs 8 m to less than 10.4 m in length must not exceed 33 1/3% of the measured butt diameter after excluding flare.
7. The diameter of butt rot in logs 10.4 m or over in length must not exceed 50% of the measured butt diameter after excluding flare.
8. Butt star checks must not be longer than half the top diameter of the log.
9. No more than one heart check or split that must not affect the outer 25% of the radius is permitted at either end of the log.
10. Heart checks must not penetrate within 12.5% of the surface of the log at either end of the check. To obtain 12.5% measurement divide diameter by 8.
11. An angular heart check will be allowed if it does not vary more than 45 degrees from a straight line but must not affect the outer 25% of the radius.
12. Only small pitch pockets ranging in numbers per end from two for logs 19 cm in radius to seven for logs 76 cm or over in radius are permitted.

13. One tight partial ring shake that does not extend around half the circumference of the ring and does not have checks at right angles to the shake, or a full ring shake with a diameter not exceeding $33 \frac{1}{3}\%$ of the diameter of the log is permitted. An allowable shake in the outer $66 \frac{2}{3}\%$ of the diameter is permitted in one end only. An allowable shake in the inner $33 \frac{1}{3}\%$ of the diameter is permitted in both ends.
14. Ring shake with a check is permitted if both can be contained in the centre of a log by a circle not exceeding one third the diameter of the log.
15. Any full or partial ring shake that has a clear separation of the annual rings and is located in the outer two thirds of the diameter of the log, will be rejected as a peeler.
16. No sap rot or run checks are allowed in logs less than 25 cm in radius. Logs 25 cm in radius and greater can exhibit sap rot or sun checks to a depth of 4% of the top diameter of the log. The maximum depth of sap rot or sun check shall not exceed 5 cm.
17. At the top end of a log, off centre heart is permitted only where distance from true centre does not exceed 10% of the top diameter of the log.
18. Sweep is permitted to the following extent:
 - a. logs 5.2 m to less than 8 m in length allow up to a 0.6 m consideration for sweep,
 - b. logs 8 m to less than 10.4 m in length allow up to a 1.2 m consideration for sweep,
 - c. logs 10.4 m and over in length allow up to a 2 m consideration for sweep.
19. Crook (a definite kink) and pistol grip (a sharp bend near the large end of a butt log) is permitted to the following extent:
 - a. logs 5.2 m to less than 8 m in length, no loss is allowed,
 - b. logs 8 m to less than 10.4 m in length, up to a 1.2 m consideration is allowed.
 - c. logs 10.4 m and over in length, up to a 2 m consideration is allowed.
20. On logs 10.4 m and over in length bucking breaks, splits, and broken ends are allowed provided the defect can be eliminated in a length equal to the top diameter.
21. Burls are permitted to the extent of one medium or large size burl for every 2.6 m of log length.

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

6.5.9.5.1 Grade Rule

The following grade rule requires a log 5 m or more in length and:

1. 19 cm or more in radius where at least 75% of the gross scale can be manufactured into lumber, or
2. 25 cm or more in radius where at least 50% of the gross scale can be manufactured into lumber, and at least 65% of that lumber will be merchantable.

6.5.9.5.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. There must be no fewer than five annual rings in each 2 cm of diameter.
2. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50% of the visible surface, or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
3. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50% of the visible surface, or reasonably well-spaced knots up to 5 cm in diameter on the upper 66 2/3% of the visible surface or reasonably well spaced knots up to 4 cm in diameter over all the visible surface.
4. Maximum twist permitted over 30 cm in length is 14% of the radius up to a maximum deviation of 8 cm.
5. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
6. Ambrosia, burls, butt rot, checks, conk, conk stain, crook, heart rot, oversized knots, pitch pockets, pocket rot, ring shake, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of log free from these defects is sufficient to meet the grade rule.

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

6.5.9.6.1 Grade Rule

The following grade rule requires a log:

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

6.5.9.6.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm of length is 20% of the radius up to a maximum deviation of 9 cm.
3. Ambrosia, bunch knots, burls, butt rot, checks, conk, conk stain, crook, heart rot, insect holes, loose knots, oversized knots, pitch pockets, pocket rot, ring shake, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.7 No. 4 Sawlog Fir and Pine, Grade Code J

6.5.9.7.1 Grade Rule

The following grade rule requires a log 5 m or more in length and 8 to 18 cm in radius where at least 75% of the gross scale can be manufactured into lumber and at least 50% of that lumber will be merchantable.

6.5.9.7.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

Log radius	Knot size diameter
8 - 13 cm	4 cm
14 - 18 cm	6 cm

2. Maximum twist permitted over 30 cm of length is 20% of the radius.
3. Ambrosia, burls, butt rot, butt shakes, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.8 No. 5 Utility Fir and Pine, Grade Code U**6.5.9.8.1 Grade Rule**

The following grade rule requires a log:

1. 5 m or more in length and
 - a. 5 to 7 cm in radius where at least 75% of the gross scale can be manufactured into lumber,
 - b. 8 to 18 cm in radius where at least 66 2/3% of the gross scale can be manufactured into lumber.
2. 3.8 m or more in length and 19 cm or more in radius where at least 50% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.9.8.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.9 No. 6 Utility Fir and Pine, Grade Code X**6.5.9.9.1 Grade Rule**

The following grade rule requires a log that 3 m or more in length and 5 cm or more in radius where at least 33 1/3% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.9.9.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.9.10 No. 7 Chipper Fir and Pine, Grade Code Y

6.5.9.10.1 Grade Rule

The following grade rule requires a log lower in grade than utility and higher in grade than firmwood reject.

6.5.10 Spruce Grades

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

6.5.10.1 No. 1 Premium Spruce, Grade Code D

6.5.10.1.1 Grade Rule

The following grade rule requires a fine grained log 4 m or more in length and 50 cm or more in radius where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 50% of that lumber will be clear.

6.5.10.1.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No conk, conk stain, or pocket rot is permitted.
2. There must be no fewer than 12 annual rings in each 2 cm of diameter.
3. Logs 50 - 59 cm in radius must have at least 90% of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 10% of two sides or the upper 20% of one side.

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

6.5.10.2 No. 2 Premium Spruce, Grade Code E

6.5.10.2.1 Grade Rule

The following grade rule requires a fine-grained log:

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

6.5.10.2.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No conk, conk stain, or pocket rot is permitted.
2. There must be fewer than 12 annual rings in each 2 cm of diameter.
3. Logs 38 - 49 cm in radius must have at least 75% of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 25% of two sides or the upper 50% of one side.
4. Logs 50 cm in radius and over will allow a few well-spaced knots or knot indications permitted on the upper 50% of two sides or the upper 75% of one side.
5. Maximum twist permitted over 30 cm of length is 8% of the radius up to a maximum deviation of 6 cm.

6. Only small pitch pockets ranging from two per end for logs 38 cm in radius to six for logs 76 cm and over are permitted.
7. Insect or worm holes other than ambrosia must not penetrate beyond the sapwood.
8. Ambrosia, burls, wavy grain (horse mane), butt rot, checks, crook, heart rot, sap rot, shatter, splits, sweep, butt, flared butt, or other defects are permitted providing the portion free from these defects is sufficient to meet the grade rule.

6.5.10.3 No. 1 Lumber Spruce, Grade Code F

6.5.10.3.1 Grade Rule

The following grade rule requires a log 4 m or more in length and 38 cm or more in radius where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 50% of that lumber will be clear.

6.5.10.3.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

6.5.10.4 No. 2 Lumber Spruce, Grade Code G

6.5.10.4.1 Grade Rule

The following grade rule requires a log 4 m or more in length and 30 cm or more in radius where at least 75% of the gross scale can be manufactured into merchantable lumber and at least 25% of that lumber will be clear.

6.5.10.4.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. No conk, conk stain, or pocket rot is permitted.
2. There must be no fewer than six annual rings in each 2 cm of diameter.
3. Logs 30 to 37 cm in radius must have at least 75% of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 25% of two sides or the upper 50% of one side.
4. Logs 38 cm or more in radius:
 - a. must have at least 50% of the visible surface clear with only a few well-spaced knots or knot indications permitted on the upper 50% of two sides or the upper 75% of one side, or
 - b. will permit large knots spaced so clear lumber, 2.6 m in length, shop type, can be cut from the area between the knots on at least 75% of the log's surface.
5. Logs 50 cm and over in radius will permit large knots spaced so clear lumber, 2.6 m in length, shop type, can be cut from the area between the knots on at least 50% of the log's surface.
6. Maximum twist permitted over 30 cm of length is 8% of the radius up to a maximum deviation of 6 cm.
7. Only small pitch pockets ranging from two per end for logs 30 cm in radius to six for logs 76 cm or over in radius are permitted.
8. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
9. Ambrosia, burls, wavy grain (horse mane), butt rot, checks, crook, heart rot, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.10.5 No. 2 Sawlog Spruce, Grade Code H

6.5.10.5.1 Grade Rule

The following grade rule requires a log:

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

6.5.10.5.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

1. There must be no fewer than five annual rings in each 2 cm of diameter.
2. On logs 19 to 24 cm in radius there must be no more than well-spaced knots up to 5 cm in diameter on the upper 50% of the visible surface or reasonable well-spaced knots up to 4 cm in diameter over all the visible surface.
3. On logs 25 cm or over in radius there must be no more than occasional knots up to 8 cm in diameter on the upper 50% of the visible surface, or reasonably well-spaced knots up to 5 cm in diameter on the upper 66 2/3% of the visible surface, or reasonably well-spaced knots up to 4 cm in diameter over all the visible surface.
4. Maximum twist permitted over 30 cm of length is 14% of the radius up to a maximum deviation of 8 cm.
5. Insect or worm holes other than ambrosia must not penetrate beyond the sap wood.
6. Ambrosia, burls, butt rot, checks, conk, conk stain, crook, heart rot, oversized knots, pitch pockets, pocket rot, ring shake, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.10.6 No. 3 Sawlog Spruce, Grade Code I

6.5.10.6.1 Grade Rule

The following grade rule requires a log 4 m or more in length and:

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

6.5.10.6.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

Log radius	Knot size diameter
19 - 24 cm	8 cm
25 - 37 cm	9 cm
38 - 49 cm	10 cm
50 + cm	13 cm

2. Maximum twist permitted over 30 cm of length is 20% of the radius up to a maximum deviation of 9 cm.
3. Ambrosia, bunch knots, burls, butt rot, checks, conk, conk stain, crook, heart rot, insect holes, loose knots, oversized knots, pitch pockets, pocket rot, ring shake, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.10.7 No. 4 Sawlog Spruce, Grade Code J

6.5.10.7.1 Grade Rule

The following grade rule requires a log 4 m or more in length and 8 to 18 cm in radius where at least 75% of the gross scale can be manufactured into lumber and at least 50% of that lumber will be merchantable.

6.5.10.7.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

Log radius	Knot size diameter
5 - 7 cm	4 cm
8 - 13 cm	4 cm
14 - 18 cm	6 cm

2. Maximum twist permitted over 30 cm of length is 20% of the radius.
3. Ambrosia, burls, butt rot, butt shakes, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, shatter, splits, sweep, or other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.10.8 No. 5 Utility Spruce, Grade Code U**6.5.10.8.1 Grade Rule**

The following grade rule requires a log:

1. 5 m or more in length, and
 - a. 5 to 7 cm in radius where at least 75% of the gross scale can be manufactured into lumber, or
 - b. 8 to 18 cm in radius where at least 66 2/3% of the gross scale can be manufactured into lumber, or
2. 3.8 m or more in length and 19 cm or more in radius where at least 50% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.10.8.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.10.9 No. 6 Utility Spruce, Grade Code X**6.5.10.9.1 Grade Rule**

The following grade rule requires a log 3 m or more in length and 5 cm or more in radius where at least 33 1/3% of the gross scale can be manufactured into lumber and at least 35% of that lumber will be merchantable.

6.5.10.9.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

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

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

2. Maximum twist permitted over 30 cm of length is 26% of the radius up to a maximum deviation of 13 cm.
3. Ambrosia, butt rot, butt shake, checks, conk, conk stain, crook, goitre, heart rot, loose knots, oversized knots, pocket rot, rotten knots, sap rot, splits, shatter, sweep, and other defects are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.10.10 No. 7 Chipper Spruce, Grade Code Y

6.5.10.10.1 Grade Rule

The following grade rule requires a log lower in grade than utility and higher in grade than firmwood reject.

6.5.11 Broadleaf Species And Yew

6.5.11.1 Applicability

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

6.5.11.2 Sawlog, Grade Code Blank**6.5.11.1.1 Grade Rule**

The following grade rule requires a log 2.6 m or more in length and 5 cm or more in radius, where at least 50% of the gross scale can be manufactured into merchantable of lumber.

6.5.11.1.2 Log Requirements to Make the Grade

The following are the log requirements to make this grade:

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

Log radius	Knot size diameter
5 - 18 cm	4 cm
19 - 24 cm	8 cm
25 - 37 cm	9 cm
38 - 49 cm	10 cm
50 + cm	16 cm

2. Maximum twist permitted over 30 cm in length is 20% of the radius up to a maximum deviation of 9 cm.
3. Ambrosia, bunch knots, burls, butt rot, checks, conk, conk stain, crook, heart rot, insect holes, loose knots, oversize knots, pocket rot, ring shake, rotten knots, sap rot, shatter, splits, sweep, or other defects, are permitted providing the portion of the log free from these defects is sufficient to meet the grade rule.

6.5.11.3 Chipper, Grade Code Y**6.5.11.3.1 Grade Rule**

The following grade rule requires a log lower in grade than sawlog but and higher in grade than firmwood reject.

6.6 Interpreting the Interior Schedule of Timber Grades

6.6.1 Grade Applicability

The following grade classifications apply to all commercial species harvested from those areas of the province where a lumber-based appraisal is employed irrespective of where the actual scaling is done. Since grade 6 is driven by the utilization specifications in the cutting authority, it is meaningless and non-applicable for timber harvested from lands outside ministry jurisdiction (e.g., private lands, federal reserves).

6.6.2 Sawlog, Grade Code Blank

Sawlogs are logs and slabs that are suitable for the manufacture of lumber. To qualify for this grade, the requirements with regard to both the percentage of the log available for the manufacture of lumber and the quality of the lumber produced must be met.

6.6.3 Sawlog Grade Rule

6.6.3.1 Minimum Gross Dimensions

To qualify for the sawlog grade logs or log segments must be at least 2.5 m in length and a minimum of 10 cm (5 rads) in diameter. Slabs, to make the grade, must also be at least 2.5 m in length and have a minimum thickness of 15 cm (7.5 rads).

All logs, except red cedar and hemlock, which have hole or heart related rot that measures more than 20% of the end diameter, must have a minimum shell (collar) thickness of 10 cm (5 rads) to permit the cutting of lumber. On red cedar and hemlock logs the shell thickness must be at least 15 cm (7.5 rads).

Similarly a minimum shell (collar) thickness of 10 cm (5 rads) must exist around ring rot, ring shake, and pocket rot on all species.

Sound hearts (cores) within circumferential sap rot, surface charred logs, or ring rots must be a minimum of 10 cm (5 rads) in diameter.

The above dimensions are to be the actual averaged, unrounded measurements of the log being graded.

Logs or portions of logs not meeting the minimum gross dimensions are grade deduction volume and deemed to be unavailable for the manufacture of lumber.

The firmwood content of such logs or portions of logs shall, however, be scaled and recorded.

6.6.3.2 Minimum Product Recovery

The appraised stumpage values of the Crown timber harvested in the interior of British Columbia takes into consideration the selling prices of the lumber that it is estimated can be recovered from a given stand of timber. Therefore, in the scaling of interior timber, the only manufactured product that is taken into consideration is lumber.

The grade rule for sawlogs states that a specified minimum percentage of the log's volume must be available for the manufacture of lumber, and that a second specified minimum percentage of the lumber cut will be merchantable. Merchantable lumber is that which is better than utility or number 3.

Factors reducing the volume available for manufacture include fractures (other than those resulting from mechanical damage or scaling delays), rot, char, excessive sweep, crook, bark seams, allowable trim around defects, and logs or portions of logs under the minimum gross dimensions. Additional information on calculating grade deductions is found in the preceding Section 6.4.2.

The two factors affecting the merchantability of the lumber cut are knot size and spiral grain (twist).

6.6.3.2.1 Knots

For logs up to and including 8 m in gross length the maximum permissible knot size is assessed against the top diameter of the log. For logs over 8 m in gross length, the log is physically measured at its midpoint and the knots in the top half of the log are assessed against the top diameter while the knots on the bottom half are assessed against the measured midpoint diameter. One oversized knot per 3 m of length is permissible in the sawlog grade. Oversize knot distribution is an important consideration. For instance oversized knots on one side, quadrant or end of a log affect only the volume attributable to the portion in which they are found.

Care must be taken to avoid measuring the knot shoulder. Only the heartwood portion of the knot is measured. The maximum allowable knot sizes are:

Log diameter	Max. knot diameter
5 - 7 R	2R (4 cm)
8 - 13 R	3R (6 cm)
14 - 18 R	4R (8 cm)
19 - 24 R	5R (10 cm)
25 - 37 R	6R (12 cm)
38+ R	7R (14 cm)

6.6.3.2.2 Twist

Twist or spiral grain is measured over a 30 cm (15 rads) distance parallel with the log's central axis. The allowable grain deflection over this distance is 15% of the top diameter for logs up to and including 8 m in length and 15% of the measured midpoint diameter for logs longer than 8 m. The minimum twist considered is 2 rads (4 cm). Twist over 4.5 rads (9 cm) will downgrade any log regardless of diameter.

The twist or spirality to be measured is the average for the log. Care must be exercised in the selection of the representative measurement area with due consideration given to the volume proportion affected by the twist. Areas near knots, burls, adventitious limbs, etc. are not good sites since the twist is abnormal. The added grain deflection around these areas is accounted for in the knot criteria.

Additional information on the assessment of twist and knots can be found in the preceding Section 6.4.3.

6.6.3.2.3 Species Specific Sawlog Recoveries

The sawlog grade lumber recovery rules by species are:

Species	Lumber Quantity % of log which must be suitable to manufacture lumber	Lumber Quality % of lumber manufactured that must be merchantable
Hemlock	75	50
Red cedar		
Midpoint diameter: 25R and less	75	50
Greater than 25R	50	50
Balsam	67	50
All other species	50	50

Logs that clearly meet the requirements of the undersize grade (grade code 6) shall not be classified as sawlog unless they originate from lands outside of provincial jurisdiction or were harvested from Crown lands without a cutting authority.

6.6.4 Dead and Dry Sawlog - Grade Code 3

Logs meeting the criteria for the sawlog grade but that were dead and dry when harvested are to be classified as DEAD and DRY sawlogs (grade code 3). Timber that was green when harvested but which has dried out prior to scaling must be classified as sawlog (grade code blank). (Please refer to Section 6.4.4.1 for details on determining the Dead/Dry status of timber.)

6.6.5 Lumber Reject - Grade Code 4

Those logs that do not meet the criteria for the sawlog grade but are better in quality than firmwood reject and do not qualify as undersize (grade code 6) shall be classified as lumber reject. If such logs were live and green at the time of harvest, they are to be coded as grade 4.

6.6.6 Dead and Dry Lumber Reject - Grade Code 5

Those logs that meet the criteria for lumber reject (grade code 4) and that were dead and dry at the time of harvest are to be classified as Dead and Dry Lumber Reject (grade code 5). (Please refer to Section 6.4.4.1 for details on determining the Dead/Dry status of timber.)

Timber that was green when harvested but that has dried prior to scaling must not be classified as grade 5.

Segments of logs cut from dead and dry trees and that measure 15 cm (7.5 rads) or less at the midpoint are considered grade deduction if they have two or more checks at least 4 cm (2 rads) in depth. If sufficient volume of the log is so affected, it shall be coded as grade 5.

6.6.7 Undersized Log - Grade Code 6

Undersized logs (grade code 6) are only those cut from trees that are below the minimum diameter at stump height (DSH) specified in the utilization specifications of the cutting authority. Timber scaled from lands outside ministry jurisdiction (e.g., private lands, and federal reserves) do not qualify.

Typically the utilization specifications in interior cutting authorities indicate a minimum DSH of 15 cm for lodgepole pine and 20 cm for other coniferous species. However, this is not always the case and scalers are advised to verify the specifications in place with the local forest district office.

Grade 6 logs are comprised of small trees or butt logs of small trees and not top logs. These logs must indicate butt flare and/or an undercut. Grading requires an outside bark diameter measurement at a point 15 cm (7.5 rads) from the butt face. Eligible logs are graded as grade 6 if this outside bark diameter is less than the minimum diameter at stump height specified in the cutting authority.

The additional outside bark measurement is made only for the purpose of grade determination and is not entered on the tally sheet. The butt diameter is always recorded in the usual scaling convention (i.e., inside bark allowing for normal taper). Parts of logs less than 10 cm (5 rads) in diameter are recorded as firmwood rejects.

6.6.8 Firmwood Reject - Grade Code Z

As explained in Section 6.1, the official scale of B.C. has been on a firmwood basis since the mid-1960s adoption of close utilization management precepts. It is, therefore, imperative that scalers recognize log volumes that do not have to be utilized because they are either too defective or too small to be merchantable. These logs and slabs (or portions of logs and slabs) are coded with the symbol Z. On weight scale sample loads the true species codes for the firmwood reject volumes of the load are replaced with the letter R (followed by a blank space and then the grade code Z).

A firmwood reject log is not considered to be merchantable for scaling purposes although the log may in fact be utilized through a manufacturing plant. These volumes bear no stumpage nor royalty and do not form part of the Allowable Annual Cut. This is also the only grade that is identical on both the coast and in the interior.

6.6.8.1 Firmwood Reject Log Definition

The simple and self explanatory definition taken directly from the *Scaling Regulation* is:

- 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.*

6.6.9 Grade Precedence

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

1. A log or portion of a log that qualifies as a firmwood reject (grade code Z) takes precedence over other grades.
2. A log that qualifies as undersize (grade code 6) takes precedence over all other grades except firmwood reject.
3. A log that qualifies as a Dead/Dry lumber reject (grade code 5) takes precedence over lumber reject (grade code 4).
4. A log which qualifies as a Dead/Dry sawlog (grade code 3) takes precedence over a green sawlog (grade code blank).

Appendix 6A Lineal Method of Grade Deduction

6A.1 Lineal Method of Grade Deduction

As stated in Section 6.3.2, where the timber being scaled is in short log form and does not possess excessive taper, a field approximation method of grade deduction may be used in the place of the volumetric methods described in Section 6.4. The Lineal Method of grade deduction described in this appendix is the approved field approximation method.

In most cases the results offered by the two methods will match. However, where the log form is such that there is appreciably more volume in the butt portion of the log than there is in the top, they may not. In such cases the methods described in Section 6.4 will govern.

6A.1.1 Minimum Gross Dimensions

The minimum gross dimensions for product recovery are:

- a. minimum lumber length - 2.5 m. Any lineal log portions less than 2.5 m in length are too short to produce lumber,
- b. minimum peeler length - 2.6 m,
- c. minimum diameter - 5 rads (10 cm),
- d. minimum collar thickness - 5 rads (10 cm) on coastal timber (see Section 6.6.2 for interior). Please refer to Section 6.4.2.3 for additional information on collars. Required collar thickness is assessed in the end that the defect occurs, regardless of log length. Where the diameter of the defect is 20% or less of the diameter of the log end in which it occurs, collar thickness is not considered, and
- e. minimum slab thickness - 5 rads (10 cm). Please refer to Section 6.5 for specific Coast grade slab requirements.

6A.1.2 Trim Allowance

In order to cut lumber from defective logs, the sawyer must "square out" the defective area. In so doing, the defect-free wood immediately adjacent to the defect is lost to lumber recovery. To compensate for the loss, a 1 rad trim allowance is added all around the defect. This trim allowance may have to be increased if the defect has an irregular shape.

The grade deduction will also include all portions of sound wood between defective areas that are less than 5 rads apart and all portions of the collar less than 5 rads thick.

6A.2 Grade Reduction (GR) Determination

There are three basic formulae for determining lineal grade deductions. In the Lineal Method the grade deduction is commonly called the Grade Reduction (denoted as GR).

They are:

- Formula # 1:

$$\frac{\text{UV of lumber loss (LL)}}{\text{UV of log area}} \times \frac{\text{length of defect}}{\text{length of log}} \times 100 = \text{GR \%}$$

- Formula # 2:

$$\frac{\text{length of GR}}{\text{log length}} \times 100 = \text{GR \%}$$

- Formula # 3 (butt rot):

$$\frac{\text{UV of lumber loss (LL)}}{\text{UV of log area}} \times \frac{\text{length of defect}}{3} \times 2 = \text{GR in metres}$$

(follow formula # 3 with formula # 2 to convert GR in metres to percent)

Following is an expanded explanation of each formula, a definition of terms and a list of defects where each of the formulae may be applied.

6A.2.1 Formula # 1

- The area of the log end not suitable to cut lumber is calculated and expressed as the unit volume of lumber loss (U.V.L.L.),
- The area of the log diameter that would be available to cut lumber if there were no defect is expressed as the unit volume of the log area. Unit Volumes are readily obtained from the scale stick. See Figure 5.5, Section 5.3.1, and
- The U.V.L.L. is compared to the U.V. of the log area for the length that the defect runs.

Therefore, the formula can be expressed as follows:

The area of the lumber loss (LL), divided by the log area, and, multiplied by the length of defect, divided by the log length, and, multiplied by 100 will give grade reduction (GR) percent, or:

$$\frac{\text{UV of lumber loss (LL)}}{\text{UV of log area}} \times \frac{\text{length of defect}}{\text{length of log}} \times 100 = \text{GR \%}$$

i. Logs < 5 m

a. UV of log

For lumber recovery purposes, all GR is calculated in relation to the top diameter. Therefore, the area of the log that would be available to cut lumber if there were no defect is expressed as the UV of the top diameter.

b. Defect length

Given no external indications, defect in the log ends is presumed to run half the log length. However, defect free portions of length less than 2.5 m must be included in the defect length.

c. UV of LL

- i. Where defect occurs in one end only, the area of the defect, plus trim if applicable, is used to determine the UV of lumber loss (LL).
- ii. Where defect occurs in both ends, an area large enough to encompass all of the defect plus trim is used to determine UV of LL.

ii. Logs > 5 m

a. UV of log

For lumber recovery purposes, all GR defect is calculated in relation to the mean log diameter. Therefore, the area of the log that would be available to cut lumber if there were no defect is expressed as the UV of the mean of the top and butt diameter.

b. Defect length

Given no external indications, defect in log ends is presumed to run half the log length up to a maximum of 6 m. There are some exceptions - see GR for konk, butt rot and water shake.

c. UV of LL

- i. Where the defect occurs in one end only, the defect plus trim is used to calculate the UV of LL.
- ii. Where defect occurs in both ends, each UV of LL is calculated separately, using the defect plus trim at each end. Separate GR% are calculated and added together to get the GR% for the log.
- iii. Where a single defect runs the full log length (through defect), the UV of the defect plus trim at each end may be averaged to calculate a mean UV of lumber loss. This mean UV of LL may be used to calculate a single GR.

iii. Application

This formula is used where there is still some lumber recovery from the lineal portion of the log segment that contains the defect, and, the defect is presumed to have a constant area for the length it runs.

Some examples of the type of defect where this formula might be used are; heart rot, ring rot, pocket rot, sap rot, splits, checks, ring shake and sun checks

This formula may not be accurate for long logs with pronounced taper! For logs 5 m and over in length the grade reduction must not exceed the defect length (i.e., if defect runs half way, grade reduction must not exceed 50%).

6A.2.2 Formula # 2

- a. The portion of the log length which will not cut lumber is determined and expressed as the length of GR.
- b. The length of GR is compared to the log length.

Therefore, the formula can be expressed as follows:

The length of the grade reduction (GR), divided by the log length, and, multiplied by 100 will give grade reduction (GR) percent, or:

$$\frac{\text{length of GR}}{\text{log length}} \times 100 = \text{GR \%}$$

i. Application

This formula is used where the shape of the defect does not lend itself to formula #1 (i.e., pistol grip, butt shake, etc.) or where there is no lumber recovery from the defective portions of the log. In these cases, for ease of application, a portion of the defect length is assumed to be GR.

Some examples of the type of defect where this formula might be used are:

- Goitre with rot,
- burnt or charred wood,
- conks,
- missing wood,
- water (butt) shake,
- sweep,
- crook,
- pistol grip,
- goitre,
- breakage,
- bark seams,
- forks,
- log segments too short to cut lumber and collars, and
- butt rot (with formula #3).

6A.2.3 Formula # 3 (Butt Rot)

- a. The diameter of the butt defect is determined and expressed as the UV of LL.
- b. The area of the log diameter that would be available to cut lumber if there were no defect is expressed as the UV of the log area.
- c. The GR length, in metres, is twice what the firmwood deduction for a cone of the same length would be.

Therefore, the formula can be expressed as follows:

The area of lumber loss (LL), divided by the log area, and, multiplied by the defect length divided by three and then multiplied by two equals the GR in metres. To calculate the GR percent, divide the GR length by the gross log length and then multiply by 100, or:

$$\frac{\text{UV of lumber loss (LL)}}{\text{UV of log area}} \times \frac{\text{Length of defect}}{3} \times 2 = \text{GR in metres}$$

$$\frac{\text{length of GR}}{\text{length of log}} \times 100 = \text{GR \%}$$

i. Conventions

a. UV of LL

For butt rot that does not run through to the top there is no trim allowance added, however, if the butt rot is scattered or has an irregular shape, the size of the LL area must be increased to compensate for all of the defect.

b. UV of log

In logs less than 5 m in length this is the UV of the top diameter. In logs 5 m and over in length this is the mean log diameter.

c. Defect length

For a guide to butt rot lengths, see the chart under "Butt Rot" later in this section.

ii. Application

This formula is used for butt rot that is only visible in the butt end of butt cut logs or in cases where rot showing in the top is not considered to be connected with the butt rot. In the latter case, the scaler will make a separate grade reduction for the top defect.

Documenting and Reporting Scale

Results

7

Under the *Forest Act*, the owner of the scale site, the operator of the scale site, the mark holder and the scaler are all individually responsible for submitting the results of the scale in the form of a scale return. This chapter covers a number of related areas:

- an explanation on how to complete the different scale returns,
- an explanation of scale and royalty invoices,
- timing requirements for submission of scale returns,
- penalties for late submission of scale data,
- data retention requirements,
- computation standards and controls,
- electronic submission of scale results,
- approvals required to compile and submit scale data,
- data loss,
- Ministry of Forests checking functions,
- changes to scale data, and
- accessibility of scale data to the public.

7.1 Scale Documentation

7.1.1 Introduction

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

Two types of documents are in place:

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

Scale Returns, for the purposes of this chapter, include the summary of scale, the original scale tally (or detailed log listing), the weight scale load slips and monthly summaries, and include any other documentation that is used as the basis for a billing.

7.1.2 Documentation Conventions

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

- **Formats.** Standard formats, set by the ministry help ensure satisfactory control of scale data. All computer generated facsimiles of the scale returns must be approved prior to their use.
- **Originals.** In all cases the original signed copy of the scale return, and or tally sheet, must be submitted to the ministry for processing.
- **Legibility.** All documents whether produced manually or electronically must be legible. Always use a sharp pencil, a pen or fresh printer cartridge when preparing originals for submission.
- **Scaler's Signature.** As detailed further in this section, the scaler performing the scale is responsible for signing various scale documents. In addition, the scaler performing the scale is responsible for initialing any changes to the scale return or other documentation.
- **Supporting Documentation.** Any supporting documentation, such as tally sheets, should always be attached to the scale return.

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

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

Contact the local Ministry of Forests office if clarification on the completion or submission requirements of any document is required.

7.1.2.1 Recording Commonly Misinterpreted Characters

When hand-written scale returns are being used, the scaler should ensure the writing implement used provides clearly discernible figures.

Record the number zero, as 0, with no line through it.

Record the alpha character, Ø , with a stroke through it.

Record the number seven without any line through the centre, 7.

Record the letter, I , and ensure it is crossed at the top and bottom, to differentiate it from a one (1) or a lower case L.

Record the letter J, with the top crossed to distinguish it from a U.

Record the letter S with an underscore to distinguish it from a 5.

Record the letter Y, not 4, to distinguish it from a 4 and a U.

Record the letter Z with a line through it to distinguish the letter from a number 2.

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

Record the following special symbols, which may form part of a timber mark, as follows:

Mark Symbol		Data Entry Key
∪ (∩) (a crescent)	=	' (apostrophe)
~ (a wavy line)	=	: (colon)
Δ < (a delta)	=	< (less than symbol)
/ (a slash within mark)	=	/ (slash)
— (a bar)	=	- (hyphen or dash)

7.1.3 Scale Documentation

As outlined in Figure 7.1, the type of scaling predicates which scale returns must be completed.

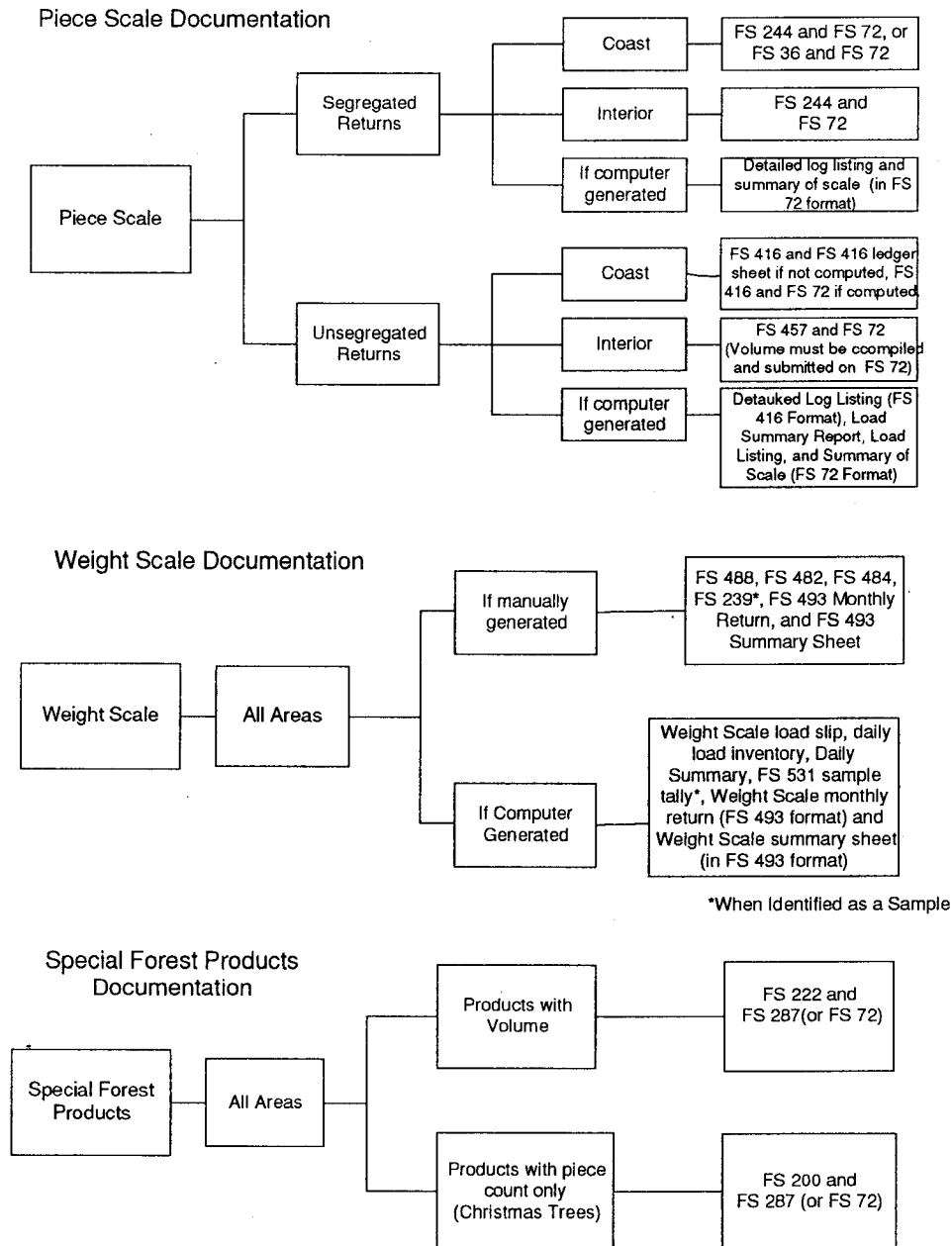


Figure 7.1 Flow chart showing documentation requirements for various scale types.

7.1.3.1 Scale Returns

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

All scale return tallies produced manually (hand-written) or electronically, must be legible and signed by the scaler performing the scale. Scale returns are a key component of the documentation trail used for auditing and checking purposes. As such, any changes made by the scaler should always be initialed by the scaler making the return. Any changes made by the ministry must follow the conventions set under Section 7.6.

7.1.3.2 Type of Scale

The method of scaling largely predicates documentation requirements. Appendix 7A details these requirements and is subdivided into four parts:

- piece scale documentation,
- weight scale documentation,
- scale and royalty invoices, and
- administrative documentation.

7.2 Timing Requirements for Submitting Scale Data

To ensure the needs of the various scale data users are served, it is important that scale data is submitted and processed on a timely basis. Scale data submission requirements must be clearly defined under the scale site authorization (see Chapter 11 for a discussion of scale site authorization).

Under the *Forest Act*, the owner of the scale site, the operator of the timber and the scaler are all responsible for ensuring the scale details are recorded in the approved form, and the scale return is completed and submitted within the time prescribed in the scale site authorization.

The following data submission guidelines for inclusion in the scale site authorization are in place.

Other requirements may be set where conditions warrant them.

Scale Return Type	The date of scale return is to be received by ministry (to be specified in the scale site authorization).
1. Weight Scale:	
Samples	Seven days after the date of scaling.
Monthly return	Five days after the month end.
2. Cruise Based	15 days after the month end.
3. Residue and Waste	60 days after completion of primary logging.
4. Piece Scale	Seven days after the reporting dates (usually specified as the middle and end of the month).
5. All other scale returns	Seven days after month end or other period(s) specified in the scale site authorization.

To assess compliance with these requirements, all scale returns are date stamped by the ministry upon receipt.

7.2.1 Penalties for Late Submission of Scale Returns

When a scale return is not received by the ministry within seven (7) days of the date specified in the scale site authorization penalties may be assessed.

When penalties are assessed, the amount of the penalty is the greater of:

- \$100.00, or
- a percentage of the stumpage or royalty payable as a result of the scale return.

The penalty percentage, as set under the *Scaling Regulation*, increases with the period of delay in receiving the scale return.

If no stumpage or royalty is payable, the minimum penalty of \$100.00 applies if a penalty is assessed.

To assess a penalty for late submission of scale data, the *Scaling Regulation* requires the scale site authorization to define when scale returns are to be received by the ministry.

7.2.2 Electronic Submission of Scale Results

The regional manager may order the scale site owner or operator to enter into arrangements to submit scale returns to the ministry electronically, under the authority of Section 75(7) of the *Forest Act*, where:

- the regional manager estimates the annual volume of timber scaled at a scale site will exceed 50 000 cubic metres per year, and
- the ministry has the ability to receive scale data electronically.

The reasons for using electronic data submission include:

- greater accuracy in scale returns, as errors in scale data processing are reduced,
- streamlining administrative effort in processing scale data, and
- significantly improved audit control.

7.3 Scale Data Computation and Documentation Standards and Controls

To ensure that scale data are consistent and reliable for all users, they must be captured, compiled, and reported in accordance with set standards. These standards are set by the Ministry of Forests.

Appendix 7B of this chapter documents standards for:

- compiling log and segregation volumes,
- compiling weight scale data, and
- reporting requirements for documenting the summary of scale and computed weight scale samples.

In addition, the ministry may set other standards regulating the submission, computation, control, and documentation of scale data. All persons processing scale data must ensure they are conversant with ministry requirements and ensure their standards are current. All standards are subject to change.

7.4 Ensuring Compliance with Standards

In addition to setting scale computation and documentation standards and controls, the Ministry of Forests is responsible for ensuring they are complied with. This responsibility is met through two activities:

- approving all applications to process scale data, and
- assessing compliance with standards and controls.

7.4.1 Approving Applications to Process Scale Data

To receive approval to process scale data, you must follow the following procedures.

7.4.1.1 Piece Scale Computation

An application must be submitted to the regional manager for approval and must include copies of supporting documentation (include both final reports and raw data). The application may also require submission of supporting software and source code.

If the applicant is a scaling bureau or scaling contractor, separate applications must be made for each licensee.

7.4.1.2 Weight Scale Computation

All weight scale programmes including the software to select samples must be submitted to Revenue Branch for approval. The application must include all supporting documentation.

7.4.1.3 Weight Scaling Operating Procedures

Weight scale operating procedures are subject to approval by the district scaling supervisor. In all instances, the weighing device must be certified by Weights and Measures Branch, and weighing must conform to weights and measures standards. These standards require that both gross and tare weights be measured. The only exception is when there is a scale breakdown and emergency procedures have been authorized by the district scaling supervisor.

7.4.1.4 Handheld Data Capture

All scaling handhelds used to capture, compile, or report scale data are subject to standards set by Revenue Branch.

Both hardware and software must be approved by Revenue Branch prior to operational use. For this approval, applications must include copies of the software and user guide, raw scale data, detailed log listings, and computed reports (FS 531 - Computed weight scale sample and FS 72 - Summary of scale), which will be submitted to the ministry for processing (see Appendix 7B).

Operational conditions to use approved handhelds at specific scale sites are set by the district scaling supervisor usually as part of the scale site authorization.

7.4.1.5 Electronic Submission of Scale Data

The standards, conditions, and approval of the electronic submission of scale data will be set by Revenue Branch.

7.4.2 Compliance Checking

District, regional, and headquarters staff are jointly responsible for assessing and ensuring compliance with ministry requirements:

Related activities include:

- routine checking of raw tallies and computed reports,
- periodic rekeying of data,
- routine checking of summaries of scale reports used for billing input,
- periodic audits of computed submissions including:
 - verify the part submitting the data has necessary approval in place,
 - verifying receipt of all tallies (log listings from handhelds) for the submission or package,
 - verifying receipt of all supporting documentation as specified in the approval to compile data,

- verify documentation is complete, is in the correct format, signatures are in place, and there are no omissions,
- rekeying of raw data to ensure key entry, calculations, and roll up of segregations are correct,
- notifying parties submitting data of unacceptable submissions or errors, and
- follow-up checking to ensure deficiencies have been remedied.

7.5 Correction of Errors

All scale returns submitted to the ministry may be subject to scrutiny for completeness and accuracy prior to further processing. Where errors or omissions are detected, they must be corrected.

The following conventions apply to all errors:

- to facilitate timely processing, obvious errors will be corrected by the ministry, and
- a copy of the corrected return will be returned to the originator.

7.5.1 Key Punch/coding Errors

The following conventions apply:

- to enable timely processing, obvious errors will be corrected by the ministry, and
- a copy of corrected returns will be returned to the originator.

7.5.2 Measurement/Grade Errors and Missing Dimensions

The scaler should be contacted directly if feasible. If in agreement, the scaler should consent to changes by initialing all changes.

If the scaler is not in agreement with the changes, changes will not be made unless the return cannot be processed in which case ministry staff will use their best judgement. A copy of the corrected returns will be returned to the originator.

Where the scaler cannot be contacted, either verbally or in writing, and no response is received in seven (7) days, the return will be processed by ministry staff using their best judgement.

In the case of weight scale samples, missing dimensions will result in cancellation of the sample unless the missing dimension can be completed and there is little doubt about its accuracy.

7.6 Data Loss

While computer technology greatly enhances the collection, computation, and reporting of scale data, there is an ever present risk that data may be lost through hardware/software failure or user error. It is essential that provisions are always in place to:

- minimize the impact of data loss, and
- reconstruct data where they are deemed lost.

7.6.1 Conventions to Minimize Data Loss

Several computer software and operating conventions should be routine to prevent data loss and minimize loss where it does occur:

- always ensure staff are adequately trained and staff are conversant with procedures to follow in the event of an equipment failure,
- always ensure a person is named and available to support any system whether mechanical or manual,
- always backup data to a host computer or other backup device as often as feasible,
- always make hard copies of handheld data as often as feasible and preferably after each load scaled,
- always keep hand-written reports and printouts organized and stored in a safe place where they won't get lost (store copies offsite where feasible),
- always store diskettes in a safe, dry, dust free place, and avoid temperature extremes (keep away from heaters and magnetic fields),
- always use a reliable power source,
- always ensure backup tapes, diskettes, disk drives, and other devices are covered in dusty conditions, and
- always ensure any system compiling scale data makes provision for backing up and recovering data to and from an external backup device (e.g., tape backup unit, or floppy diskette).

If data loss is detected or suspected:

- contact the system support person for instruction, and
- contact the district scaling supervisor.

7.6.2 Reconstructing Data Which is Lost

Where data are known to be lost, it is essential that:

- the data loss be reported to the district office, and
- the lost data be estimated from previous data as instructed by the district office and submitted to the Forest Service for processing.

The following guidelines are in place:

1. Weight Scale Data

- Weight scale breakdown

The appendix to Chapter 10 of this manual lays out the procedures to be followed in the event of a weight scale breakdown as well as the detailed calculations required to reconstruct load weights, and

- Loss of Sample Scale Data

Because weight scale samples are used to estimate volumes for the entire population, it is essential that they are accurate. If any data loss is detected, the sample must be cancelled. Similarly, weight scale samples that contain missing dimension data would usually be cancelled unless the missing dimension(s) can be reconstructed with no doubt about their accuracy.

2. Piece Scale Data

Under piece scaling the log-by-log scale details are the basis for billing. Any loss of piece scale data represents a potential revenue loss. As such, it is essential that where losses of this kind are detected they must be estimated and the estimate used as the basis for billing.

Most piece scale production is scaled in the form of truckloads spread on the ground with all logs on each truck bearing the same timber mark. To reconstruct lost data, you must use the data from scaling immediately prior to the breakdown to estimate the volumes by species and grade for each missing truckload as follows:

- for each timber mark, determine the five most recently scale loads ensuring the truck size and timber mix are representative,
- based on the five loads, calculate average volumes for each species and grade combination, and
- for reporting purposes, ensure any estimated loads are noted with the notation "estimated volume" and include your background calculations identifying which load numbers were used for averaging.

Where data are lost during a boom scale or other scaling arrangements where truckload identities are not maintained, it may be essential to reconstruct lost data using approaches other than truckload averages. Such approaches may include using piece counts.

In all cases, data must be reconstructed using the best and most representative data available from previously scaled timber. Timber scaled after the data loss may be used where there is inadequate data available prior to the loss.

7.7 Access to Scale Data

The release of information such as scale data falls under the *Freedom of Information and Protection of Privacy Act*. The following guidelines apply to the release of scale data:

RELEASE OF SCALE DATA

1. Under the *Freedom of Information and Protection of Privacy Act* policy, all scale data is available at the request of any party.
2. Upon completion of a check scale, the check scale detailed log listing will be provided to the scaler who performed the scale.
3. Check scale detailed log listings are available to other parties upon request, subject to:
 - where the ministry has reasonable grounds to believe that the release of check scale data to parties other than the scaler may cause harm, may place undue pressure on the scaler, or impair the scaler's impartiality, release should be denied, and
 - if access to check scale data is denied, the person requesting the data may make a formal written request for the information through the *Freedom of Information and Protection of Privacy Act* procedures.

Appendix 7A Scale Documentation

1. Piece Scale,
2. Weight Scale,
3. Scale and Royalty Invoices, and
4. Administrative Documentation.

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7A.1 Piece Scale Documentation

For piece scale billing there are various ways of scaling logs that require different forms. Segregated scaling requires the logs to be grouped together according to timber mark species and grade. This method is used primarily for water scaling, log salvage, and small mill operations. Unsegregated scaling is usually performed for truck loads at dryland sorts where unsorted logs are scaled in the order that they are spread out for scaling. As the billing system requires that the data be segregated prior to processing, the unsegregated tallies must first be computed and summarized in FS 72 format, either before submission to the ministry or by through a pre-processing system performed in the Revenue Branch.

7A.1.1 Tally Sheet Scale Returns for Segregated Scale

A scaler performing a scale using the segregated method must create separate *segregation* on the tally for each timber mark/species/grade, then record the log measurements beside the corresponding entry as it is scaled. The forms used for segregated scaling are the FS 36 and the FS 244. These forms are identical in content, but the FS 36 is larger and can accommodate a higher number of logs, therefore making it preferable for boom scaling. Although the coded header fields and position numbers are identical on both forms, the rows have been split to accommodate the smaller page on the FS 244. Both forms are available in wet (duksbak) and dry (paper) media.

A maximum of ten tally sheets may be used for a single submission, unless the volumes have been compiled, and summarized on a completed FS 72 (summary of scale), which then becomes the document submitted for input into the billing system for invoicing. The signed and completed tallies must be summarized and submitted to the ministry with the FS 72, within the time prescribed in the Scaling Regulation.

The data entered on piece scale tallies are formatted in lines called *records*. The record *number* identifies the type of information that will follow on the line. For example, there are two types of *header* records that provide information that identifies the scale, such as the scaler, the location, and the date the scale was performed. These records are followed by *detail* records, that provide the actual description of the logs, such as timber mark species, grade, and log dimensions.

Each record number contains a unique set of fields that are identifiable by both a field name and by position numbers. The column number is located directly below the first position in each data field.

7A.1.2 Tally Sheet Scale Returns for Unsegregated Scale

There are two types of unsegregated scale returns currently in use: the FS 457 is used commonly in the interior regions and contains only one mark per tally, and the FS 416, which can accommodate the identification of a second mark or NMV (no mark visible), as it is a requirement to record NMV logs on the coast. The FS 457 must be computed and summarized in an FS 72 summary format prior to submission. The FS 416 can either be summarized prior to submission, or put through a pre-processing system in the Revenue Branch. This system sorts the data into segregations in FS 72 summary format, which is an acceptable input document for the HDBS piece scale billing system.

1. FS 244 Tally Sheet Scale Return - Small

Tally Sheet Scale Return - Small - FS 244

For a more detailed description of each field see page 21.

- A** Page. Enter the page number of the return. Maximum number of pages is 10, using numbers 0 - 9.
- B** Scaler's licence number. Enter the four character licence number.
- C** Scaler's return number. Enter the three digit return or tally number.
- D** Scaled for. Enter the name of the person or company the timber is being scaled for.
- E** Camp boom number. Enter the load number, boom number, or other identification assigned to the parcel.
- F** Date. Enter the date the scaling is completed.
- G** Payable by. Enter the five digit name and address code for the party to receive the invoice. If unknown leave blank.
- H** FRS. Enter the number corresponding to the region of scale. See the detailed instructions for a list of the region code numbers.
- I** FRI. Forest region of invoice. Enter the number of the region to be invoiced.
- J** Scaler's log count. Enter the total number of logs in the return.
- K** Scaling station number. Enter the three character site code number.
- L** Place of scaling. Enter the name of the place where the scale is performed.
- M** Card Type 2. Enter the mark, species, grade, and up to five sets of log measurements. Once the scaling is complete, the total piece count for the segregation must be entered on this line ending in column 26.
- N** Card Type 3. This line is used only in conjunction with a card type 2. It is used to add additional log dimensions to the segregation.

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June 1, 1995

2. FS 36 Tally Sheet Scale Return - Large

Tally Sheet Scale Return - Large - FS 36

For a more detailed description of each field see page 24.

- A** The tally sheet must be signed by the scaler upon completion.
- B** Scaled for. Enter the name of the person or company the timber is being scaled for.
- C** Page. Enter the page number of the return. Maximum number of pages is 10, using numbers 0 - 9.
- D** Scaler's licence number. Enter the four character licence number.
- E** Scaler's return number. Enter the three digit return or tally number.
- F** Camp boom number. Enter the load number, boom number, or other identification assigned to the parcel.
- G** Date. Enter the date the scaling is completed.
- H** Payable by. Enter the five digit name and address code for the party to receive the invoice. If unknown leave blank.
- I** FRS. Enter the number corresponding to the forest region of scale. See the detailed instructions for a list of the region code numbers.
- J** Scaler's log count. Enter the total number of logs in the return.
- K** Scaling station number. Enter the three character site code number.
- L** Place of scaling. Enter the name of the place where the scale is performed.
- M** Card type 2. Enter the mark, species, grade, and up to five sets of log measurements. Once the scaling is complete, the total piece count for the segregation must be entered on this line ending in column 26.
- N** Card type 3. This line is used only in conjunction with a card type 2. It is used to add additional log dimensions to the segregation.
- O** Remarks. Enter any pertinent information that pertains to the scale in this field.

[illegible]

Figure 7A.2 FS 36 - Tally sheet scale return - large.


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PRINTED          Ministry of Forests, Vancouver Region          PAGE 1
95.03.07          LOG LISTING - FS36-STYLE FORMAT

-----
STATION          SCALER          REF MOD    DATE OF SCALE    TIME    PCS
13K              1234            152  0      95.02.01        :       31

COMPANY NAME      CAMP BOOM NO.          NO. OF SECTIONS    CHAIN COUNT
ABC LOGGING CO.   ABC 95-023

FNF PLACE OF SCALING  REMARKS          SCALED BY
1    BLACK CREEK

-----
TBRMARKPTS PCS SP G ST  LENTPBT ->
EA5026      1 CE H      1243645
EA5026      2 CE I      0423640 0822533
EA5026      16 CE J      0921016 0661015 0662332 1221625 0681520 0940815 0961015
0920812 0921621 0841216 1900922 1240917 1260916 0921619 1641018 1041523
EA5026      2 CE M      0901824 1162838
EA5026      3 CE U      0782029 0961020 1201728
EA5026      5 CE X      0961016 0861319 0601016 0901317 1181527
EA5026      2 CE Y      0440810 0991217

```

Figure 7A.3 Computer-generated FS 36.

Recording a Tally Sheet Scale Return for Segregated Scale FS 244 and FS 36

See Figure 7.2 (FS 244) and Figure 7.3 (FS 36) for examples of tally sheets.

Record Type 0 (1st Header)

Position	Field Name	Description of Data
1	Page	If more than one tally sheet is required to record all the scale, the tallies must be numbered and put in sequential order. The one character field will accept numbers 0 to 9, to allow a maximum of ten pages for a single return.
2	Sequence or Line	This field is precoded on all lines of the tally sheets. The header lines are all 80 characters in length, though the header line on the FS 244 is split into 2 rows to fit the page.
4	Type	This field identifies the record type. The record type identifies the type of data that will be displayed on the remaining 76 positions of the line.
5	Scaler's number	The 4 character scaler licence number is entered in this field.
9	Raft	Also called a return or tally number. For each scaler, at the beginning of each year the first raft number, 001, should be assigned to the first parcel the scaler scales, and run consecutively through to 999 regardless of the scale site at which he/she is employed. When the scaler reaches raft number 999, he/she must restart with 001.
12	Predominant mark	For ministry use only. This field identifies alternative billing logic methods.
19	Number of chains	The number of chains, swifter wires, dog straps, etc. used on a boom. This field is not edited and is provided for company use to record information.
33	Camp boom number	The boom number or other identification assigned to the parcel by the owner. As the field is not edited it may contain alpha and/or numeric characters.

51	Number of sections	The number of sections within the boom. There is an implied decimal point between the last two characters (e.g., code 10.0 as 100). If the boom is not sectioned leave the field blank, as alpha characters (e.g., bag), will cause the tally to be rejected by the billing system.
54	Date	Enter the date the timber is scaled in YY MM DD format. If the scaling spans more than one day, enter the day the scaling is completed. See Remarks section.
60	Payable by	For ministry use. This is the five digit Harvest Data Base System (HDBS) Name and Address (N&A) code for the party responsible for paying the invoice. This party will receive the original (first) copy of the invoice and the accounts receivable statement.
65	Second copy to	For ministry use. This is the five digit HDBS N&A code to be entered if a copy of the invoice is to be directed to a second party, such as a broker.
70	Expenses	For ministry use. The field is in the format \$ nnn.nn, and is used to record any expenses, such as mileage, incurred by a ministry scaler when performing an original scale.
75	Time charge	For ministry use. The field is in the format \$nnn.nn, and is used to record the total charges for a ministry scaler's time based on an hourly rate. The hours are multiplied by the current rate and entered in this field with preceding zeros when necessary.
80	Launch	Leave blank. Obsolete field.

Record Type 1 (2nd Header)

Position	Field Name	Description of Data
1	Page	The page number is automatically repeated from the header field of the tally.
2	Sequence or Line	This number is precoded on the line for all tally sheets. The second header is 01.
4	Type	This field identifies the record type. The record type identifies the type of data that will be displayed on the remaining 76 positions of the line.

12	FRS	Forest Region of Scale. This position must be coded with the numeric code for the corresponding region. 1 Vancouver 4 Prince George 2 Prince Rupert 5 Nelson 3 Kamloops 6 Cariboo
13	NSF	This field is no longer in use and any entry in this field will be disregarded.
14	FRI	Forest Region of Invoice. This field, when populated with the corresponding region code (see Forest Region of Scale), will indicate the region that is to be invoiced when timber from one region is scaled in another region.
15	Scaler's log count	The total number of pieces in the boom or parcel is entered in this field, right oriented and pre-filled with zeros if necessary. If the piece count for the return exceeds the space provided, the last 4 digits of the piece count are to be entered in this field, as the billing system will do an edit check to ensure the last 4 digits agree with the last four digits in the total pieces scaled.
19	Scaling station number	The three character code identifying the scale site where the timber is scaled. This must be a valid site in the HDBS.
22	Place of scaling	The name of the place where the timber is scaled.
62	-	This field is not in use and any entry in this field will be disregarded by the system.
68	-	This field is not in use and any entry in this field will be disregarded by the system.
80	T	Topscale indicator for ministry use. This field is used to identify a top scale that must be prorated by the HDBS.

Record Type 2 (Segregation detail)

This record type is used to identify the segregation and to record the first five sets of log dimensions. n, as reAdditional lines each containing eight sets of log dimensions can be added to the segregation required, using a record type 3.

Position	Field Name	Description
1	Page	Automatically duplicated from the header record.
2	Sequence or Line	This number is precoded on the line for all tally sheets.
4	Type	This field identifies the record type. The record type identifies the type of data that will be displayed on the remaining 76 positions of the line. Record type 2 identifies the segregation.
5-11	Scaler's number/raft	These fields are not displayed on the form as they are repeated from the header for all lines of the tally.
12	Mark	The timber mark that is stamped on the logs. This mark must be a valid timber mark in the HDBS mark file, NMV (no mark visible) or SB4 (scaled before) or else the tally will be rejected by the HDBS.
19	Paint	This field is not in use and should be left blank.
21	-	One position field, used to identify NMV or SB4 in conjunction with a valid timber mark in position 12. An N in this field indicates the logs are unmarked but would be rated and the volume attributed to the mark indicated in position 12 to 18 (e.g., a truck load that was not 100% marked but all logs originate from the same setting). An S in this column would indicate the logs were previously scaled as the mark indicated in columns 12-18. If SB4 is entered in this field no charges are applied and no volumes are added to the harvest history.

22	Number of Pieces	Once the scaling is completed the number of pieces for the mark/species/grade segregation should be added up and entered in this field. The piece count should be right oriented and the last digit should be entered in position 26.
27	Species	The species of the timber in the segregation.
29	Grade	The grade of the timber in the segregation.
30	Other Description	<p>Left blank or if applicable to the logs in the segregation it must be a valid code from the following list:</p> <p>B/S Boomsticks SLA Slabs CHU Chunks SLI Slivers DEA Deadheads SUB Submerged S/W Swifters SUN Sunken CA Cants</p>
33	Length	The length of the log expressed in decimetres. There are three positions allocated for each length measurement, and they are displayed on the form with a white background to provide a visual distinction dimension of each log's measurements (e.g., the length of each new log will begin in a white 'em' dash field, the next dimension for a log length would be recorded in 40-42). The field must be pre-filled with zeros if the length dimension does not require the entire field. See <i>Recording log dimensions</i> , below.
34	Top	The radius of the top of the log, measured in centimetres. The top measurement is always recorded in the first two positions shaded in green following the white length measurement field. Therefore the next log's top measurement would be recorded in positions 43-44. See <i>Recording log dimensions</i> , below.
38	Butt	The radius of the butt of the log measured in centimetres. The butt measurement is always recorded in the two positions directly following the top measurement, shaded in green. Therefore the next log's butt measurement would be recorded in positions 45-46. See <i>Recording log dimensions</i> , below.

Recording of log dimensions.

There are seven character spaces allotted on a tally sheet for recording the dimensions of one log. The first three are for recording the length, the next two are for recording the top radius, and the last two are for recording the butt radius. If the dimension does not fill the spaces allotted for the measurement, the space must be pre-filled with zeros so that all the seven character spaces are filled (e.g., a log with a length of 4.8 m, a top radius of 9 cm, and a butt radius of 11 cm, would be recorded as 0480911).

Oversize logs

If a log has a top or butt measurement that exceeds the space allotted for it, or over 99, it should be recorded on a separate line and the first character shown as a dollar sign (\$). This allows three character spaces for each dimension (e.g., \$122082103, where the length is 12.2 m, the top is 82 cm, and the butt is 103 cm). If the next log for the segregation is also oversized, it may be recorded on the same line, again starting with a dollar sign (\$).

Record type 3 (Log detail)

Record type 2 identifies the segregation and will accommodate up to five sets of log dimensions. Additional sets of dimensions can be added to the segregation using a record type 3, which allows eight sets of log dimensions per line.

Position	Field Name	Description
1	Page	Duplicated from the header record.
2	Sequence or Line	Pre-coded on the tally sheet. Starts at line 3 (header records are 00 and 01, record type 2 is line 02).
4	Type	Enter a 3 in this position. This record must always follow directly beneath a record type 2, which has identified the mark/species/grade.
5-11	Scaler's number/raft	These fields are not displayed on the form as they are repeated from the header for all lines of the tally.
12-14	Length	The length of the log measured in decimetres. The background for the length measurement on the tally sheet is always white, displaying the next log's length in positions 19-21, and the next log's length in positions, 26-28, etc.

15-16	Top	The radius of the top of the log measured in centimetres. The top measurement is always recorded in the first two positions shaded in green following the white length measurement field. Therefore, the next log's top measurement would be recorded in positions 22-23, and the next log's top measurement would be recorded in positions 29-30, etc.
17-18	Butt	The radius of the butt of the log, measured in centimetres. The butt measurement is always recorded in the two positions directly following the top measurement, shaded in green. Therefore, the next log's butt measurement would be recorded in positions 24-25, and the next log's butt dimension would be recorded in positions 31-32, etc.

Non coded fields.

The tally sheets also have fields for recording information that may be required but do not have record numbers. These fields are identified by name only.

Field Name	Description
Scaler's signature	All tally sheets must be signed by the scaler upon completion.
Scaled for	The name of the company or person the logs are being scaled for.
Scaling order number	Leave blank.
S&R invoice number	Leave Blank
Remarks	Any information pertinent to the scale such as log salvage, beachcombed, topscale, insect or fire damage.

3. FS 457 Interior Piece Scale Return

Recording the Interior Piece Scale Return - FS 457

For more detailed instructions on each data field refer to page 35.

- A** Enter the number of pages making up the total return.
- B** Enter the Scaler's four character licence number.
- C** Enter the three-digit return number.
- D** Enter the three-character site code assigned to the scale site by the ministry.
- E** Enter the date the scaling was completed in the format YY/MM/DD.
- F** Enter the number of pages that make up the return.
- G** Enter the total volume for all pages of the return.
- H** Enter the code for the forest region to be invoiced.
- I** Enter the name and address code for the party responsible for payment of the invoice.
- J** Enter 0 (zero), unless otherwise specified.
- K** Enter the timber mark displayed on the logs.
- L** Enter the name of the party responsible for paying the invoice.
- M** Enter the name of the location where the timber is being scaled.
- N** Ensure the tally sheet scale return is signed upon completion.
- O** Enter the species code for the log.
- P** Enter the net length recorded to the nearest 0.2 m.
- Q** Enter the inside bark diameter to the nearest radius class.
- R** Enter the inside bark diameter to the nearest radius class.
- S** Enter the grade for the log.
- T** Enter the volume of the log in cubic decimetres (dm³).
- U** Enter the total volume (dm³) for the column.
- V** Enter the total volume for the page in cubic metres (m³).

Province of British Columbia Ministry of Forests

INTERIOR PIECE SCALE RETURN

S&R INVOICE NO. _____

PAGE LINE NO. SCALE NO. RETURN NO. SCALING STATION SCALE DATE NO. OF PAGES THIS RETURN LOG COUNT ALL PAGES THIS RETURN TOTAL VOLUME THIS RETURN

01 01 P 8303721 411A94 113000 135 406

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63

PAGE LINE NO. MARK NO. OF PIECES THIS PAGE PAYABLE BY

01 01 M E11234 0 135 COUNTRY CEDAR LTD.

SCALED AT _____ SCALERS SIGNATURE _____

CEDAR LOG YARD **N** Jack Woodman

PAGE	LINE	SPE. CIES	LENGTH	TOP	BUTT	VOLUME (dm ³)	PAGE	LINE	SPE. CIES	LENGTH	TOP	BUTT	VOLUME (dm ³)	PAGE	LINE	SPE. CIES	LENGTH	TOP	BUTT	VOLUME (dm ³)
01	L	CE0760612	1215			1215	34	L	CE092071114	1354			1354	67	L					
02	L	CE0600509	1100			1100	35	L	CE18731294	3765			3765	68	L					
03	L	CE0780612	1221			1221	36	L	CE181061174	924			924	69	L					
04	L	CE1520714	1585			1585	37	L	CE13906144	1507			1507	70	L					
05	L	CE1230514	427			427	38	L	CE18812154	1089			1089	71	L					
06	L	CE1300616	597			597	39	L	CE18717194	1909			1909	72	L					
07	L	CE18711022	17116			17116	40	L	CE18213154	1126			1126	73	L					
08	L	CE18711126	2341			2341	41	L	CE18313154	1133			1133	74	L					
09	L	CE18710818	11140			11140	42	L	CE18718284	3255			3255	75	L					
10	L	CE1881320	1680			1680	43	L	CE18614214	1861			1861	76	L					
11	L	CE1780613	574			574	44	L	CE16913174	1216			1216	77	L					
12	L	CE1150613	370			370	45	L	CE18917214	2155			2155	78	L					
13	L	CE1950616	894			894	46	L	CE18712204	1598			1598	79	L					
14	L	CE1310613	422			422	47	L						80	L					
15	L	CE171106114	1623			1623	48	L						81	L					
16	L	CE1871218	1175			1175	49	L						82	L					
17	L	CE18607113	1637			1637	50	L						83	L					
18	L	CE1881218	1382			1382	51	L						84	L					
19	L	CE1881627	2909			2909	52	L						85	L					
20	L	CE1810513	1551			1551	53	L						86	L					
21	L	CE1450615	594			594	54	L						87	L					
22	L	CE1420615	582			582	55	L						88	L					
23	L						56	L						89	L					
24	L						57	L						90	L					
25	L						58	L						91	L					
26	L						59	L						92	L					
27	L						60	L						93	L					
28	L						61	L						94	L					
29	L						62	L						95	L					
30	L						63	L						96	L					
31	L						64	L						97	L					
32	L						65	L						98	L					
33	L						66	L						99	L					
TOTAL 19135							TOTAL 20892							TOTAL VOL. THIS PAGE (m ³) 40.6						

FS 457 VAL 8806

Figure 7A.4 FS 457 - Interior piece scale return.

Recording a Tally Sheet for Unsegregated Scale (Detailed)**Recording the FS 457**

Record Type P (1st Header)

Position	Field Name	Description
1	Page	If more than one page is required, enter the page number right oriented and submit the tally sheet in sequential order.
3	Line	Pre-coded on the form.
5	Record type	Pre-coded on the form. The record type indicates the type of data that will follow on the line. For the first header the record type is P.
6	Scaler number	Enter the four character scaler licence number in this field.
10	Return number	Also called a tally or raft number. For each scaler, at the beginning of each year the first return number, 001, should be assigned to the first parcel the scaler scales, and run consecutively through to 999 regardless of the scale site at which he/she is employed. When the scaler reaches return number 999, they must restart with 001.
14	Scaling station	The three character code identifying the scale site where the timber is scaled. This must be a valid site in the HDBS.
17	Scale date	Enter the date the timber is scaled in YY MM DD format. If the scaling spans more than one day, enter the day the scaling is completed. See Remarks section.
23	Number of pages this return	Enter the total number of pages that make up the return. The final page number should equal the number of pages in the return.
26	Log count all pages this return	Enter the total number of logs for all pages of the return.
31	Total volume this return	Enter the total volume of all pages of the return rounded to one decimal place.
38	Purpose of return	Leave blank.

39	Time charges	For ministry use. The field is in the format \$ nnn.nn, and is used to record the total charges for a ministry scaler's time based on an hourly rate. The hours are multiplied by the current rate and entered in this field with preceding zeros when necessary.
45	Expenses	For ministry use. The field is in the format \$nnn.nn, and is used to record any expenses, such as mileage, incurred by a ministry scaler when performing an original scale.
51	FRI	Forest region of invoice. Enter the code for the region to be invoiced. 1 Vancouver 4 Prince George 2 Prince Rupert 5 Nelson 3 Kamloops 6 Cariboo
52	Payable by	Enter the HDBS name and address code of the party to be invoiced.
57	Account code	Code '0' (numeric) unless otherwise advised. This will post the invoice to the licensee's general account.
58	Copy to	Enter the HDBS name and address code of the party to receive the second copy of the invoice if required.
63	-	Leave blank.

Record Type M (2nd Header)

Position	Field Name	Description
1	Page	Refers only to the page of the return. The final page number should equal the total number of pages in the return.
3	Line	Pre-coded on the form.
5	Record type	Pre-coded on the form. The record type indicates the type of data that will follow on the line. For line 00 the record type is M.
6	Mark	Enter the timber mark. Only one mark may be entered per page.
13-15	-	Leave blank.

16	Number of pieces this page	Enter the total piece count for the page. If more than one page is used for the return, enter the total piece count of all pages on the first header in positions 26-30, right oriented.
20-42	-	This field is not edited and can be used to record remarks pertaining to the scale.
43	Payable by	Enter the name of the party to be invoiced.

Record type L (Log detail)

Position	Field Name	Description
1	Page	Leave blank.
3	Line	Pre-coded on tally sheet.
5	Record type	Pre-coded on tally sheet. The record type indicates the type of data that will follow on the line. For the log detail the record number is L.
6	Species	Enter the species code for the log.
8	Length	Enter the net length recorded to the nearest 0.2 m with exact odd 0.1 m being rounded to the nearest lower even number. Where a forest officer permits the timber to be cut into two or more pieces before scaling, the nearest 0.1 m is to be recorded.
11	Top	Enter the inside bark diameter to the nearest radius class.
13	Butt	Enter the inside bark diameter to the nearest radius class.
15	Grade	Enter the grade for the log.
16	Volume (dm ³)	Enter the volume of the log in cubic decimetres.

Logs are to be recorded by species and grade, and organized on the return into groups having the same species and grade to facilitate the preparation of the Summary of Scale.

The total page volumes are determined by adding up the piece volumes in the columns. Divide the sum by 1000 to express the volume in cubic metres. This volume is entered in the 'Total Volume this Page' field located in the lower right hand corner of the form. To calculate the total volume for the return, these page totals are added and the sum is rounded to one decimal place and entered in the header.

There are two additional fields located below the header records that are not identified by a record type, just a field name.

Position	Field Name	Description
1	Scaled at	Enter the name of the location where the timber is scaled.
10	Scaler's signature	The scaler must sign the return upon completion of the scale.

Upon completion of the return, the pieces and volumes by mark species and grade are taken from the tally sheet and transferred to the summary of scale (see FS 72). Volumes on the summary of scale are taken to one decimal point.

4. FS 416 Scale Return Unsegregated Timber

Unsegregated Timber - FS 416

The following is a list of the fields that must be completed on the return by the scaler. For a more detailed explanation of each field, turn to page 42.

- A** Scaler licence number.
- B** Scaler return or raft number.
- C** Scale site number.
- D** Date of the scale.
- E** Number of pages for the return.
- F** Log count. This is the total log count from columns 16-17 of the upper and lower portions of the scale return. If more than one page is required for the parcel, their totals should be added to this figure.
- G** Forest region to be invoiced.
- H** Camp boom number. Load number, or other parcel identification.
- I** Scaled for. The company or person requesting the scale.
- J** Scaler signature. All scale returns must bear the scaler's signature once completed.
- K** The timber mark must be entered stating in column 6 of line 01.
- L** The piece count for the logs recorded on the upper portion of the tally (lines 01 to 25) is entered ending in column 17 (maximum 99).
- M** The first log is recorded species, length, top, butt, and grade. The sort code is for company use only and is not mandatory for ministry purposes.
- N** This line shows the recording of an oversized log. The dollar sign in the first position indicates there will be three digits for each dimension (i.e., a fir D log with dimensions of 6.2 length, a 92 top, and a 102 butt measurement would be recorded \$FI062092102D).
- O** The 2nd mark (M) line is used either for recording dimensions of additional logs, or to identify the logs within the load that did not have a visible timber mark. Unmarked logs are identified by entering the mark beginning in column 6, and an 'N' in column . The piece count for the lower section of the tally (rows 26-37) is entered ending in column 17.
- P** The species, length, top, and butt measurements and grade are entered for the lower section of the tally sheet.

Province of British Columbia Ministry of Forests

SCALE RETURN — UNSEGREGATED TIMBER

SCALING ORDER NO. 6 & INVOICE NO.

SCALER NO.	RETURN NO.	SCALING STATION	DATE	LOG COUNT ALL PAGES	UNIT	HOURS CHARGED	EXPENSES	LIFE	PAYABLE BY	ACTG	SECOND COPY TO
01001P	123A016	18R95013001	23		FR				102493		

COMPANY TIMBER IDENTITY — ALL PAGES

CAMP ROOM NO. NO. OF CHAINS NO. OF RECTIONS

ABC-95-067 ABC LOGGING CO. LTD.

PAGE NO. LINE OPERATION SETTING YARDER LOADER TRUCK

00 U

SCALER'S SIGNATURE

A. Scaler

MARK	PAINT	NO. OF PIECES	SPECIES	LENGTH	TOP	BUTT	GRADE	SORT	SPECIES	LENGTH	TOP	BUTT	GRADE	SORT
01 M	T0123A	21												
02 L	FI0541114J													
03 L	FI0521416J													
04 L	FI0621924I													
05 L	FI0660709U													
06 L	SP0481214J													
07 L	L00420809X													
08 L	FI0400910X													
09 L	FI0581215J													
10 L	L00440810Y													
11 L	FI1001116J													
12 L	FI0841013J													
13 L	SP0641012J													
14 L	SP0628290D													
15 L	FI0641214J													
16 L	FI0701923I													
17 L	L00601114J													
18 L	FI0441113X													
19 L	FI0361316X													
20 L	FI0520910J													
21 L	FI0641012J													
22 L	SP060110118D													
23 L														
24 L														
25 L														
26 M	T0123A	N 2												
27 L	FI0320708X													
28 L	FI0920508Y													
29 L														
30 L														
31 L														
32 L														
33 L														
34 L														
35 L														
36 L														
37 L														

FS 416 HVA 91/5 QP 97349

Figure 7A.5 FS 416 - Scale return unsegregated timber.

Ministry of Forests

CHECKS
DETAILED LOG LISTING WITH DEFECTS

Region : NE NELSON
District : AR ARROW
Scaled By: E. KUSY

Page 1 of 1
Date of Scale: 94.07.13
Time of Scale: 13:11
Date Printed : 95.03.09

Signature: _____

Site Scalar Ret. G Log
No. No. No. N Count Parcel ID Company
5G5 861A 040 G 0021

Log#	Mark	Pt	S	SpG	Gross			Volume	Defects				Net		Srt	Rm	
					Len	Top	But		DTM	Len	Top	Bt	Volume	Volume			
0001	NACRS			CE2	100	010	012	0.383	BF3	20	0	5	0.005	0.379			
0002	NACRS			CE2	150	010	019	1.086						1.086			
0003	NACRS			CE2	140	007	012	0.424	BF3	25	0	7	0.013	0.412			
0004	NACRS			CE2	110	006	012	0.311						0.311			
0005	NACRS			CE2	100	012	014	0.534						0.534			
0006	NACRS			CE2	138	008	014	0.564						0.564			
0007	NACRS			CE2	140	006	011	0.345						0.345			
0008	NACRS			CE4	100	015	021	1.046	HF1	100	1	14	0.309	0.732			
0009	NACRS			CE2	100	018	021	1.202						1.202			
0010	NACRS			CE2	150	006	013	0.483						0.483			
0011	NACRS			CE2	100	010	011	0.347						0.347			
0012	NACRS			CE2	100	005	010	0.196						0.196			
0013	NACRS			R Z	004	004	005	0.003						0.003			
0014	NACRS			CE2	100	008	014	0.408						0.408			
0015	NACRS			CE2	076	007	011	0.203						0.203			
0016	NACRS			CE4	100	010	012	0.383						0.383			
0017	NACRS			CE2	100	008	015	0.454						0.454			
0018	NACRS			CE2	058	008	012	0.190						0.190			
0019	NACRS			CE2	110	008	014	0.449						0.449			
0020	NACRS			CE2	110	005	010	0.216						0.216			
0021	NACRS			CE2	100	010	013	0.423	BF3	30	0	8	0.020	0.401			
PARCEL					2186	181	276	9.650		40	0	0	0.352	9.298			

DEFECT CODES

A Ring Count	G Goiter	O Conk	U Sweep
B Butt Rot	H Heart Rot	P Pocket Rot	V Crook
C Star Check	I Pitch Pockets	Q Ring Shake	W Water Shake
D Straight Check	K Knots	R Ring Rot	
E Sun Check	L Hole	S Sap Rot	
F Fire Damage	M Missing Wood	T Twist	

Figure 7A.6 Computer generated FS 416 or detailed log listing for unsegregated scale.

Recording the FS 416**Record Type P (Header)**

Position	Field Name	Description
1 - 6	Untitled	Precoded or left blank.
7	Scaler number	Enter the four character scaler licence number in this field.
11	Return number	Also called a raft or tally number. For each scaler, at the beginning of each year the first raft number, 001, should be assigned to the first parcel the scaler scales, and run consecutively through to 999 regardless of the scale site at which he/she is employed. When the scaler reaches raft number 999, he/she must restart with 001.
14	Scaling station	The three character code identifying the scale site where the timber is scaled.
17	Date	Enter the date the timber is scaled in YY MM DD format. If the scaling spans more than one day, enter the day the scaling is completed (on the front page if more than one page is used). See remarks section.
23	Number of pages	Enter the total number of pages that make up the return. The final page number should equal the number of pages in the return.
25	Log count - all pages	Enter the total number of logs for all pages of the return.
30-50	Various	Leave blank. Some fields are pre-coded
51	FRI	Forest region of invoice. Enter the code for the region to be invoiced. <div style="display: flex; justify-content: space-between;"> <div> 1 Vancouver 2 Prince Rupert 3 Kamloops </div> <div> 4 Prince George 5 Nelson 6 Cariboo </div> </div>

Record Type P (Header) continued.

52	Payable by	Enter the five digit HDBS name and address code of the party to be invoiced. If unknown, leave blank.
58	Second copy to	Enter the five digit HDBS name and address code if a second party is to receive a copy of the invoice. If unknown, leave blank.

Record Type C (Header)

Position	Field Name	Description
6	Camp boom number	Enter the boom, load, or parcel number.
24	Number of chains	Enter the number of boom chains, swifter wires, dog lines, etc., if applicable.
38	Number of sections	Enter the number of sections if applicable.
? ___?	Scaled for	Enter the name of the party the timber is being scaled for.

Record Type U (Header)

Position	Field Name	Description
6	Operation	For industry use only. Any text entered in this field is not keyed by the ministry.
16	Setting	For industry use only. Any text entered in this field is not keyed by the ministry.
21	Yarder	For industry use only. Any text entered in this field is not keyed by the ministry.
26	Loader	For industry use only. Any text entered in this field is not keyed by the ministry.
31	Truck	For industry use only. Any text entered in this field is not keyed by the ministry.
36	Untitled	For industry use only. Any text entered in this field is not keyed by the ministry.
41	Scaler's signature	All scale returns must be signed by the scaler upon completion.

Record Type M (Detail)

Position	Field Name	Description
6	Mark	Enter the timber mark left oriented beginning in column 6. If the top portion of the tally sheet is completely filled with log records, the lower portion can be used to record additional log dimensions, starting in column 6 of line 26. The lower portion could also be used to identify any logs from the truck load that were not marked, by entering an N in column 15.
13	Paint	Leave blank.
15	S/SB4	An S entered in this field identifies the timber as scaled before. No volumes or charges will be generated for the mark. An N entered in this field identifies the timber as unmarked. The volumes and rates will be attributed to the mark entered in column 6.
16	Number of pieces	This is the total number of pieces contained on the upper portion of the tally, rows 01 to 25.

Record Type L (Log Detail)

Log details are recorded beginning in row 2 directly under the timber mark. The logs can be recorded on each consecutive row, row 3, row 4, etc. until row 25 has been completed. If there are more logs to be scaled, they can be recorded starting in column 18 of the first row, and then the second row etc. This can continue at lines 30, and 42, until the whole top portion of the return is completed (see example). The species and grade columns have been shaded in green to assist the scaler in identifying the correct starting point for recording the logs. The position numbers listed in bold print on the chart, do not have the field name printed on the tally sheet, as they are located in the same position as the mark line, but on the following row (see example).

Record Type L (Log Detail) continued.

Position	Field Name	Description
6, 18, 30, 42	Species	Enter the two character species code.
8, 20, 32, 44	Length	Enter the net length recorded to the nearest 0.2 m with exact odd 0.1 m being rounded to the nearest lower even number. Where a forest officer permits the timber to be cut into two or more pieces before scaling, the nearest 0.1 m is to be recorded.
11, 23, 35, 47	Top	Enter the inside bark diameter to the nearest radius class.
13, 25, 37, 49	Butt	Enter the inside bark diameter to the nearest radius class.
15, 27, 39, 51	Grade	Enter the grade code for the log.
16, 28, 40, 52	Sort	The sort code is not a mandatory field, and is for industry use only. As industry sort codes are not standardized, the ministry does not capture this information

The total number of pieces for the top portion of the tally (column 16-17 of record M on line 01) is added to the total number of pieces for the bottom portion of the tally (column 16-17 of Record M on line 26), and this is entered in the header of the tally in columns 25-29, right oriented*.

The maximum number of logs that can be recorded on the top portion of the tally sheet is 99. An additional 35 log measurements can be recorded on the lower portion of the tally. The timber mark is recorded in row 26, as identified in the chart above. The remainder of the logs can be recorded in rows 27 to 34 for the first column, then rows 26 to row 34 until the tally sheet is full. The FS 416 can accommodate up to a maximum of 134 logs per page.

- * If additional pages are used for the return (i.e., there are more than 134 logs), the total piece count for all the pages that make up the return is entered in columns 25-29 of the header of the first page of the return.

Once the scale is complete, it should be batched with any other returns performed by the scaler, bearing the same scale site, payable by, and month and year of scale. These returns must be listed on an FS 416 Ledger sheet and summarized prior to submission to the ministry. An example of an unsegregated tally ledger batch sheet is shown.



Province of
British Columbia

Ministry of
Forests



UNSEGREGATED TALLY LEDGER SHEET

Vancouver Forest Region

S & R Invoice #: _____
 Record #: _____
 Company/Payable By: ABC LOGGING CO. Second Copy To: _____
 Scale Site Name: RIVER BANK MILL Scale Station #: 18R
 Scaler License #: 123A Number of Tallies: 5
 Last Tally/Rtn #: 018 Date of Scale: 95/01/30 - 95/01/31

	Tally/Rtn#	Camp Boom Number	Timber Mark	# of Pages	# of Pieces
1.	014	ABC-95-065	EACDX	1	54
2.	015	ABC-95-066	NDQRT	2	143
3.	016	ABC-95-067	T0123A	1	23
4.	017	ABC-95-068	EACDX	1	65
5.	018	ABC-95-069	T0123A	1	21
6.					206
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
				Total	

Figure 7A.7 Summary ledger sheet to accompany non-computed FS 416 tally sheets.

Summary of Scale or Monthly Scale Return

The FS 72 (Summary of scale) and the FS 287 (Monthly scale return) have identical data fields, and are therefore *interchangeable*. They can be used to summarize all piece scale returns. Some of the field names and the non-keyed areas of the forms carry different headings, but the edits on the fields are identical.

The FS 287 was designed for Special forest products returns and contains a list of valid Special forest product codes on it. It is used to summarize FS 222s (Record of purchase of special forest products) and FS 200s (Christmas tree returns). The FS 72 can be used to summarize these forms, as well as the FS 244 (Tally sheet scale return - small), the FS 36 (Tally sheet scale return - large), the FS 457 (Interior piece scale return), and the FS 416 (Scale return - unsegregated timber).

5. FS 72 Summary of Scale

Summary of Scale - FS 72

- A** Scaler's Licence Number. Enter the four-character licence number.
- B** Scaler's return number. Enter the three-digit return or tally number (this number should not be duplicated by the same scaler, to ensure each return has a unique identity).
- C** Camp boom number. Enter the load number, boom number, or other identity given to the parcel.
- D** Number of sections. If a boom is divided into sections, enter the number of sections to one decimal place, and with leading zeros if applicable.
- E** Date of scale. Enter the date the scaling was completed.
- F** Payable by. Enter the five digit name and address code for the party to receive the invoice. If unknown leave blank.
- G** FRS. Forest region scaled. Enter the number of the region in which the timber is scaled.
- H** Scaler's log count. Enter the total number of pieces included in the return. If there is no piece count, enter 0 (zero), as this field must be populated.
- I** Scaling Station Number. Enter the three character scale site number issued by the ministry.
- J** Place of scaling. Enter the name of the location where the timber is scaled.
- K** Timber mark. Enter the timber mark left oriented.
- L** Number of pieces. Enter the number of pieces for the species/grade and/or product segregation. If there is no piece count, enter 0 (zero) as this field must be populated.
- M** Species. Enter the two character species code.
- N** Grade. Enter the grade (if any) that applies to the timber.
- O** Other description. This field can be used to enter other descriptions for the timber, such as B/S for boomsticks, or a special forest product code.
- P** Quantity. Enter the volume right oriented and to one decimal place. If there is no volume (i.e., the volume is < 0.1, or it is a Christmas tree return), enter 0 (zero), as this field must be populated.

- Q** Scaler's signature. Completed summaries must be signed by the scaler performing the scale.
- R** Payable by. Enter the name of the party who is responsible for payment of the invoice.
- S** The piece count and/or volumes should be totalled and written below the entries, when there is more than one line of data. The sequence number of the line where the totals are entered should be obliterated so the totals do not get keyed.
- T** Remarks. Any special notations or remarks, such as beachcombed wood, topscale, or stock scale, should be noted in this field.

[illegible]

Figure 7A.8 FS 72 - Summary of scale.

CHECKS
SUMMARY OF SCALE (F.S. 72)

Region : NE NELSON
District : AR ARROW
Scaled By: E. KUSY

Page 1 of 1
Date of Scale: 94.07.13
Time of Scale: 13:11
Date Printed : 95.03.09

Signature: _____ S & R # _____

Company :

SEQ#	SCLR#	RET#	PRED.MARK	NUM. OF CHAINS	CAMP BOOM NUMBER
(1)0000	(5)861A	(9)040	(12)	(19)_____	(33)

SECT	YYMMDD	PAY BY	COPY TO	EXPENSES	TIME CHG
(51) 0	(54)940713	(60)_____	(65)_____	(70)_____	(75)_____

SEQ#	FNF	LOGS	SITE#	PLACE OF SCALING
(1)0011	(12)5__	(15)0021	(19)5G5	(22)POPLAR CREEK NEAR

SEQ#	MARK	PAINT	SB4	PIECES	SPGR	OTHER	QUANTITY	RATE
(1)----(12)-----	(19)--(21)-(22)-----	(27)---(30)---	(33)-----	(40)-----				
0024	NACRS			18	CE		8.2	
0034	NACRS			2	CE4		1.1	
0044	NACRS			1	R Z		0.0	

TOTALS				21			9.3	

Figure 7A.9 Computer-generated FS 72 Summary of scale.

6. FS 287 Monthly Scale Return

Monthly Scale Return - FS 287

- A** Scaler's licence number. Enter the four character licence number.
- B** Day of year. Enter the three digit tally number, using the Julian Calendar date. However, if the scaler performs more than one scale on the same day, the same number should not be used, as the return must maintain a unique identity (see also 'raft number' under recording a tally sheet scale return, page 104).
- C** Position 33 - 50 untitled. This field can be used to record any identification such as the FS 222, or FS 200 number. The information entered in this field is displayed on the invoice.
- D** Date of return. Enter the date the scaling was completed.
- E** Payable by. Enter the five digit name and address code for the party to receive the invoice. If the name and address code is unknown, leave this field blank.
- F** FRS. Forest region scaled. Enter the number of the region in which the timber is scaled.
- G** Total pieces. Enter the total number of pieces included in the return. If there is no piece count enter 0 (zero), as this field must be populated.
- H** Scaling station number. Enter the three character scale site number issued by the ministry.
- I** Place of scaling. Enter the name of the location where the timber is scaled.
- J** Timber mark. Enter the timber mark left oriented.
- K** Number of pieces. Enter the number of pieces for the species/grade or product segregation. If there is no piece count, enter 0 (zero), as this field must be populated.
- L** Species. Enter the two character species code.
- M** Grade. Enter the grade (if any) that applies to the timber.
- N** Product code. Enter the special forest product code that applies to the timber. Leave blank for logs.
- O** Quantity. Enter the volume right oriented and to one decimal place. If there is no volume (e.g., Christmas trees), enter 0 (zero).

- P** Scaler's signature. Completed monthly returns must be signed by the scaler performing the scale.
- Q** How delivered.
- R** The piece count and/or volumes should be totalled and written in the field below the entries. The sequence number of the line where the totals are entered should be obliterated so the totals do not get keyed.

FS 287 HVA 90/12

Figure 7A.10 FS 287 - Monthly scale return for special forest products.

7. FS 222 Record of Purchase of Special Forest Products

Record of Purchase of Special Forest Products - FS 222

Special forest products, excluding Christmas trees and those products best suited to the B.C. Metric Scale, are scaled on the form FS 222. As this is not a valid input document for the HDBS, it must be summarized on a Monthly return (FS 287) or a Summary of scale (FS 72).

- A** Timber mark. Only one timber mark per page.
- B** Date. Date when scale was completed.
- C** Place. Name of the site and site number assigned by the ministry.
- D** Purchaser. Name of the person or company that purchased the product.
- E** Vendor. Name of the person or company that sold the product.
- F** Description. Enter the species and a full description of the special forest product including the size and number of pallets where applicable (see scaling special forest products, Chapter 8).
- G** Length or squares. Enter the length to the nearest 0.2 m (2 cm).
- H** Width or bundles. Enter the width measured to the nearest 0.2 m (2 cm).
- I** Height or pieces. Enter the height measured to the nearest 0.2 m (2 cm).
- J** Factor. Enter the factor applied to the volume of the special forest product (for stacked method).
- K** Metres. Enter the volume calculated to the nearest 0.1 m³.
- L** Signature of scaler. Must be signed by the scaler upon completion, and include the scaler's licence number.
- M** Signature of vendor or agent.
- N** Address of purchaser and destination of product.
- O** Address of vendor.

Province of British Columbia Ministry of Forests

RECORD OF PURCHASE OF SPECIAL FOREST PRODUCTS

TIMBER MARK 23 4560 **451210**

DATE 94 11 16 **PLACE** WESTSIDE CEDAR 32B

PURCHASER JOHN SMITH **VENDOR** THOMAS BROWN

DESCRIPTION	LENGTH OR SQUARES	WIDTH OR BUNDLES	HEIGHT OR PIECES	FACTOR	METRES ³
CE SB	4.92	2.44	3.24	0.08	31.1

AMOUNT OF STUMPAGE * AND/OR ROYALTY COLLECTED

SCALER'S SIGNATURE Joe Scaler **VENDOR OR AGENT'S SIGNATURE** T. Brown

PURCHASER'S ADDRESS 123 MAIN ST. KAMLOOPS **VENDOR'S ADDRESS** 225 MAJOR AVE. VERNON

FS 222 HVA 89/7 DISTRIBUTION: WHITE - VENDOR; CANARY - DISTRICT FORESTER (attached to scale); PINK - PURCHASER

Figure 7A.11 FS 222 - Record of purchase of special forest products.

8. FS 200 Christmas Tree Return

Christmas Tree Return - FS 200

Christmas trees are classified as a special forest product, but because they are scaled only using a piece and size count require a separate form. The FS 200 is the ministry form used in collecting return information on Christmas trees. Christmas trees must be scaled on the area of origin.

- A** Date of scaling.
- B** Place. Enter the name of the site where the Christmas trees were scaled.
- C** Area of origin.
- D** C.T.P. number Christmas tree permit number.
- E** Lot number.
- F** Land district.
- G** Timber mark.
- H** Stumpage owner's name.
- I** Stumpage owner's address.
- J** Cutter's name.
- K** Cutter's address.
- L** Scaled for. Enter the name or company that requested the scale.
- M** Enter the name of the party to receive the invoice.
- N** Enter the number of trees by height category.
- O** Ensure the cutter signs and dates the return.
- P** Ensure the scaler signs the return.
- Q** Ensure the trucker signs the return.
- R** Enter licence plate number of truck.
- S** Destination.
- T** Date hauled.

Province of British Columbia Ministry of Forests

61841 C

TREES MUST BE SCALED ON AREA OF ORIGIN: CHRISTMAS-TREE RETURN

1. DATE OF SCALING Y M D 94 11 16		PLACE 1234 MAIN STREET	
2. AREA OF ORIGIN	C.T.P. NO.	LOT NO.	LAND DISTRICT
3. STUMPAGE OWNER'S NAME H JOHN SMITH	ADDRESS I 5432 GOVERNMENT AVE.		
4. CUTTER'S NAME J JACK BROWN	ADDRESS K 3456 NEWTON ST.		
5. SCALED FOR L M. THOMSON			
6. CHARGES PAYABLE BY (Please print) M MARIE THOMSON			
ADDRESS 1145 BROADWAY			
7. TREES SCALED			
SIZE	MERCHANTABLE TREES	CULLS	COMMENTS (SPECIES, ETC.)
N LESS THAN 3 m	514		
3 m TO 5 m	24		
MORE THAN 5 m			
TOTALS	538		
8. CUTTER'S SIGNATURE O J. Brown		DATE Y M D 94 11 15	9. SCALER'S SIGNATURE P A. Scaler
10. NUMBER OF TRUCKLOADS THIS MANIFEST COVERS	TRUCKER'S SIGNATURE Q R. Jackson	TRUCK LICENCE NUMBER	
11. DESTINATION OR SHIPPING POINT S MARIE'S NURSERY		12. DATE HAULED Y M D 94 11 16	IS CUTTING COMPLETED ON AREA? ☐ Yes ☒ No
13. COMMENTS			

DISTRIBUTION: WHITE - DISTRICT MANAGER; CANARY - DISTRICT MANAGER; PINK - BUYER;
GREEN - CARRIED BY TRUCKER; BLUE - LAND-OWNER OR CUTTER

Spilled return forms must be left in the book with the word "cancelled" written thereon.

FS 200 HVA 91/2

Figure 7A.12 FS 200 - Christmas tree return.

7A.2 Weight Scale Forms

For weight scaling, the forms required for submission are the Weight scale load slip (FS 488), Weight scale station daily load inventory (FS 482), the Weight scale sample tally (FS 239), the Weight scale monthly return (FS 493), and the Weight scale monthly return summary sheet (also reported on an FS 493). Most companies today are using hand held computers, random number generators, and systems that produce computer generated versions of these forms. All computer generated forms must be approved by the ministry, prior to their use.

A Weight scale load slip (see Figure 7.14) is generated for every truck load of logs arriving at the scale site. It records the gross weight upon arrival, and the tare weight prior to departure. The net weight is then calculated, and the sum of the net weight of all the loads for the day is entered on the weight scale monthly return.

The weight scale station daily load inventory is a list of all loads arriving at the scale station on a daily basis. It lists the load arrival number, stratum, timber mark, weight slip number, truck number, in and out times, as well as the gross, tare and net weight (see Figure 7.16).

The Weight Scale Sample Tally

When a truck load is identified as a sample, it must be 100% piece scaled on a weight scale sample tally, or its electronically produced equivalent. The sample tallies (see Figure 7.20) are submitted to the ministry and input into the Harvest Billing System (HBS), which establishes a volume to weight ratio for each species grade.

A weight scale monthly return (see Figure 7.22) must be completed at the end of each month for each population, stratum, and timber mark. It displays the total loads and weight for each day, as well as the monthly totals. This is the input document used to generate a scale and royalty invoice.

A weight scale summary sheet monthly scale return summarizes all the monthly returns for a population and must be submitted with them.

1. FS 488 Weight Scale Load Slip

Weigh Scale Load Slip - FS 488

The following fields are mandatory and must be filled in by the scaler. To view a computer generated version of this form see Figure 7.14.

- A** Place of scale.
- B** Scale station number.
- C** Enter the time the truck was weighed in at the station.
- D** Enter the time the truck was weighed out.
- E** Enter the date the truck was weighed.
- F** Enter the gross weight (the total weight of the load and the truck).
- G** Enter the tare weight (the weight of the unloaded truck).
- H** Enter the net weight of the load (subtract the tare weight from the gross weight).
- I** Enter the species in the load from the load description slip.
- J** Enter the load arrival number. This is a consecutive number assigned to each load as it arrives at the scale station.
- K** Enter the population, the stratum, and the year. The 'year' is the cyclic billing year end.
- L** Enter the truck number.
- M** Enter the contractor number.
- N** Enter the timber mark on the load. There can be only one timber mark per load.
- O** Ensure the truck driver has signed the load slip.
- P** The load slip must be signed by the scaler.

 Province of British Columbia		 Ministry of Forests		WEIGH SCALE LOAD SLIP		NO. 474352 P	
WEIGHED AT (Place) A PACIFIC INLAND RESOURCES LTD.				(Scaling Station No.) B 236			
C	TIME IN 07:25		GROSS WEIGHT 44780		F		
D	TIME OUT 07:43		TARE 13780		G		
	DATE 09-13-94 E		NET WEIGHT 31000		H		
LOGS: ☐ Short ☐ Long		SPECIES BALSAM I		ARRIVAL LOAD NO. 490		J	
REMARKS		POPULATION / STRATUM / YEAR 2336 / 12 / 95				K	
L	TRUCKER 028		BLOCK NO.		BLOCK LOAD NO.		
M	CONTRACTOR 329		LOG MARK 44165 N				
DRIVER'S SIGNATURE O		SCALER'S SIGNATURE P					

FS 488 HVA 91/1

Figure 7A.13 FS 488 - Weight scale load slip.



PACIFIC INLAND RESOURCES LTD.
A DIVISION OF WEST FRASER MILLS LTD.

P.O. BOX 3130
SMITHERS, B.C.
V0J 2N0
PHONE: (604) 847-2656
SCALES: 847-3637

NO. 161137

WEIGHT SCALE LOAD SLIP

DRIVER'S SIGNATURE _____

SCALER'S SIGNATURE _____

SPECIES _____

Weighed at SMITHERS

Scaling Station No. 236

Time In 07:25
Time Out 07:43
Date Out 09-13-94

Gross 44780 kg
Tare 13780 kg
Net 31000 kg

Sample/Redtag	SAMPLE	Sample number	9		
Stratum	12	Yearly load no.	143	Year	95
Population	2336	Ticket Retrieve No.	672431	Type	L
Timber Mark	44165	Arrival Load No.	490	Edited	NQ

Company Name PIR SCALE BASE
Trucker 028 HEA
Contractor 329 HEA
Bucker
Yarder

Loader
Yard No. S

Company Code A
Block No.
Skidder
Faller 490
Description MB

Remarks: _____

APPROVED IN LIEU OF FS488 - MINISTRY OF FORESTS

Figure 7A.14 Example of a computer-generated weight scale load slip.

2. FS 482 Weight Scale Daily Load Inventory

Recording the Weight Scale Daily Load Inventory - FS 482

For an example of a computer-generated daily load inventory see Figure 7.16.

- A** Enter the three digit site number assigned by the ministry.
- B** Enter the name of location of the scale station.
- C** Enter name of the company or operation.
- D** Enter the page sequence you are working on. If there is more than one page for the day, enter the total pages in second line upon completion.
- E** Enter the day the loads were weighed.
- F** Enter the name/licence number of the weight-scaler.
- G** Enter the monthly load arrival number, assigned sequentially throughout the month at the site.
- H** Enter the load slip number or ticket retrieval number from the load slip (also called a load description slip or bush slip).
- I** Enter the number of the stratum into which the load is designated.
- J** Enter the block and load number where applicable.
- K** Enter an S to indicate a sample load to be set aside for scaling.
- L** Enter the timber mark on the load.
- M** Enter the truck number.
- N** Enter the times the truck was weighed upon arrival to, and departure from, at the scale site.
- O** Enter the gross (truck and load), tare (truck only), and net (gross minus tare) weight in kilograms.
- P** Enter the total number of loads and weights at the bottom of the page.

Weight Scale No. 236 ^A  Province of British Columbia Ministry of Forests Page 1 of 2 ^D

Location SMITHERS ^B ^C **WEIGHT-SCALE STATION** Date of weighing 09-13-94 ^E

Operation PACIFIC INLAND RESOURCES ^F **DAILY LOAD INVENTORY** Weight-scales ^F

Monthly Load No.	Ship No.	Stratum	Block and Load No.	S	Mark	Truck	Time		O	Weight		
							In	Out		Gross	Tare	Net kg
484	671489	11			NAGPA	090	06:07	06:19		45540	18540	27000
485	671646	04			EM7626	018	06:26	06:42		59580	19240	40340
486	671803	08			WG8357	542	06:39	06:56		40520	13320	27200
487	671960	08			WG8357	168	06:38	07:03		45440	13660	31780
488	672117	04			EM7626	017	06:49	07:05		50880	17140	33740
489	672274	04			EM7602	108	07:20	07:36		41480	14620	26860
490	672431	12		S	44165	028	07:35	07:43		44780	13780	31000
491	672588	03			YR1142	050	07:38	08:03		42600	13420	29180
492	672745	03			L40205	004	07:45	08:05		51140	16380	34760
493	672902	03			L40205	800	07:46	08:08		49380	15940	33440
494	673059	04			EM7626	036	07:50	08:15		51320	16100	35220
495	673216	11			NAGPA	090	07:57	08:11		46560	18560	28000
496	673373	04			EM7626	021	08:13	08:26		51160	15760	35400
497	673530	04			EM7626	035	08:24	08:43		52100	15400	36700
498	673687	08			44165	038	08:30	08:47		45000	14260	30740
499	673844	06			EM7626	010	08:44	08:58		42620	14000	28620
500	674001	08			WG8357	542	08:48	09:09		44360	13280	31080
501	674158	07			WG8374	015	08:50	09:07		44100	14400	29700
502	674315	01			FD2600	972	09:02	09:21		49040	15900	33140
503	674472	08			WG8357	168	09:19	09:47		44020	13660	30360
504	674629	03			YR1142	050	09:37	09:45		42420	13420	29000
505	674786	11			NAGPA	090	09:41	09:53		44760	18720	26040
506	675257	07			WG8374	098	10:01	10:30		47400	16140	31260
507	675414	04			EM7602	053	10:07	10:27		44160	15900	28260
508	675571	01			FD2201	650	10:15	10:39		52720	15120	37600
509	675728	04			EM7602	014	10:31	10:51		42100	12300	29800
510	675885	08			WG8357	542	10:44	11:03		43680	13280	30400
511	676042	04			EM7602	335	10:55	11:13		41480	14220	27260
512	676199	12			44165	028	10:59	11:19		44800	13880	30920
513	676356	11			NAGPA	090	11:17	11:31		45260	18700	26560
514	676513	04			EM7602	023	11:43	12:00		42160	12500	29660
515	676670	03			L40205	004	11:45	12:04		50280	16520	33760
516	676827	03			L40205	800	11:48	12:09		50020	15980	34040
517	676984	11			NADHU	023	11:49	12:10		50840	15740	35100
518	677141	07			WG8357	168	12:01	12:18		43520	13660	29860
519	677298	07			WG8374	015	12:17	12:39		42540	14440	28100
520	677455	06			44165	050	12:35	12:52		38300	13420	24880
521	677612	04			EM7602	121	12:37	12:58		58820	16180	37640
522	677769	08			WG8357	542	13:06	13:22		44560	13240	31320
523	677926	11			NAGPA	090	13:11	13:24		46500	18660	27840
524	678083	08			WG8374	098	13:25	13:40		43900	16140	27760
525	678240	04			EM7527	185	13:27	13:48		42020	16500	25520
526	678397	02			365175	042	13:36	13:56		56520	17500	39020
527	678554	04			EM7626	018	13:53	14:09		58380	19620	38760
528	678711	04			EM7626	017	14:04	14:29		51860	17120	34740
529	678868	04			EM7626	017	14:04	14:29		51860	17120	34740
530	679025	04			EM7626	017	14:04	14:29		51860	17120	34740
531	679182	04			EM7626	017	14:04	14:29		51860	17120	34740
532	679339	04			EM7626	017	14:04	14:29		51860	17120	34740
533	679496	04			EM7626	017	14:04	14:29		51860	17120	34740
534	679653	04			EM7626	017	14:04	14:29		51860	17120	34740
535	679810	04			EM7626	017	14:04	14:29		51860	17120	34740
536	679967	04			EM7626	017	14:04	14:29		51860	17120	34740
537	680124	04			EM7626	017	14:04	14:29		51860	17120	34740
538	680281	04			EM7626	017	14:04	14:29		51860	17120	34740
539	680438	04			EM7626	017	14:04	14:29		51860	17120	34740
540	680595	04			EM7626	017	14:04	14:29		51860	17120	34740
541	680752	04			EM7626	017	14:04	14:29		51860	17120	34740
542	680909	04			EM7626	017	14:04	14:29		51860	17120	34740
543	681066	04			EM7626	017	14:04	14:29		51860	17120	34740
544	681223	04			EM7626	017	14:04	14:29		51860	17120	34740
545	681380	04			EM7626	017	14:04	14:29		51860	17120	34740
546	681537	04			EM7626	017	14:04	14:29		51860	17120	34740
547	681694	04			EM7626	017	14:04	14:29		51860	17120	34740
548	681851	04			EM7626	017	14:04	14:29		51860	17120	34740
549	682008	04			EM7626	017	14:04	14:29		51860	17120	34740
550	682165	04			EM7626	017	14:04	14:29		51860	17120	34740
551	682322	04			EM7626	017	14:04	14:29		51860	17120	34740
552	682479	04			EM7626	017	14:04	14:29		51860	17120	34740
553	682636	04			EM7626	017	14:04	14:29		51860	17120	34740
554	682793	04			EM7626	017	14:04	14:29		51860	17120	34740
555	682950	04			EM7626	017	14:04	14:29		51860	17120	34740
556	683107	04			EM7626	017	14:04	14:29		51860	17120	34740
557	683264	04			EM7626	017	14:04	14:29		51860	17120	34740
558	683421	04			EM7626	017	14:04	14:29		51860	17120	34740
559	683578	04			EM7626	017	14:04	14:29		51860	17120	34740
560	683735	04			EM7626	017	14:04	14:29		51860	17120	34740
561	683892	04			EM7626	017	14:04	14:29		51860	17120	34740
562	684049	04			EM7626	017	14:04	14:29		51860	17120	34740
563	684206	04			EM7626	017	14:04	14:29		51860	17120	34740
564	684363	04			EM7626	017	14:04	14:29		51860	17120	34740
565	684520	04			EM7626	017	14:04	14:29		51860	17120	34740
566	684677	04			EM7626	017	14:04	14:29		51860	17120	34740
567	684834	04			EM7626	017	14:04	14:29		51860	17120	34740
568	684991	04			EM7626	017	14:04	14:29		51860	17120	34740
569	685148	04			EM7626	017	14:04	14:29		51860	17120	34740
570	685305	04			EM7626	017	14:04	14:29		51860	17120	34740
571	685462	04			EM7626	017	14:04	14:29		51860	17120	34740
572	685619	04			EM7626	017	14:04	14:29		51860	17120	34740
573	685776	04			EM7626	017	14:04	14:29		51860	17120	34740
574	685933	04			EM7626	017	14:04	14:29		51860	17120	34740
575	686090	04			EM7626	017	14:04	14:29		51860	17120	34740
576	686247	04			EM7626	017	14:04	14:29		51860	17120	34740
577	686404	04			EM7626	017	14:04	14:29		51860	17120	34740
578	686561	04			EM7626	017	14:04	14:29		51860	17120	34740
579	686718	04			EM7626	017	14:04	14:29		51860	17120	34740
580	686875	04			EM7626	017	14:04	14:29		51860	17120	34740
581	687032	04			EM7626	017	14:04	14:29		51860	17120	34740
582	687189	04			EM7626	017	14:04	14:29		51860	17120	34740
583	687346	04			EM7626	017	14:04	14:29		51860	17120	34740
584	687503	04			EM7626	017	14:04	14:29		51860	17120	34740
585	687660	04			EM7626	017	14:04	14:29		51860	17120	34740
586	687817	04			EM7626	017	14:04	14:29		51860	17120	34740
587	687974	04			EM7626	017	14:04	14:29		51860	17120	34740
588	688131	04			EM7626	017	14:04	14:29		51860	17120	34740
589	688288	04			EM7626	017	14:04	14:29		51860	17120	34740
590	688445	04			EM7626	017	14:04	14:29		51860	17120	34740
591	688602	04			EM7626	017	14:04					

WEIGHT - SCALE STATION										Page: 1 of 2	
DAILY LOAD INVENTORY										Date of Weighing 09-13-94	
Weight Scale No. 239										Date of Printing 09-13-94	
Location: SMITHERS										Time of Printing 18:04	
Operation PR SCALE BASE										Weight Scaler _____	

Figure 7A.16 Computer-generated weight scale daily load inventory.

3. FS 484 Daily Report by Stratum

0-44-2-19480-2

June 1, 1995

4. Computer Generated Daily Report by Stratum

Population No.: 6001
Scaling Year: 94

Daily Summary
For 10/03/94

Page: 1
Weigh Scale No. 619

Location: AINSWORTH LUMBER - CHASM DIV.
Report By Company By Stratum By Timber Mark

Company: A	Stratum	Timbermark	Loads	Net kg
Ainsworth Lumber	20	33444	4	136500
Chasm Div.		EU9111	4	108500
		EU9124	2	65750
	Stratum	Totals	10	310750
	22	EU9116	1	36370
		EU9124	2	66850
	Stratum	Totals	3	103220
	Scale Base Totals		13	413970
	30	26228	2	57180
		39333	26	1026100
	Stratum	Totals	28	1083280
	31	ES8538	8	281080
		ES8545	4	136840
	Stratum	Totals	12	417920
	Cruise Base Totals		40	1501200
	35	DWL604	10	281080
		DPG413	8	136840
	Stratum	Totals	18	417920
	Prescaled Totals		18	417920
COMPANY TOTAL			71	2333090

Figure 7A.18 Computer generated daily report by stratum.

5. FS 239 Weight Scale Sample Tally

Weight Scale Sample Tally - FS 239

The computerized version of an FS 239 is called an FS 531. An example of an FS 531 can be viewed in Figure 7.20.

- A** Enter the Scaler's four character licence number.
- B** Enter the scaler's tally number (for a more detailed explanation of this field see page 78).
- C** Enter the three digit site number assigned by the ministry.
- D** Enter the date the sample scale is performed.
- E** Enter the load arrival number.
- F** Enter the load description (bush) slip or ticket retrieval number, left oriented.
- G** Enter the population/stratum/cyclic billing year (billing year end).
- H** Enter the block or sample number, right oriented (zero filled to the left).
- I** Enter the net weight (from the load slip), right oriented.
- J** Enter the timber mark on the load.
- K** Enter an F if the load is an original scale. Enter a C if the load is a check scale.
- L** Enter the total number of logs in the load, right oriented.
- M** Enter M for metric if not hardwired (pre-printed) in system.
- N** Enter the name of the scale site.
- O** The scaler must sign the tally upon completion of the scale.
- P** Enter a 2, in card type 3 column, followed by the species and grade for the following segregation of logs.
- Q** Enter a 3, in card type 3 column to continue to add log dimensions to the segregation. Each card type 3 must be preceded by a card type 2 identifying the species and grade.
- R** Enter the total number of piece for the segregation once the scale is completed. For a more detailed explanation of the card types, refer to page 76.

Province of British Columbia Ministry of Forests

WEIGH SCALE SAMPLE TALLY

METRIC SCALE RECORD

CARD		A		B		C		D		E		F		G		H		I		J		K		L		M	
LINE	TYPE	SCALERS NUMBER	SCALERS TALLY NUMBER	WEIGH SCALE STATION NUMBER	DATE OF SCALE	LOAD ARRIVAL NUMBER	WEIGH SCALE SUP NUMBER	POPULATION	STATUS	SAMPLE BLOCK	BLOCK NUMBER	BLOCK LOAD NUMBER	NET WEIGHT	MARK	F&C	LOG COUNT	PAGES										
01		744A	2502	0394	0913	1146	220224	250302	294049				0319	204154	71	F	48	MM									
		SCALED AT GREENVILLE N BY FEW O																									
02	HEH	2	1102	936	054	2125																					
03	HEJ	9	164	1015	094	1117	154	1430	124	1317	058	1012	138	1620	126	1317											
04	HEJ	16	115	126	1317																						
05	HEU	16	042	1314	048	0712	062	1016	130	0715	130	0714	102	0916	124	2227											
06	HEU	15	17	036	2023	070	0812	062	1016	056	0711	096	0716	172	0820	124	2213										
07	HEU	08	09																								
08	HEX	5	080	1520	134	0915	108	0709	106	0713	062	1415															
09	HEY	5	042	2024	078	1622	056	2022	094	0821	102	0612															
10	BAI	1	042	2025																							
11	BAJ	1	098	0812																							
12	BAU	9	050	1519	080	2931	112	0715																			
13	BAX	1	092	0515																							
14	BAY	1	082	1222																							
15	SPJ	1	074	1014																							
16	SPU	2	118	1121	094	1015																					
17	SPX	1	084	1013																							
18																											
19																											
20																											
21																											
22																											
23																											
24																											
25																											
26																											
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44																											
45																											
46																											
47																											
48																											
49																											
50																											
51																											

FS 239W HVA 9008

Figure 7A.19 FS 239 - Weight scale sample tally.

6. FS 531 Weight Scale Computed Sample Tally

FS 531 Weight Scale Computed Sample Tally

COMPUTED WEIGHT SCALE SAMPLE (FS. 531)

ABC LOGGING COMPANY
GREEN LAND DIVISIONREGION: SMITHERS
DISTRICT: BULKLEYPAGE: 01 OF 01
DATE: 01.16.95
TIME: 17:22SIGNED: A. Scaler

COL	SEQ#	SCALER#	TALLY#	WEIGHT SCALE#	DATE SCALED	LOAD ARRIVAL#	SLIP#	POP/STR/YR		
1-3	4-7	8-10	11-13	14-19	20-23	24-30	31-38			
---	---	---	---	---	---	---	---	---		
	1234	016	109	950116	141	19382	20101395			
	BLOCK#	BLOCK LOAD#	NET WEIGHT	MARK	F or C	SIGN	#LOGS	O/R	M or I	PAGES
	39-41	42-44	45-50	51-57	58	59	60-63	64	65-66	67
---	---	---	---	---	---	---	---	---	---	---
14	16	42950	EA2089	F			0140		M	1

SPECIES - GRADE SUMMARY
[-METRIC SCALE-]

COL	SEQ#	SPECIES	GR	NUMBER OF PIECES	SAMPLE VOLUME
1-3	11-12	13	14-16	17-21	
---	---	---	---	---	---
024	FI		006	3.76	
034	WH	5	006	2.21	
044	BA	3	021	4.98	
054	BA	5	005	0.84	
064	WH	3	004	1.60	
074	BA		082	35.20	
084	BA	6	010	1.34	
094	WH		001	0.20	
104	SP		001	0.34	
114	HE		002	0.30	
124	FI	3	001	0.11	
134	R	Z	001	0.00	

14T	TOTAL	140	50.88
-----	-------	-----	-------

Figure 7A.20 FS 531 - Computer-generated weight scale sample tally.

7. FS 493 Weight Scale Monthly Return

Recording the Weight Scale Monthly Return - FS 493

- A** Enter the name of the forest region of scale.
- B** Enter the name of the forest district of scale.
- C** Ensure the scaler's signature is recorded as verifying the document..
- D** Enter the scaler's licence number.
- E** Enter the number of loads for each day of the month.
- F** Enter the net weight for the total loads weighed each day.
- G** Enter the population/stratum/cyclic billing year (billing year end).
- H** Enter the timber mark on the loads (only one mark can be summarized per FS 493).
- I** Enter the last date of the month of scale in the format year/month/day.
- J** Enter the total number of loads weighed during the month.
- K** Enter the total net weight for all the loads weighed during the month.
- L** Enter the three digit scale site number.

Recording the Weight Scale Monthly Summary Sheet - FS 493

Although identical in format to the monthly return, the FS 493 Summary sheet is a summary of all the FS 493s (i.e., all the timber marks) for a population for each month.

The fields are filled out exactly the same as the monthly return with the following exceptions. An example of a computer generated weight scale monthly return is shown in Figure 7.22.

- E** Enter the total number of loads for each day from all the FS 493s for the month.
- F** Enter the total net volume for those corresponding loads.
- H** Enter *summary* in the timber mark field.
- J** Enter the total number of loads for the month, for all timber marks.
- K** Enter the total net weight for the month, for all timber marks.



Province of
British Columbia

Ministry of
Forests



452009

WEIGH SCALE MONTHLY RETURN

Forest Region PRINCE RUPERT

Forest District BULKLEY

Verified by W. Aronson

Scaler's License/
Permit No. 9471

Remarks: _____

Billed under
S and R No. _____

Day	Loads	Weight
1	4	119540
2	2	59880
3		
4		
5		
6	2	64120
7	2	60420
8	1	31560
9	2	48620
10		
11		
12	2	55380
13	1	30740
14	3	87100
15	3	84980
16	2	51920
17		
18		
19	3	96940
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Record No.	Type	Population 3	Stratum 7	Sampling 9	Year 11	Mark	Month Ending			Total No. of Loads for Month	Total Weight for Month	Weigh Scale Number 37
							Yr. 18	Mo. 20	Day 22			
A 0		2336089544165					94	09	30	27	791200	236

FC 493 VOL 60/08

Figure 7A.21 FS 493 - Weight scale monthly return.

FOR Weight Scale Monthly Return AUDIT NO. 002217
 A.B.C. Logging Company
 Month Ending: 94/09/30 TUE. OCT. 4, 1994 11:19 AM Pg 39 of 60
 SCALERS LICENCE NO.: 1234 BILLED UNDER S AND R NO.:

Day	Loads	Weight
1	4	119540
2	2	59880
3		
4		
5		
6	2	64120
7	2	60420
8	1	31560
9	2	48620
10		
11		
12	2	55380
13	1	30740
14	3	87100
15	3	84980
16	2	51920
17		
18		
19	3	96940
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

CARD

MO. END

SEQ.	TYPE	POPUL.	STR.	YR	MARK	YR	MO	DA	LOADS	WEIGHT	WS#
1	2	3-6	7-8	9-10	11-17	18	20	22	24-27	28-36	37-39
1	0	2839	08	95	45168	94	09	30	0027	000791200	236

** Electronically Transmitted in Batch 10041116 - Not For Submission **

Approved in lieu of FS 493 for use in the
 PRINCE RUPERT FOREST REGION - MINISTRY OF FORESTS
 Verified By :
 Remarks :

Figure 7A.22 Computer-generated weight scale monthly return.

7A.3 Scale and Royalty Invoices

A scale return, for a truck load, a boom, a monthly production, or any other identifiable parcel of timber must be input into the ministry billing system to produce a scale and royalty invoice (S&R). The invoices are the means by which the ministry bills the clients for stumpage and or royalty charges due on the timber. In addition, the volumes from the invoices make up the harvest history, which is used for cut control purposes. For this reason all timber must be scaled and reported to the ministry regardless of whether there are any charges owing.

A scale and royalty invoice displays the calculated volume for each mark by species and grade. The volume is then multiplied by the applicable stumpage or royalty rate to determine the charges due the ministry. The invoices are payable upon receipt. In addition, each client will receive a statement of account at regular intervals identifying the invoices issued and any payments received. If unpaid by the due date, interest is applied at a prescribed rate.

The ministry issues two types of S&R invoices to provide for the different scaling methods used in the province. An example of a weight scale invoice (FS 433) is shown in Figure 7.23, and an example of a piece scale invoice (FS 37) is shown in Figure 7.24.

Scale and royalty invoices are sometimes issued for alternate types of billing. For further information see the HBS Administration Manuals, piece scale billing: regions and districts and weight scale billing: regions and districts.

1. FS 433 Scale and Royalty Invoice - Weight

Description of a Weight Scale Invoice FS 433

- A** The date the invoice was issued.
- B** The scale and royalty (S&R) invoice number.
- C** The forest region of the origin of the timber mark.
- D** The forest district of the origin of the timber mark.
- E** The name of the scaling station where the timber was scaled.
- F** The billing name and address code, in the format #####.
- G** The client and location number in the format ##### ##.
- H** The name and address of the client responsible for paying the invoice.
- I** The first column in the identification box contains the population, stratum, year, timber mark, and number of loads represented on the return. The second column contains the licence number associated with the timber mark, the cutting permit associated with the mark, the scaling station, and the kind of charge (S = Stumpage or R = Royalty).
- J** The previous invoice number issued for the population/stratum/year/timber mark. If this field is not populated, then this is the first invoice of the billing year.
- K** The year to date weight on the previous invoice (in kilograms).
- L** The first period ending will contain the last date of scale for the month, providing there was only one rate applicable for the entire month. If more than one rate applies during the month, this is the last date the first rate was in effect.
- M** The second period ending is used when there are two rates in effect during the month. In these cases the date would be the last day of the billing month.
- N** The third and fourth period ending fields are used if the original invoice had a split rate, and the invoice is used to adjust the weight, or if both the weight and rate are being adjusted on the invoice.
- O** The weight that applies to the dates identified by the period ending.
- P** The new year to date weight for the pop/strat/yr/mark. This is the previous YTD weight plus the weight for each additional period ending, in sequence.
- Q** The species and grades that have been appraised for the timber mark, or have been scaled in samples for the pop/strat/yr/mark.

- R** The weight reference identifies the period ending associated with the species grade.
- S** The rate that applies to the species/grade that is in effect for the period ending date.
- T** The weight X Rate YTD is the total weight for the appropriate period ending (see above) multiplied by the applicable rate for the period (for each species/grade), and then added to the previous accumulated weight X rate.
- U** The ratio of volume (m³) to mass (kg) is established for each species/grade based on the sample scale data accumulated on the sample statistical file.
- V** The total YTD volume is the product of the year to date (kg) times the ratio/1000, to arrive at a figure in metric tonnes.
- W** The additional volume is the current year to date volume minus the previous year to date volume.
- X** The new year-to-date value is derived from the formula:
- $$\frac{\text{ratio} \times \text{new YTD (kg)} \times \text{rate}}{1000}$$
- Y** The additional charges are calculated using the new YTD value minus the previous YTD value. This can be a negative value if little or no weight for the species grade was recorded in the last sample.
- Z** The total scale shows the sum of the ratio, total YTD volume, the additional volume and the total additional charges.

 Province of British Columbia Ministry of Forests		FACSIMILE	
SCALE AND ROYALTY INVOICE		DATE OF ISSUE 95 01 24 YEAR MONTH DAY	INVOICE NUMBER WR77912
FOREST REGION C Prince Rupert		FOREST DISTRICT D Lakes	SCALING STATION E East Ootsa
PAYABLE BY: F 01621	CUSTOMER ACCOUNT NO.: G 00001227 02	SECOND COPY TO:	NAME CODE:

H WEST FRASER MILLS LTD.
 C/O FRASER LAKE SAWMILLS
 P.O. BOX 100
 FRASER LAKE, BC
 V0J 1S0

I IDENTIFICATION		J TIMBER WEIGHED		K THIS PERIOD (kg)		L YEAR TO DATE (kg)	
POPULATION: 2145	LICENCE NO.: R06712	PREVIOUS INVOICE: WR77510		1923090		1923090	
STRATUM: 31	PERMIT NO.: 95	1 PERIOD ENDING: 94-12-31		1360030		3283120	
YEAR: R06712	SCALING STATION: 245	2 PERIOD ENDING:					
MARK: R06712	SCALE RETURN NO.:	3 PERIOD ENDING:					
NUMBER OF LOADS: 30	KIND OF CHARGE: Stumpage	4 PERIOD ENDING:					

SPECIES	GRADE	WEIGHT (kg)	RATE	HEIGHT X RATE V.T.D.	RATIO	VOLUME		CHARGES	
						TOTAL V.T.D.	ADDITIONAL	TOTAL V.T.D.	ADDITIONAL
			\$ c	kg \$/m ³	m ³ /TONNE	m ³	m ³	\$ c	\$ c
Balsam	6	1	39 18	128632641	0.02263	74.3	30.8	2910 96	1205 86
Balsam	1	1	0 25	820781	0.00125	4.1	1.7	1 03	0 43
Lodge-Pine	3	1	39 18	128632641	0.60386	1982.7	821.5	77676 11	32177 27
Lodge-Pine	4	1	0 25	820781	0.01231	40.4	16.7	10 10	4 18
Lodge-Pine	5	1	0 25	820781	0.02435	79.9	33.1	19 99	8 28
Lodge-Pine	6	1	0 25	820781	0.00275	9.0	3.7	2 26	0 94
Lodge-Pine	1	1	0 25	820781	0.00030	1.0	0.4	0 25	0 11
Spruce	3	1	39 18	128632641	0.49201	1615.3	669.1	63288 55	26217 24
Spruce	4	1	0 25	820781	0.02589	85.0	35.2	21 25	8 80
Spruce	5	1	0 25	820781	0.02882	94.6	39.2	23 65	9 79
Spruce	6	1	0 25	820781	0.00655	21.5	8.9	5 38	2 23
Spruce	1	1	0 25	820781	0.01126	37.0	15.3	9 24	3 83
Rejects	5	1	0 00	0	0.00172	5.6	2.3	0 00	0 00
Other Spec	1	1	39 18	128632641	0.00000	0.0	0.0	0 00	0 00
* Total Scale						123370	4050.4	1677.9	\$59,638.96
** Total Fees									\$0.00

TERMS: NET PAYABLE ON RECEIPT. INTEREST IS CHARGED AT A PRESCRIBED RATE TO PREVIOUS MONTHS BALANCE ON OVERDUE ACCOUNTS. PLEASE QUOTE CUSTOMER ACCOUNT NO. AND INVOICE NO. WHEN MAKING PAYMENT. MAKE CHEQUE PAYABLE TO MINISTER OF FINANCE AND CORPORATE RELATIONS, AND MAIL TO REGIONAL MANAGER, MINISTRY OF FORESTS AT THE APPROPRIATE REGIONAL ADDRESS. POSSESSION OF THIS SCALE BILL DOES NOT CONSTITUTE OWNERSHIP OF MATERIAL SCALED. ALL CHARGES ON THIS INVOICE ARE GST EXEMPT UNLESS OTHERWISE INDICATED. PROVINCIAL GST REGISTRATION NUMBER: R107064750.

PAY THIS AMOUNT → **\$59,638.96**

Figure 7A.23 FS 433 - Scale and royalty invoice for weight scaled timber.

2. FS 37 Scale and Royalty Invoice - Piece

Description of a Piece Scale Invoice FS 37

- A** The date the scaling was completed.
- B** The date the invoice was issued.
- C** The scale and royalty invoice number (S&R number).
- D** The location and scale site where the timber was scaled.
- E** The scaler's licence number.
- F** The scaler's raft (or return) number.
- G** The scaler's name.
- H** The camp boom number, load number, or any other identification number assigned to the parcel of timber.
- I** The client number(in the format ##### ##), and HDBS name and address code (in the format #####) for the part responsible for payment of the invoice.
- J** The name and address of the client responsible for payment of the invoice.
- K** The timber mark that appears on the timber (when NMV is recorded beside the timber mark, it indicates the log mark was not visible, but the volume and charges are attributed to the mark preceding the NMV).
- L** The number of species for a species and grade segregation.
- M** The species of the timber.
- N** The grade of the timber.
- O** The volume for the species grade segregation.
- P** The type of charge applied to the timber, S = stumpage or R = royalty.
- Q** The charges owing for the species grade segregation.
- R** The total piece count and volume for the timber mark.
- S** The total piece count and volume for the invoice.
- T** The total stumpage charges.

- U** The total of all other charges (i.e., time charges, expenses).
- V** The total of all charges on the invoice.
- W** The summary of all the timber on the invoice, by species and grade (regardless of timber mark).

WESTERN FOREST PRODUCTS LIMITED
2300 - 1111 WEST GEORGIA STREET
VANCOUVER, BC
V6E 4M3

K		L		M		N		O		P		Q	
MARKS ON TIMBER		NO. OF PIECES	DESCRIPTION OF TIMBER		GRADE	SCALE MEASURE CUBIC FEET		SCALE MEASURE CUBIC METERS		RATE		AMOUNT	
6/2	M	2	Hemlock		H	10.0	S	52	12			521	20
	R	2				10.0							
6/2 NMV	M	4	Hemlock		H	17.4	S	52	12			906	89
6/2 NMV	M	1	Hemlock		I	3.5	S	52	12			182	42
	R	5				20.9							
* Mark Totals		7				30.9							
** Total Pieces	S	7	** Total Volume			30.9							
			*** Total Stumpage									\$1,610	51
			Total of all Other Charges									\$0	00
			Total of all Charges									\$1,610	51
			Summary of Log Volumes										
		6	Hemlock		H	27.4							
		1	Hemlock		I	3.5							
		7	Total			30.9							

TERMS: NET PAYABLE UPON RECEIPT. INTEREST IS CHARGED AT PRESCRIBED RATE TO PREVIOUS MONTH'S BALANCE ON OVERDUE ACCOUNTS.
POSSESSION OF THIS SCALE BILL DOES NOT CONSTITUTE OWNERSHIP OF MATERIAL. FOR WHICH SCALE IS INDICATED.
PLEASE MAKE CHECKS PAYABLE TO MINISTER OF FINANCE AND CORPORATE RELATIONS, AND MAIL TO REGIONAL MANAGER AT APPROPRIATE REGION ADDRESS.
ALL CHARGES ON THIS INVOICE ARE GST EXEMPT UNLESS OTHERWISE INDICATED. PROVINCIAL GST REGISTRATION NUMBER: R197864736.

Figure 7A.24 FS 37 - Scale and royalty invoice for piece scaled timber.

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7A.4 Administrative Documents

Other documentation is required to ensure controlled timber transport and a complete and accurate scale. As scaling and timber transport occur under a diversity of operating conditions, documentation requirements may vary to reflect these varying conditions.

Load Description Slips

Load description slips are documents that accompany timber in transport from the cut block or initial load out area to the place of scale, and provides a description of timber being transported, its origin, and its destination. It can also be used for scaled timber in which case it must identify the place where the timber was scaled. A forest officer can use this to monitor the movement of timber while in transport. The ministry load slip is called an FS 649, and is illustrated in Figure 7.25.

Load Destination Notice

Load destination notices (FS 1146s) are similar to the Load description slip, but are large pieces of sturdy paper that are physically attached to the load. They provide a forest officer with clearly visual description of the timber being transported and location where it is being transported. This may enable the forest officer to monitor timber movement without having to stop the vehicle in transport. It is often used for timber crossing district or regional boundaries. An example of the load destination notice is shown in Figure 7.26.

These documents are included in this manual to reflect the type of administrative documentation which may be required through the scaler and/or scale site authorization - or other directive. Please ensure you are familiar with the specific requirements as set by the ministry.

Water Transport Record

The water transport record is similar to the load description slip used when transporting by truck. The record identifies the place of loading, the destination, the estimated arrival and scale dates, the tug boat operator, and the barge name. It must be accompanied by a bundle addendum, and must be signed by a responsible company official. An example of a water transport record is provide in Figure 7.27.

Bundle Addendum

Bundle addenda list each bundle included on a barge and provides details such as bundle numbers, piece counts, timber marks. An example of a bundle addendum is provided in Figure 7.28.

Raft Tags

Raft tags are tags attached to the parcel by the scaler, to show the parcel has been scaled. The tag provides the parcel number, scaler number, timber mark, piece count, and scaler return number. The ministry form is called an FS 308 and is displayed in Figure 7.29.

Scaler Diaries or Scaler Site Diaries

Scaler diaries are documents that list all the timber that a scaler has scaled for a specified time period. It includes details such as timber marks, piece counts, load numbers, and is signed by the scaler upon completion. The diaries are used to ensure the ministry receives all the scale returns completed by the scaler. An example of a scaler diary is shown in Figure 7.30.

Incoming Site Ledgers and Outgoing Site Ledgers

Site ledgers are documents that record every parcel or load of timber that is received at, or transported from a scale site. It can also be used as a 'nil' report. It lists the load number, the timber mark, the number of pieces, and must be signed by the scale site operator. An example of a incoming scale site ledger is provided in Figure 7.31, and an example of an outgoing scale site ledger is provided in Figure 7.32.

Site Activity Report

Site activity reports list all the scaler's working at a specific scale site for a specified time period, which assists the ministry in determining which scaler's should be submitting scale returns. This is especially important in areas where scaler's work at various scale sites. It is also submitted when no scaling activity is occurring, therefore, the ministry would not anticipate the receipt of any scale returns from the site for that time period. It must be signed by a responsible company representative. An example of a site activity report is shown in Figure 7.33.

Load Listing

The load listing is a computer generated list of all loads that make up an FS 72, Summary of scale. It is supplied by the computing service and will assist the ministry in identifying any missing documentation. An example of a load listing is shown in Figure 7.34.

Load Summary Report

A load summary report is a summary of each individual load within a summary package (i.e., all the loads that make up the summary). It is supplied by the computing service and enables the ministry to audit individual loads for accuracy and completeness. An example of a load summary is shown in Figure 7.35.

1. FS 649 Load Description Slip

Load Description Slips - FS 649

The ministry may require the use of load description slips, to accompany timber in transport, as part of the scale site authorization. The FS 649 is the ministry form used for this purpose, and may be used for both scaled and non-scaled timber. Alternate industry load slips may be approved by the ministry providing they meet ministry requirements. As the FS 649 is designed for truck transportation, an alternate form may be required when transporting timber by water. An example of a suitable description slip for water transportation is provided under Figure 7.24.

- A** Date. Enter the date the timber is being transported from the cutblock.
- B** Timber mark. Enter the timber mark that is applied to the timber.
- C** Destination. Enter the scale site where the timber is being transported for scaling.
- D** Contractor. Enter the contractor's name.
- E** Name of carrier. Enter the truck driver's name.
- F** Landing supervisor's signature must be obtained prior to departure.
- G** Driver's signature must be obtained before delivery of the timber.
- H** Receiver's signature must be obtained at the time of delivery to the scale site or mill.
- I** Geographic location of timber's origin. Enter the location name.
- J** Tenure number or legal description. Enter where applicable.
- K** Cutting permit number. Enter where applicable.
- L** Cut block/landing/setting number. Enter where applicable.
- M** Description of timber and load. Check the appropriate species box, and special forest products if applicable. If the special forest products box is marked, enter the product code(s) on the 'type' lines listed below the box.
- N** Certification of previously scaled timber. Check this box if the timber has been scaled. Proof of scale may be required by a forest officer.
- O** Signature of scaler.
- P** Licence number.

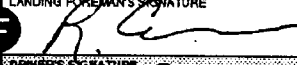
As local site conditions and approved scaling methods vary, distribution, retention, and submission of the loads slips may differ from site to site. Ensure you are familiar with the requirements as set out in the scale site authorization. Contact your local Forest Service office if clarification is required.


 Province of British Columbia Ministry of Forests 

SR. NO. 57882

LOAD DESCRIPTION SLIP

FOR CARRIERS OF TIMBER AND SPECIAL FOREST PRODUCTS

DATE	TIMBER MARK	GEOGRAPHIC LOCATION OF TIMBER'S ORIGIN	TENURE NO. OR LEGAL DESCRIPTION	CUTTING PERMIT NO.	CUT BLOCK / LANDING / SETTING NO.
9412182	EABXC	FALSE CREEK	LOT 2415		
CONTRACTOR		NAME OF CARRIER			
JOHN SMITH		JACK WHITE			
LANDING FOREMAN'S COMMENTS		DESCRIPTION OF TIMBER AND LOAD			
		☐ FIR ☐ BIRCH ☒ CEDAR ☐ ASPEN ☐ HEMLOCK ☐ OFF HIGHWAY ☐ BALSAM ☐ HIGHWAY ☐ SPRUCE ☐ SHORT ☐ PINE, WHITE ☐ LONG ☐ LOGS ☒ SPECIAL FOREST PROD. ☐ YELLOW TYPE: 3B ☐ COTTONWOOD			
LANDING FOREMAN'S SIGNATURE		CARRIER'S SIGNATURE			
					
RECEIVER'S SIGNATURE		SIGNATURE OF SCALES			
CERTIFICATION OF PREVIOUSLY SCALED TIMBER STATUS ☐ I CERTIFY THAT THE TIMBER BEING TRANSPORTED HAS BEEN SCALED.					
SIGNATURE OF SCALES		LICENCE NO.			

NOTE: SECTIONS SHADED GREEN **MUST** BE FILLED IN, IF APPLICABLE.

DISTRIBUTION: WHITE - Forest Service; CANARY - Trucker; PINK - Contractor; GREEN - Remains in book
FS 649 HVA 935

Island Business Forms Ltd. 10143

Figure 7A.25 FS 649 - Load description slip.



Province of
British Columbia
Ministry of
Forests

LOAD DESTINATION NOTICE

USE PERMANENT INK WHEN COMPLETING.
THIS FORM IS TO BE USED ONLY ONCE AND
MUST BE LEFT ON THE LOAD AT DESTINATION.

DATE OF HAUL

Y	M	D

DELIVERED FROM

FOREST DISTRICT

FOREST REGION

PRODUCER

NAME

SCALED BY

NAME

SCALER'S No.

Y

M

D

CHECK (✓) BOX
IF NOT SCALED

☐

TIMBER MARKS

FS 222 No.'s
(IF APPLICABLE)

DELIVERED TO

BUYER'S NAME

LOCATION

ADDRESS

NOTE: THIS COMPLETED NOTICE IS TO BE FIRMLY AFFIXED TO ALL VEHICLES CARRYING TIMBER OR SPECIAL FOREST PRODUCTS. ONE NOTICE ON THE LEFT SIDE OF LOAD AND ONE NOTICE AT THE REAR OF THE LOAD IN A CONSPICUOUS PLACE.

REGIONAL MANAGER

FS-1146 VAN 89/01

Figure 7A.26 FS 1146 - Load destination notice.

2. Water Transport Record

Province of
British Columbia

Ministry of
Forests

**UNSCALED TIMBER TRANSPORT RECORD
FOR WATER TRANSPORTATION OF TIMBER**

Applicant:		T.S.L. No.	
Place of Loading:		Transport Date:	
Destination:		Estimated Arrival Date:	
Towing Company:			
Barge Name:		Tug Name:	
Barge Load Number:			
Number of Bundles:		SB4:	
Date Timber is Required to be Scaled:		Site Where Timber was Scaled:	
Boom Numbers:			
Volume Estimate:		Insured Value:	
Insurance Expiry Date:		Insurance Policy Number:	
Received By:		Date Received:	

Shaded areas to be completed for previously scaled timber only.

Signature

Position

Figure 7A.27 Example of a water transport record.

[illegible]

June 1, 1995

3. FS 308 Scaler's Raft Tag

Scaler's Raft Tag - FS 308

A scaler may be required to tag a parcel of timber with a Scaler's raft tag (FS 308), as part of the authorization to scale, to identify it as scaled timber.

- A** Parcel number. The load number, boom number, or other identification assigned to the parcel.
- B** Scaler number. Enter the four character scaler licence number.
- C** Return number. Also called a return or tally number. For each scaler, at the beginning of each year the first raft number, 001, should be assigned to the first parcel the scaler scales, and run consecutively through to 999 regardless of the scale site at which he/she is employed. When the scaler reaches raft number 999, he/she must restart with 001.
- D** Timber mark. Enter the timber mark that is applied to the logs.
- E** Pieces. Enter the total piece count for the scaled parcel.

SCALER'S		 Province of British Columbia		 Ministry of Forests	
		PARCEL NUMBER			
		A ABC - 95 - 067			
		SCALER NUMBER		RETURN NUMBER	
B 123A		D 016		RAFT	
TIMBER MARK		PIECES			
C T0123A		E 23			
FS 308 HVA 84/2					

Figure 7A.29 FS 308 - Scaler's raft tag.

4. Scaler's Diary

Page ___ of ___

SCALER SITE DIARY

SCALER LICENCE _____ SITE _____ SCALING PERIOD 1st - 15th ☐ 16th-Month End ☐
 SITE OPERATOR _____ OTHER _____
 LOCATION _____ From _____ To _____ Inclusive
 MONTH _____ YEAR _____ COMMENTS _____

	Day	Return	Parcel Number (Load, Boom, etc.)	Timber Mark	Piece Count	Timber Transport Permit #	SB4 or Replaced	Other
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

TOTAL LOADS _____ TOTAL PIECES _____
 TOTALS EXCLUDING SB4 AND REPLACEMENTS; NAME (PRINT) _____
 PIECE LOADS _____ PIECE COUNT _____ SCALER SIGNATURE _____
 WORK TELEPHONE # _____

Figure 7A.30 Example of a scaler diary.

5. Site Ledgers

INCOMING LOADS SITE DIARY

Unscaled Timber Received?

☐ **YES** Provide load details below

Month/Year: _____/_____

☐ NO

Scaled Timber Received?

☐ YES Provide load details below

Scaling Site No: _____

☐ NO

Timber Shipped Out?

☐ YES Provide load details on an Outgoing Site Diary

Site Name: _____

☐ NO[illegible]

This Diary must be:

- kept current and available on site for inspection by a Forest Officer
- submitted to the Ministry of Forests District Office as directed in the Scaling Site Authorization

This certifies that the above information is a true statement of site activity.

Operator's Signature

Date Signed yy/mm/dd

Version: December 15, 1994

Figure 7A.31 Example of an incoming site ledger.

OUTGOING LOADS SITE DIARY

Scaling Site No: _____ Scaling Site Name: _____ Month/Year: _____

[illegible]

This Diary must be:

- submitted in conjunction with an "Incoming Site Diary"
- kept current and available on site for inspection by a Forest Officer

This certifies that the above information is a true statement of site activity.

Operator's Signature

Date Signed yy/mm/dd

Version December 15, 1994

Figure 7A.32 Example of an outgoing site ledger.

SITE ACTIVITY REPORT

Site Operator _____

Billing Period for S&R

Scale Site _____

YEAR 19____ MONTH____

Location _____

From _____ To _____

[illegible]

Total Number of Scalpers Active on this site for this billing period is _____
(if none enter (0) and send)

If '0' entered above, estimated date scaling will commence _____

SIGNING AUTHORITY FOR THIS SCALE SITE

PRINT NAME

Figure 7A.33 Example of a scale site activity report.

6. Load Reports

ABC LOGGING COMPANY LTD.

Printed 93:11:30

Load Listing for FS 72 - Mainland Division

<u>LOAD</u>	<u>SCALER</u>	<u>RET#</u>	<u>DATE</u>	<u>MARK</u>	<u>PIECES</u>	<u>VOLUME</u>
149305	1234	943	931129	45123	23	28.0
149306	1234	944	931129	EA2036	29	30.3
149307	1234	945	931129	EADSC	17	14.3
149310	1234	946	931129	45123	15	46.0
149312	1234	947	931129	EA2036	59	45.2
149313	1234	948	931129	EA2036	33	49.0
149315	1234	949	931129	EA2036	30	70.1
149317	1234	950	931129	45123	42	44.6
149318	1234	951	931129	EA2036	53	44.9
149319	1234	952	931129	EADSC	29	62.3
149320	1234	953	931129	45123	42	38.7

Scaler Totals:	11 Loads				372	473.4
----------------	----------	--	--	--	-----	-------

Figure 7A.34 Example of a load listing report.

ABC LOGGING COMPANY LTD.

Printed 93.11.30

Load Summary for FS 72 - Mainland Division

LOAD#	SCALER	RET#	DATE	MARK	SPECIES	GRADE	PIECES	VOLUME
149305	1234	943	931129	45123	BA	H	2	5.1
				45123	BA	J	6	4.9
				45123	FI	C	1	2.5
				45123	FI	H	2	3.8
				45123	FI	I	1	2.8
				45123	FI	J	2	2.0
				45123	FI	U	1	1.4
				45123	HE	J	8	5.5
				Load Total				
<hr/>								
149306	1234	944	931129	EA2036	BA	J	2	1.1
				EA2036	BA	I	1	1.5
				EA2036	BA	J	11	9.4
				EA2036	CE	J	1	0.4
				EA2036	HE	J	13	12.0
				Load Total				
<hr/>								
149307	1234	945	931129	EADSC	BA	J	2	1.1
				EADSC	CY	H	1	2.0
				EADSC	CY	J	2	0.6
				EADSC	CY	K	1	1.2
				EADSC	CY	M	3	3.4
				EADSC	FI	J	1	0.6
				EADSC	HE	H	1	1.0
				EADSC	HE	J	6	4.4
Load Total						17	14.3	
<hr/>								
Scaler Totals:		3 Loads					69	72.6

Figure 7A.35 Example of a load summary report.

Appendix 7B Scale Data Computation and Documentation Standards

1. Standard for compiling log and segregation volumes.
2. Standard for Weight Scale calculations.
3. HBS Source Document Requirements:
 - i. FS 72 - Summary of Scale, and
 - ii. FS 531 - Computed Weight Scale Sample.

**Ministry of Forests
Valuation Branch**

**Version 1.0
December 1, 1989**

7B.1 Standard for Compiling Log and Segregation Volumes

7B.1.1 Calculation Standard

Steps to Compute Log Volumes	Units	Decimal	Maximum Value	Source	Example
1. Top Radius Squared	cm ²	0	99999		51844
= Top Radius	cm	0	999	Tally	72
* Top Radius	cm	0	999	Tally	72
2. Top Area	cm ²	0	99999		16286
= 3.141592				pi	
* Top Radius Squared	cm ²	0	99999	Step 1	5184
3. Top Area	m ²	4	9.9999		1.6286
= Top Area	cm ²	0	99999	Step 2	16286
/ 10000					
4. Butt Radius Squared	cm ²	0	99999		6241
= Butt Radius	cm	0	999	Tally	79
* Butt Radius	cm	0	999	Tally	79
5. Butt Area	cm ²	0	99999		19607
= 3.141592				pi	
* Butt Radius Squared	cm ²	0	99999	Step 4	6241
6. Butt Area	m ²	4	9.9999		1.9607
= Butt Area	cm ²	0	99999	Step 5	19607
/ 10000					
7. Total Area	m ²	0	9.9999		3.5983
= Top Area	m ²	0	9.9999	Step 3	1.6826
+ Butt Area	m ²	0	9.9999	Step 6	1.9607
8. Average Area	m ²	0	9.9999		1.7947
= Total Area	m ²	0	9.9999	Step 7	3.5893
/ 2					
9. Length	m	1	99.9		6.2
= Length	dm	0	999	Tally	62
/ 10					
10. Log Volume	m ³	3	999.999		11.127
= Average Area	m ²	4	9.9999	Step 8	1.7947
* Length	m	1	99.9	Step 9	6.2
11. Log Volume Sum	m ³	3	99999.999		11.127
= Sum of Log Volumes (all logs)	m ³	3	999.999	Step 10	11.127
12. Segregation Volume (Piece Scale)	m ³	1	99999.9		11.1
= Log Volume Sum	m ³	3	99999.999	Step 11	11.127
13. Segregation Volume (Weight Scale)	m ³	2	99999.99		11.13
= Log Volume Sum	m ³	3	99999.999	Step 11	11.127

7B.1.2 Calculation Conventions

Rule: Use only single-operation calculations, except in compound additions and subtractions where all operands have the same number of decimal places.

7B.1.2.1 Multiplication

Compute each product to a number of decimal places equal to the sum of the number of decimal places specified for the two operands, then round to the number of decimal places specified for the product. For example, the calculation to compute the product, to two decimal places, of two numbers, one with no decimal places, and the other with three decimal places, would be done as follows:

$$\begin{array}{rcl} \text{e.g.} & & 262 \\ & \times & \underline{.234} \\ & = & 61.308 \end{array} = 61.31 \text{ rounded to two decimal places}$$

7B.1.2.2 Division

Compute each quotient to a number of decimal places equal to the number of decimal places specified for the quotient plus one, then round to the number of decimal places specified for the quotient. For example, the calculation to compute the quotient, to two decimal places, of two numbers, each with zero decimal places, would be done as follows:

$$\begin{array}{rcl} & & 62.616 \\ \text{e.g.} & 234309 \overline{)14671518} & = 62.62 \text{ rounded to two decimal places} \end{array}$$

7B.1.2.3 Addition

Computer each sum to a number of decimal places equal to the larger of the number of decimal places specified for the two operands, then round to the number of decimal places specified for the sum. For example, the calculation to compute the sum, to two decimal places, of two numbers, each with four decimal places, would be done as follows:

$$\begin{array}{rcl} \text{e.g.} & & 13.5837 \\ & + & \underline{11.6489} \\ & = & 25.2326 \end{array} = 25.23 \text{ rounded to two decimal places}$$

7B.1.2.4 Subtraction

Compute each difference to a number of decimal places equal to the larger of the number of decimal places specified for the two operands, then round to the number of decimal places specified for the difference. For example, the calculation to compute the difference, to two decimal places, of two numbers, one with five decimal places, and the other with three decimal places, would be done as follows:

$$\begin{array}{rclcl} \text{e.g.} & & 12.69999 & & \\ & - & 9.375 & & \\ \hline & = & 3.32499 & = & 3.32 \text{ rounded to two decimal places} \end{array}$$

7B.1.2.5 Rounding

Determine the rightmost digit to be retained (e.g., 12.3449).

Determine the leftmost digit to be dropped (e.g., 12.3449).

If the leftmost digit to be dropped is less than five, then the rightmost digit retained is unchanged (e.g., 12.3449 rounded to 2 decimal places is 12.34).

If the leftmost digit to be dropped is five or greater, then the rightmost digit retained is incremented by one (e.g., 12.3450 rounded to 2 decimal places is 12.35).

**Ministry of Forests
Valuation Branch**

**Version 1.0
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7B.2 Standard for Weight Scale Calculations

7B.2.1 Calculation Standard

Calculation Steps for Each Species	Units	Decimal	Maximum Value	Source	Example
1. Ratio = Sample-Volume / Sample-Weight	m ³ /kg m ³ kg	8 2 0	9(01).9(08) 9(07).9(02) 9(09)	SSF SSF	0.00099119
2. Monthly-Weight-X-Rate = Monthly-Weight * Species-Rate	kg\$/m ³ kg \$	0 0 2	9(12) 9(09) 9(03).9(02)	Return Mark	128138 51255 2.50
3. New-Accumulated-Weight = Old-Accumulated-Weight + Monthly-Weight	kg kg kg	0 0 0	9(09) 9(09) 9(09)	CBF Return	25422540 25371285 51255
4. New-Accumulated-Weight-X-Rate = Old-Accumulated-Weight-X-Rate + Monthly-Weight-X-Rate	kg\$m ³ kg\$m ³ kg\$m ³	0 0 0	9(12) 9(12) 9(12)	CBF Step 2	3291564 3163426 128138
5. New-Accumulated-Volume = Ratio * New-Accumulated-Weight	m ³ m ³ /kg kg	1 8 0	9(07).9(01) 9(01).9(08) 9(09)	Step 1 Step 3	25198.6 0.00099119 25422540
6. New-Accumulated-Value = Ratio * New-Accumulated-Weight-X-Rate	\$ m ³ /kg kg\$m ³	2 8 0	9(08).9(02) 9(01).9(08) 9(12)	Step 1 Step 4	3262.57 0.00099119 3291564
7. Display-Ratio = Ratio * 1000	m ³ /tonne m ³ /kg kg/tonne	5 8 0	9(01).9(05) 9(01).9(08)	Step 1	0.99119 0.00099119 1000

7B.2.2 Calculation Conventions

Rule: Use only single-operation calculations, except in compound additions and subtractions where all operands have the same number of decimal places.

7B.2.2.1 Multiplication

Compute each product to a number of decimal places equal to the sum of the number of decimal places specified for the two operands, then round to the number of decimal places specified for the product.

For example, the calculation to compute the product, to two decimal places, of two numbers, one with no decimal places, and the other with three decimal places, would be done as follows:

$$\begin{array}{rcl} \text{e.g.} & & 2.62 \\ & - & .234 \\ \hline & = & 61.308 \end{array} = 61.31 \text{ rounded to two decimal places}$$

7B.2.2.2 Division

Compute each quotient to a number of decimal places equal to the number of decimal places specified for the quotient plus one, then round to the number of decimal places specified for the quotient.

For example, the calculation to compute the quotient, to two decimal places, of two numbers, each with zero decimal places, would be done as follows:

$$\text{e.g.} \quad 234309 \overline{)14671518}^{62.616} = 62.62 \text{ rounded to two decimal places}$$

7B.2.2.3 Addition

Compute each sum to a number of decimal places equal to the larger of the number of decimal places specified for the two operands, then round to the number of decimal places specified for the sum.

For example, the calculation to compute the sum, to two decimal places, of two numbers, each with four decimal places, would be done as follows:

$$\begin{array}{rcl} \text{e.g.} & & 13.5837 \\ & + & 11.6489 \\ \hline & = & 25.2326 \end{array} = 25.23 \text{ rounded to two decimal places}$$

7B.2.2.4 Subtraction

Compute each difference to a number of decimal places equal to the larger of the number of decimal places specified for the two operands, then round to the number of decimal places specified for the difference.

For example, the calculation to compute the difference, to two decimal places, of two numbers, one with five decimal places, and the other with three decimal places, would be done as follows:

$$\begin{array}{rclcl} \text{e.g.} & & 12.69999 & & \\ & - & \underline{9.375} & & \\ & = & 3.32499 & = & 3.32 \text{ rounded to two decimal places} \end{array}$$

7B.2.2.5 Rounding

Determine the rightmost digit to be retained (e.g., 12.3449).

Determine the leftmost digit to be dropped (e.g., 12.3449).

If the leftmost digit to be dropped is less than five, then the rightmost digit retained is unchanged. (e.g., 12.3449 rounded to two decimal places is 12.34).

If the leftmost digit to be dropped is five or greater, then the rightmost digit retained is incremental by one (e.g., 12.3450 rounded to two decimal places is 12.35).

7B.3 Source Document Requirements

1. FS 72 - Summary of Scale.
2. FS 531 - Computed Weight Scale Sample.

7B.3.1 Harvest Data Base System - Source Document Requirements

Appendices 6A and 6B of the "Field Data Capture Standard for Scaling" outline the required formats of the Summary of Scale (FS 72) and the Computed Weight Scale Sample (FS 531) reports which are to be forwarded to Victoria for computer processing.

Some handheld units may be programmed to produce these reports directly out of the Handheld unit, other units may be set up to produce only the log listing on site, and pass the information into a Host computer to produce the above reports.

Regardless of the approach taken, any FS 72/FS 531 replica report forwarded to Victoria for data processing must meet the requirements specified below.

7B.3.1.1 General Requirements

The Summary of Scale (FS 72) and the Computed Weight Scale Sample (FS 531) will be the medium for passing information from Handheld units to the Harvest Data Base System. Currently the process will rely on the formatted paper reports, and ultimately the transfer will be electronic with paper backup.

The FS 72 and FS 531 reports must meet the needs of:

- Key-Entry,
- Data Control and Billing,
- Audit, and
- Administration.

Consequently the following general characteristics must be present:

1. The reports must show certain administration and ownership information.
2. The reports must have a standard title and must reference the form in order to identify what the document is (i.e., refers to ministry form number and name).
3. The reports must have standard layout, so that information can be easily and efficiently located in ledgering, keying and correction activities.
4. The field names must be standard in order to ensure that key-entry can be efficiently handled.
5. The print must be clear and legible with adequate spacing to help all aspects of data processing, audit, and administration.
6. The reports must clearly show what scale information has been summarized to ensure that audit and administration is straight forward.

7B.4 Specific Requirements - Computed - Summary of Scale (FS 72)

See attachments #1 and #2 for visual reference of the following requirements.

7B.4.1 Administration and Ownership Identification

The report name "Summary of Scale (FS 72)" is to appear in the top centre area of each page of the report. See 2 c. below.

The Company Name and Place of Scaling fields are also to appear in the top centre area of each page of the report.

The Forest Region, Forest District, and Scaler (Name or Signature) fields are to appear at the top left hand side of the report.

The "Page ____ of ____", Date, and Time fields are to be presented at the top right hand side of the report.

Provision is to be made for the "S and R Number ____" at the very top right of the report to record the invoice number. Refer to Sections 2 and 3 below for detailed requirements.

7B.4.2 Title

- a. The Company Name is to be shown at the top-centre of the report.
- b. The report name "Summary of Scale (FS 72)" is to be printed either above or below the company name, and the Place of Scaling is to be printed below the company name.
- c. The form # (FS 72) must be printed at the top of the report, preferably in the report name (see 2b). If not in the name, place it at the top left side of the report.

7B.4.3 Standard Layout

- a. The title and report name are to be in the top-centre of the report.
- b. The "Forest Region", "Forest District", and "Scaled By" are to appear in order at the top left hand side of the report. Note - the "FS 72" may be placed above "Forest Region" if it is not placed in the report title (see 2c above).
- c. The "S and R Number ____" must be at the top right hand side of the report to assure a ready reference to filed documents.
- d. The "Page ____ of ____", "Date" (95/01/01, or 95:01:01), and "Time (HH:MM or HH/MM)" are to appear in vertical order on the right hand side at the top of the report.
- e. There must be sufficient spacing between the report heading and each record to ensure legibility. Leave at least one line between the report heading, and the first record layout, one space between the first record and the second record (continuation of the first record type), and two spaces between the header records and the detail records (type four detail records). Nothing is to be printed in between records, as it will confuse key-entry.

Remarks may be shown at the top right hand side in the report heading as required, below the page, date, and time information.

- f. Standard field headings are required and these will be addressed in Section 3 below.

7B.4.4 Standard Field Names and Formats - Summary of Scale (FS 72)

Head Record (Record Type 0)

<u>Position</u>	<u>Length</u> <u>Top Print Line</u>	<u>Format</u>	<u>Field Name</u>	<u>Permissible Abbreviations</u>	<u>Comments</u>
1	1	N	Page Number	Seq #	0 (For multi-page tallies, increment by one - Max. 9)
2-3	2	N	Line Number	Seq #	0
4	1	N	Card Type	Seq #	0
5	4	A/N	Scalers Licence Number	Scaler, Scaler #	
9	3	N	Raft #	Raft, Raft #, Return #, Ret. #	Print the last return # of the returns being summarized
12	7	A/N	Predominant Mark	PRED, MARK	
19	14	A/N	Number of Chains	# OF CHAINS	Optional
33	18	A/N	Camp Boom Number	Camp Boom #	
51	c	A/N	Number of Sections	Sections, Sec., Sect	Only applies to boomsaling, pos 53 may be "?"
<u>Second Print Line</u>					
54	6	N	Date of Scaling	YYMMDD	Space 1 line, INDENT PAST SEQ # FIELD print the last date of scale for all returns being summarized
60	5	N	Payable By Code	PAY BY	
65	5	N	Copy to Code	COPY TO, COPY	
70	5	N	Scalers Expenses	EXPENSES	
75	5	N	Time Charges	TIME CHG	Leave data as blank

Place of Scale Record (Record Type 1)

Position	Length	Format	Field Name (Double Space from 2nd print line)	Permissible Abbreviations	Comments
1	1	N	Page Number	Seq #	0
2-3	2	N	Line #	SEQ #	01
4	1	N	Card Type	SEQ #	1
12	3	A/N	Forest Region Scaled, No Scaling Fees, Forest Region Invoiced	FNF	Position 12 is mandatory, 13, 14 are left blank unless all volume is SB4, or mark from other region, then position 14. If count larger than 9999, enter right most digits e.g., 10003 is 0003.
15	4	N	Scalers Log Count	LOG COUNT, LOGS	Use the field name.
19	3	A/N	Scaling Station Number	STN#	
22	40	A/N	Place of Scaling		
Summary Records (Record Type 4)					
Fourth Print Line (Double Space from 3rd print line)					
(Single Space the data lines)					
1	1	N	Page #	SEQ #	0
2-3	2	N	Line #	SEQ #	02
4	1	N	Card Type	SEQ #	4
12	7	A/N	* Timber Mark	MARK	Special Characters ' , - , : permitted
19	2	A	* Paint Colour Code	PAINT	
21	1	A	* Scaled Before Code	SB4	'S' if logs have been scaled before
22	5	N	Number of Pieces	# of Pieces, Pieces	"Number of Pieces" is preferred
27	3	A/N	Species, Grade	SPGR	Position 27-28 is species, Position 29 is Grade
30	3	A	Other Description	OTHER	"B/S" for boomsticks, "S/W" for Swifters, Product codes, Blank for sawlogs.
33	7	N	Quantity	QUANTITY	Print the decimal point for legibility. To nearest decimetre
40	5	N	Rate	RATE	Leave blank
* Print the Mark, Paint, and SB4 Code on each detail line.					

Totals Record (Record Type 'T') (Insert one blank line after last type '4' record and the 'T' record)

<u>Position</u>	<u>Length</u>	<u>Format</u>	<u>Field Name</u> (Double Space from 2nd print line)	<u>Permissible Abbreviations</u>	<u>Comments</u>
1	4	N	Sequence Number	N/A	Do not print the seq # now
5		A	Totals	N/A	Print "Totals" under "Mark" field
22	5	N	N/A	N/A	Print total piece count under record type 4 "pieces"
33	7	N	N/A	N/A	Print total volume under record type 4 "quantity"

Notation Records (Record Type '5') (Insert 1 blank line after type 'T' record)

<u>First Notation Print Line</u>	<u>Length</u>	<u>Format</u>	<u>Field Name</u> (Double Space from 2nd print line)	<u>Permissible Abbreviations</u>	<u>Comments</u>
1	1	N	Page #	N/A	0
2-3	2	N	Line #		
4	1	N	Card Type		5
5	72	A/N	N/A		Print "Includes Volumes from Returns _____, _____, ..., _____". This will list all return #'s included in the summary. Print as many additional lines as necessary to list all return numbers. Increment the line # for each record. Do not print field headings.

Last Notation Print Line

1	1	N	Page #	N/A	0 Line # incremented by 1 from last record.
2-3	2	N	Line #		Print "Scaled YYMMDD - YYMMDD". Shows range of scale dates for all returns included in the summary. Do not print field headings.
4	1	N	Card Type		5

Summary of Scale - Volume Calculations

Log volumes in the handheld units are calculated to three decimal places for each log. For the purposes of presenting a summary of scale to the ministry, volumes will be computed and presented to the nearest 1/10 of a cubic metre for each type 4 record as follows.

- a. Determine the volume for each segregation (i.e., type 4 record) by aggregating volumes by:
 - i. Timber Mark
 - ii. Paint Colour
 - iii. SB4 indicator
 - iv. Other description
 - v. Species
 - vi. Grade

For each change of any of the above sort levels, a type 4 summary line will be printed on the summary of scale report. Note that boomstick and swifter volumes (other description) are also shown on a separate summary line.

- b. Add the volumes for all logs within each segregation as described above, and round as follows:

0.445 rounds to 0.4
0.444 rounds to 0.4
0.454 rounds to 0.5
0.455 rounds to 0.5

In other words a '5' in the 2nd decimal place is rounded up, a '4' is rounded down.

7B.4.5 Clarify and Legibility

The print will be dark, clear, and of a size that is easily read for key entry. The minimum character size is 16 characters to the inch horizontally and 10 lines to the inch vertically.

7B.4.6 Identification of Summarized Information

The summary of scale is to include volumes scaled at one scale site for one scaler number over a time period that does not span the last day of a calendar month. Each return number for the scaler number is to be listed on the summary of scale according to the notation record layouts in 4. above. The range of scale dates is to be printed on the summary of scale as described in the notation record layouts in 4. above.

These notations will serve as an audit trail and administrative check on what volumes and source documents are being summarized.

FS 72		SUMMARY OF SCALE				S&R #	
REGION: _____		COMPANY NAME				PAGE _____ OF _____	
DISTRICT: _____		PLACE OF SCALING				DATE: _____	
SCALED BY: _____						TIME: _____	
SEQ#	SCALER#	RETURN #	PRED.MARK	# OF CHAINS	CAMP	BOOM NUMBER	SECTIONS
0000	9479	066					
(1)----	(5)----	(9)---	(12)---	(19)---	(33)---	(51)---	
		YYMMDD	PAY BY	COPY TO	EXPENSES	TIME CHG	
		950508	01278	17303			
		(54)-----	(60)-----	(65)-----	(70)-----	(75)-----	
SEQ#	FNF	LOGS	STN#	PLACE OF SCALING			
0000	2	438	265	LOG BOOM BAY			
(1)----	(12)---	(15)---	(19)---	(22)---			
SEQ#	MARK	PAINT	SB4	PIECES	SPGR	OTHER	RATE
(1)----	(12)-----	(19)---	(21)---	(22)-----	(27)---	(30)---	(40)-----
					QUANTITY		
					(33)-----		(40)-----
0024	1/63G		23		46.0		
0034	1/63N		32	HE	17.4		
0044	1/63N		63	SP	76.8		
0054	1/63T		44	SP	56.6		
0064	1/643		65	BA	56.4		
0074	1/643		93	HE	65.9		
0084	1/643		11	SP	12.4		
0094	1/65AC		5	HE	6.7		
0104	1/65AC		21	SP	50.2		
0114	1/65Y		1	BA	1.4		
0124	1/65Y		62	HE	61.1		
0134	1/65Y		13	SP	28.8		
TOTALS				433	479.7		
0145	INCLUDES VOLUMES FROM RETURNS :				058 059 060 061 062 063 064		
0155					065 066		
0165	SCALED : 950508 - 950508						
ATTACHMENT #1							

SUMMARY OF SCALE (FS 72)									
REGION:		COMPANY NAME		S & R #		PAGE		OF	
DISTRICT:		PLACE OF SCALING		DATE		TIME		SECT	
SCALED BY:		PLACE OF SCALING		CAMP BOOM NUMBER		EXPENSES		TIME CHG	
SEQ#	SCALER #	RET#	PRED.MARK	# OF CHAINS	CAMP BOOM NUMBER	EXPENSES	TIME CHG		
0000	9958	007			PN-105-85				
(1)	(5)----	(9)---	(12)-----	(19)-----	(33)-----	(75)-----			
			YMMDD	PAY BY	COPY TO	EXPENSES	TIME CHG		
			951010	01278					
			(54)-----	(60)-----	(65)-----	(70)-----	(75)-----		
SEQ#	FNF	LOGS	STN#	PLACE OF SCALING					
0011	1	0043	19U	LOG BOOM BAY					
(1)----	(12)---	(15)----	(19)---	(22)-----					
SEQ#	MARK	PAINT	SB4	PIECES	SPGR	OTHER	QUANTITY	RATE	
(1)----	(12)-----	(19)---	(21)---	(22)-----	(27)---	(30)---	(33)---	(40)-----	
0024	L98205	WH		1	HEH		3.3	0.7	
0034	L98205			1	HEJ		0.7	3.7	
0044	L98205			2	HEI		3.7	5.7	
0054	L98205			11	HEJ		5.7	5.2	
0064	L98205			1	CEH		5.2	1.3	
0074	L98205			3	CEJ		1.3	0.6	
0084	L98205			1	CEX		0.6	0.5	
0094	L98205			1	SPJ		0.5	3.0	
0104	L98205			1	SPC		3.0	44.4	
0114	L98205			8	CEH		44.4	14.1	
0124	L98205	WH	S	7	CEI		14.1	5.6	
0134	L98205			3	CEJ		5.6	2.7	
0144	L98205			1	CEM		2.7	2.0	
0154	L98205			2	CEX		2.0		
TOTALS				43			92.8		
0165 INCLUDES VOLUMES FROM RETURNS 007									
0175 SCALED: 94/10/10-94/10/10									
ATTACHMENT #2									

REGION:		COMPANY NAME		S & R #		
DISTRICT:		PLACE OF SCALING		PAGE _____ OF _____		
SCALED BY:		SUMMARY OF SCALE (FS 72)		DATE _____		
				TIME _____		
SEQUENCE	SCALER #	RET#	PRED.MARK	# OF CHAINS	CAMP BOOM NUMBER	SECT
COL 1-4	5-8	9-11	12-18	19-32	33-50	51-53
---	---	---	---	---	---	---
0000	9958	007			PH-105-85	
			YMMDD	PAY BY	COPY TO	EXPENSES
			54-59	60-64	65-69	70-74
			---	---	---	---
			941010	01278		
SEQUENCE	FN#	LOGS	STN#	PLACE OF SCALING		
COL 1-4	12-14	15-18	19-21	22-61		
---	---	---	---	---		
0011	1	0043	123	SCALING BAY		
SEQUENCE	MARK	PAINT	SB4	PIECES	SPGR	OTHER
COL 1-4	12-18	19-20	21	22-26	27-29	30-32
---	---	---	---	---	---	---
0024	L98205	WH		1	HEH	3.3
0034	L98205			1	HEJ	0.7
0044	L98205			2	HEI	3.7
0054	L98205			11	HEJ	5.7
0064	L98205			1	CEH	5.2
0074	L98205			3	CEJ	1.3
0084	L98205			1	CEX	0.6
0094	L98205			1	SPJ	0.5
0104	L98205			1	SPC	3.0
0114	L98205			8	CEH	44.4
0124	L98205	WH	S	7	CEI	14.1
0134	L98205			3	CEJ	5.6
0144	L98205			1	CEM	2.7
0154	L98205			2	CEX	2.0
---	---	---	---	---	---	---
TOTALS				43		92.8
0165	INCLUDES VOLUMES FROM RETURNS 007					
0175	SCALED: 94/10/10-94/10/10					
ATTACHMENT #3						

7B.5 Specific Requirements - Computer Weight Scale Sample CFS531

7B.5.1 Administration and Ownership Identification

The report name "Computed Weight Scale Sample (FS 531)" is to appear in the top centre area of each page of the report. See 2 c. below.

The Company Name and Place of Scaling fields are also to appear in the top centre area of each page of the report.

The Forest Region, Forest District, and Scale (Name or Signature) fields are to appear in at the top left hand side of the report.

The "Page ____ of ____", Date and Time fields are to be presented at the top right hand side of the report. Refer to Sections 2 and 3 below for detailed requirements.

7B.5.2 Title

See attachments #3, #4 and #5 for a visual reference of the following requirements:

- a. The Company Name is to be shown at the top centre of the report.
- b. The report name "Computed Weight Scale Sample (FS 531)" be printed either above or below the company name, and the Place of Scaling is to be printed below the Company Name.
- c. The form # (FS 531) must be printed at the top of the report, preferably in the report name (see 2b). If not in the name, place it at the top left side of the report.

7B.5.3 Standard Layout

- a. The title and report name are to be in the top-centre of the report.
- b. The "Forest Region", "Forest District", and "Scaled By" are to appear in vertical order at the top left hand side of the report. Note - the "FS 531" may be the first field if it is not placed in the report title (see 2c above).
- c. The 'Page ____ of ____', "Date" (94/10/01, or 94:10:01), and "Time (HH:MM or HH/MM)" are to appear in vertical order on the right hand side of the top of the report.

- d. There must be sufficient spacing between the report heading and each record to ensure legibility. Leave at least one line between the Report heading, and the 1st record layout, one space between the first record and the second record (continuation of the 1st record type), and two spaces between the header record and the detail records (type 4 detail records). Nothing is to be printed in between record descriptions, as it will confuse key-entry. Remarks may be shown at the top right hand side in the report heading if required, but these should be below the page date and time information.
- e. Standard field headings are required and these will be addressed in Section 3 below.
- f. The general lay out of the data to be keyed is as follows:
- There will be a standard field name (see Section 3 below)
 - The column number will either be shown in brackets followed by the keyed information (the keyed information may be optionally highlighted by having underscores under the full length of the data to be keyed).

e.g., MARK
 (51)12345

(optional dotted lines)

or the field name will be printed, then the column numbers, followed by the keyed data.

e.g., MARK
 51-57

 12345

The former format is more space efficient.

Type 4 detail records will be single spaced.

- g. Size of paper is to be governed as follows:

Preferably, the Computed Weight Scale Sample should be presented on 8 1/2 x 11" paper. See Attachment #3 and #4 for the preferred example layouts.

Example #4 shows the one line header approach. Example #5 shows the split header approach for printers which cannot print all of the information on one line.

Alternatively, the Computed Weight Scale Sample could be presented on 8 1/2 x 15" stock tab computer paper. See Attachment #6 for an example. This alternative is not recommended as standard sample tallies are 8 1/2 x 11" format for ease of storage. However, stock tab computer paper will be accepted.

7B.5.4 Standard Field Names and Formats - Computed Weight Scale Sample (FS 531)

Header Record (Record Type 0)

<u>Position</u>	<u>Length</u> <u>Top Print Line</u>	<u>Format</u>	<u>Field Name</u>	<u>Permissible</u> <u>Abbreviations</u>	<u>Comments</u>
1	3	N	Sequence Number	Seq #	Position 1-2 - line No., Position 3 - Record Type '0'
4	4	A/N	Scalers Number	Scaler, Scaler Number, Scaler #	
8	3	N	Scalers Tally Number	Tally #	
11	3	A/N	Weight Scale Station #	STN #, STATION, Weight Scale Number	
14	6	N	Date of Scale	YYMMDD, DATE SCALED	Print in YYMMDD Format
20	4	N	Load Arrival Number	LOAD ARRIVAL, LOAD ARR #	
24	7	A/N	Weight Scale Slip Number	SLIP #	
31	4	N	Population	POP#	
35	2	N	Stratum	STRAT	
37	2	N	Sample Year	YY	
39	3	N	Block Number	BLOCK #	
42	3	N	Block Load Number	BLK LOAD #	
45	6	N	Net Weight	WEIGHT	
51	7	A/N	Mark	MARK	

Header Record (Record Type 0) - continued

58	1	A	F or C	Data must be 'F' or 'C'
59	1	A	SIGN	Leave data area blank - unless adding check scale to SSF.
60	4	N	LOG COUNT	Is this information for industry scaler only? If not, then 'I' or cancelling then " ____".
64	1	A	EDIT BYPASS	Leave data area blank
65	1	A	METRIC WEIGHT	Print an 'M'
66	1	A	METRIC VOLUME	Print an 'M'
67	1	N	Number of Pages	Print the # of pages for the tally.

Summary Records (Record Type 4) - Double Space from previous print line

<u>Position</u>	<u>Length</u>	<u>Format</u>	<u>Field Name</u>	<u>Permissible Abbreviations</u>	<u>Comments</u>
1	3	N	Sequence Number	Seq #	Position 1-2 - line No., Position 3 - Record Type '4'
11	2	A	Species		
13	1	A/N	Grade		
14	3	N	Number of Pieces		
17	5	N	Sample Volume (M ³)	SAMPLE VOLUME	Volume is recorded to 2 decimal places, i.e., 743.12 m ³ is keyed as "743.12" with a decimal at two positions from the right.

Header Record (Record Type 0) - continued

Totals Record (Record Type 'T') - Double Space from previous print line

<u>Position</u>	<u>Length</u>	<u>Format</u>	<u>Field Name</u>	<u>Permissible Abbreviations</u>	<u>Comments</u>
1	3	N	Sequence Number	N/A	Increment line # from previous # by 1, record type 'T' (optional)
11	6	A	Totals		Print "Totals" under "Species" on Type 4 record
14	4	N	N/A		Print total piece count under Number of Pieces
17	6	N	N/A		Print total volume under Sample Volume. Do not print field headings.

7B.5.4.1 Computed Weight Scale Sample

Volumes in the handheld units are calculated to three decimal places for each log. In presenting the Computed Sample, volumes will be computed and presented to the nearest 1/100th of a cubic metre for each type '4' record as follows:

- a. Determine the volume for each segregation (type '4' record) by summing volumes by:
 - i. Species
 - ii. Grade

For each change in species and for grade, a type '4' volume summary line will be printed.

- b. Add the volumes for all logs within each segregation (described above) and round as follows:

0.445 rounds to 0.45

0.444 rounds to 0.44

0.454 rounds to 0.45

0.455 rounds to 0.46

The rule is a '5' in the 3rd decimal place is rounded up, a '4' is rounded down.

7B.5.5 Clarity and Legibility

The print will be dark, clear and of a size that is easily read for key entry. The minimum character size is 16 characters to the inch horizontally and 10 lines to the inch vertically.

7B.5.6 Identification of Summarized Information

Identified by the Scaler # and Scaler Tally Numbers.

June 1, 1995

FS 531

REGION: _____

DISTRICT: _____

SCALED BY: _____

COMPANY NAME

PLACE OF SCALING

COMPUTED WEIGHT SCALE SAMPLE

PAGE 1 of 1

DATE: _____

TIME: _____

SEQ#	SCALER	TALLY#	STN#	YMMDD	LOAD	POP#	STRAT/YY	BLK #	BLK LOAD#
(1)010	(4)9292	(8)139	(11)540	(14)941010	(20)0116	(24)154016N	(31)50100295	(39)	(42)

WEIGHT	MARK	F/C	SIGN	LOGS	EDIT	BYPASS	WT.	VOL.	PAGES
(45)040260	(51)13/17	(58)	(59)	(60)0077	(64)	(65)M	(66)M	(67)1	

SEQ#	SPECIES	GRADE	NUMBER OF PIECES	SAMPLE VOLUME (M³)
(1)---	(11)---	(13)---	(14)---	(17)---
024	BA		1	0.38
034	CE		6	2.18
044	FI		40	28.58
054	LA		8	5.36
064	L0		11	4.31
074	SP		1	0.30
084	WH		10	0.80
TOTALS				41.91

ATTACHMENT #5

June 1, 1995

Special Forest Products

8

Some scaling consists of scaling partially or fully manufactured products instead of raw logs. These products are known as special forest product. This chapter documents the classification and scaling requirements for special forest products. Topics covered include:

- when can timber be scaled as a special forest products instead of a raw log,
- exportability of partially manufactured products,
- product descriptions for each product including botanical forest products,
- timber marking requirements, and
- scaling methods and documentation requirements.

8.1 Definition of Special Forest Products

In some cases, operators are permitted to partially or fully manufacture products before having timber scaled. Such products are known as Special Forest Products.

Special Forest Products are designated in the *Forest Act* and the *Special Forest Products Regulation* to include:

building logs	pilings
car stakes	poles
Christmas trees	posts
cribbing	round stakes, sticks and pickets
firewood and fuel logs	shakes
hop poles	shake bolts, blocks and blanks
mining timbers props and caps	split stakes, pickets, palings and laggings
orchard props	shingle bolts and blocks

The *Appraisal Manual* maintains an up-to-date listing of Special Forest Products and their reserve stumpage rates.

8.1.1 Classification as Special Forest Products

The *Forest Act* requires that timber must be scaled prior to manufacture into any product other than Special Forest Products manufactured on the harvest site. The Special Forest Product may then be scaled instead of the timber.

To be classified as a Special Forest Product, the product:

- must be manufactured on the harvest site;
- the product must conform to the product description; and
- the product must be contemplated (named) in the harvesting authority (for Crown timber).

Timber that does not conform to these requirements must be scaled in log form using the B.C. Metric Scale (described in Chapter 5) and graded using appropriate grade schedules (described in Chapter 6) prior to any manufacturing.

8.1.2 Exporting Special Forest Products

While special forest products, by definition, are partially or fully manufactured, they still may not be considered manufactured for the purpose of export.

As such, if scalers are requested by their employer to classify special forest products with respect to their exportability, a knowledge of export requirements is essential.

If scalers are asked to classify any material for the purpose of export, they must be familiar with the current export policy set by the Ministry of Forests. Contact either the district or regional office for copies of the policy and clarification.

A forest officer should be contacted to determine export criteria and product specifications. The special forest product descriptions under Section 8.2 provide some guidance on current export criteria.

8.2 Special Forest Product Descriptions

Royalty rate schedules in the *Appraisal Manual* and some timber sale contracts set a charge rate for Special Forest Products. A scaler must be able to identify and code the products, know how to calculate the volume of the product in cubic metres, and be able to document the scale so that charges may be calculated.

The designation of product names and descriptions may change with the markets as new products evolve and existing products are no longer manufactured. The following list not only includes the products listed in the *Forest Act*, the *Special Forest Products Regulation* and in current *Policy* statements, but also those outdated products which have not been scaled in the past two years, and those newer products that have not yet been designated in the *Forest Act* or *Regulations*.

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

8.2.1 Building Logs

Product Code	Recorded as BL, but most building logs are not recorded this way because they are often selected from material that was already scaled and recorded as a log. When in transit, they are recorded as BL whether they are scaled or unscaled.
Description:	Building logs are logs that are completely debarked and are cylindrical or partially cylindrical for use in house construction. Most building logs are pre-notched and fitted to accommodate the prefabricated log home market, and are a finished product at this stage.
Dimensions:	There are no set specifications for end dimensions or length, but export restrictions apply, and building logs destined for export are required to be notched and cut to precise length, for a specific building or building design.
Scale Method(s):	In all cases, building logs are piece scaled or weight scaled as logs using the B.C. Metric Scale described in Chapter 5.

8.2.2 Car Stakes

Product Code: CS

Description: Car stakes are round stakes used as side supports on railroad flat cars. They often have one squared end to fit the side pockets built into the car deck and the remainder of the stake has the bark left on. It is now more common to make car stakes from sawn timbers from a mill. These sawn timbers are not classified as car stakes. Car stakes are a finished product and cannot be classified as such with the intent to further process the product into another finished product.

Dimensions: Stakes are approximately 10 to 15 cm in diameter and 3 to 5 m in length. The diameter at any place on a piece must not exceed 15 cm.

Scale Method(s): Either the Piece Sampling method or the Stacked Special Forest Product method may be used.

8.2.3 Christmas Trees

Product Code: XM

Description: In British Columbia, most Christmas trees are Douglas-fir. Trees are selected for appearance, density, form, vigour, taper, balance, foliage condition, cleanliness, freshness and size. The Crown sells Christmas trees by the piece with charges dependent on the height of the tree. Christmas trees are a finished product and are exportable.

Dimensions: Three height categories are recognized and segregated as grades. These are:

Height Category

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

Scale Method(s): Christmas Tree Piece Count method is used in all cases.

8.2.4 Cribbing

Product Code:	CR
Description:	Cribbing or crib timbers are peeled logs of a suitable diameter and length. The intended use is to hold back mineral matter between main supports in dock or bridge construction and mines. They are an end product and are only for use at a specific site for a specified project.
Dimensions:	There are no restrictions for end dimensions or length but this classification is not intended for marketing to an end use other than its described use.
Scale Method(s):	The B.C. Metric Scale is appropriate. Although listed in the <i>Special Forest Products Regulation</i> , there have been no crib timbers scaled as such in the past two years. Rather, a contractor or licensee will be allowed to consume a certain portion of timber as part of a right of way agreement, or cutting permit and the timber is classified as logs and charged at the rates set out in the agreement.

8.2.5 Cants

Product Code:	CA
Description:	A cant is a partially manufactured product which has two flat faces that are further processed through an edger or resaw to make boards. Wane areas are where the bark or the sapwood surface are still present on the product. Cants are produced from dead and down post- logging residue that, as determined by the regional manager, would not make a sawlog.
Dimensions:	There are no restrictions for end dimensions or length because the classification was established to allow improved utilization of waste material left on a harvest site. If scaler's are asked to further classify cants for the export market, they should refer to the current export policy. This policy defines maximum wane allowances and other criteria which must be met to classify cants as a manufactured product for the purposes of export.
Scale Method(s):	The piece sampling method or the B.C. Metric Scale method may be used to obtain a volume in cubic metres.

8.2.6 Fence Posts (Round)

Product Code: PR

Description: Round fence posts are peeled logs (usually lodgepole pine) manufactured to various dimensions for use in the construction of a fence. Modern fence post manufacturing processes include sharpening and chemical treatment against decay. Fence posts are a finished product and are not further processed into another end product, but will not require treatment at the harvest site to qualify.

Dimensions: Posts are graded in sizes to suit consumer markets. Line post top diameters range from 6 to 15 cm and butt diameters range up to 18 cm in these size classes. Corner post top diameters are usually larger than line posts but do not exceed 22 cm. Standard length classes are "sixes" (1.8 m), "six-sixes" (2 m), "sevens" (2.2 m), "eights" (2.4 m), and "tens" (3 m). Posts exceeding these dimensions are an exception, and their consideration as a Special Forest Product is doubtful.

Scale Method(s): Either the piece sampling or the stacked methods may be used depending on practicality. Unless provided for in the cutting authority, piece scale or weight scale as logs using the B.C. Metric Scale described in Chapters 5 and 6.

8.2.7 Fence Posts (Split)

Product Code: PS

Description: Split fence posts are normally manufactured from red cedar trees considered unsuitable for the manufacture of lumber. They have three or four split, debarked faces and serve the same function as round posts. Pockets are often drilled for two or three fence rails to suit the decorative rail fence market. Split fence posts are a finished product and are not further manufactured.

Dimensions: Each split face ranges from 8 to 13 cm in width at any point depending on the size class. In manufacture, a circumference range is often used to grade posts into sizes. A "Jumbo" post is approximately 46 cm around, a "Pony" post is about 40 cm and a "Garden" post is less than 40 cm around. Corner post top diameters are usually larger than line posts but do not exceed 15 cm per face or 60 cm around. Length classes are the same as for round posts at 1.8, 2, 2.2, 2.4 and 3 m.

Scale Method(s): The Stacked Special Forest Product method is the practical scaling method.

8.2.8 Fence Rails (Round)

Product Code: RR

Description: Round fence rails are peeled logs (usually lodgepole pine) manufactured to various dimensions for use in the construction of a fence. Fence rails are used in place of or in addition to wires and boards. Because rails are not exposed to conditions as harsh as posts are, treatment against decay is not as common. Fence rails are a finished product and are not processed further.

Dimensions: Rails are graded to diameter and length classes to suit site conditions or consumer markets. Rail diameters range up to 10 cm measured at any point in the length. Lengths are commonly classed in "sixes" (1.8 m), "eights" (2.4 m), "tens" (3 m) and "twelves" (3.6 m). Rails exceeding these dimensions are an exception, and their consideration as a Special Forest Product is unlikely.

Scale Method(s): Either the piece sampling or the stacked methods may be used depending on the practicality. Unless provided for in the cutting authority, dimensions larger than 10 cm are scaled as logs using the B.C. Metric Scale.

8.2.9 Fence Rails (Split)

Product Code: RS

Description: Split fence rails are normally manufactured from red cedar trees unsuitable for the manufacture of lumber. They have three or four split, debarked faces and serve the same function as round rails. Both ends of rails are often chamfered to fit pockets drilled in split red cedar posts to suit the decorative rail fence market. Split fence rails are a finished product and are not manufactured further.

Dimensions: Each split face ranges from 5 to 10 cm in width at any point depending on the size class. In manufacture, a circumference range is often used to grade rails into sizes corresponding to particular markets. A "Jumbo" rail is about 33 cm around, a "pony" rail is about 25 cm around, and a "Garden" rail is less than 25 cm around. Length classes are the same as for round rails at 1.8, 2, 2.2, 2.4, 3, and 3.6 m.

Scale Method(s): The stacked method is considered the most practical scaling method.

8.2.10 Firewood and Fuel Logs

Product Code:	FW
Description:	Firewood is manufactured from round or split fuel logs to specific sizes for heating purposes. Fuel logs are logs of any species, usually dead and dry, with or without bark, which are considered to be unsuitable for the manufacture of merchantable lumber products. Firewood is a finished product and fuel logs are only partially manufactured (bucked to a multiple of a standard firewood length).
Dimensions:	Firewood lengths range from 30 to 60 cm. Although 60 cm is the longest common length, some modern heating systems will take a "cordwood" length up to 1.2 m. Firewood is consumer marketed in diameters up to 20 cm. If the scaler is asked to further classify firewood for export, however, the diameter at any place on round pieces is limited to 15 cm and no face of split firewood may exceed 15 cm across at any place. Fuel logs, not being a finished product, are not exportable.
Scale Method(s):	<p>The stacked Special Forest Product method is used for scaling both split and round firewood. Fuel logs are scaled and graded using the B.C. Metric Scale.</p> <p>Unless specified in a cutting authority, firewood and fuel logs are not to be classified as such.</p>

8.2.11 Grape Stakes

Product Code:	GS
Description:	Grape stakes are either split or round pieces of any species, with or without bark, and are used to support grape vines. They are also used to support ginseng sun shades. Grape stakes are an end product.
Dimensions:	The diameter range is from 7 to 10 cm and may not to exceed 10 cm in diameter at any point. Maximum length is 3.5 m.
Scale Method(s):	The Piece Sampling method is preferred if the stakes are round and well sorted by size categories and the Stacked method used if the stakes are split and/or the stack is unsorted to size category.

8.2.12 Hop Poles

Product Code:	HP
Description:	Hop poles are either split or round pieces of any species without bark and are used to support hop vines.
Dimensions:	Top diameters range is from 7 cm to a maximum of 13 cm. Length ranges from 4 m to a maximum of 6 m. Hop poles are an end product and are not classified as such if their intended use is for manufacturing another product.
Scale Method(s):	As with grape stakes, the Piece Sampling method is preferred if the poles are round and well sorted by size categories and the Stacked method used if the poles are split and/or the stack is unsorted by size. Unless provided for in the cutting authority, hop poles with diameters exceeding 10 cm at any point must be scaled using the B.C. Metric Scale.

8.2.13 Lagging (Split)

Product Code:	LA
Description:	Split wood of varying thickness, width and length. Lagging is split planking used especially for preventing cave-ins in earthwork or for supporting an arch during construction. As with cribbing, lagging is only manufactured for use as an end product at a specific site for a specified project.
Dimensions:	There are no restrictions for thickness, width or length but they cannot be classified as lagging if marketed for projects or uses other than their described use at a specific site.
Scale Method(s):	The Stacked Special Forest Product method is used. Although designated in the <i>Special Forest Products Regulation</i> , no lagging has been scaled in the past two years because of its limited application.

8.2.14 Mining Timbers Props and Caps

Product Code:	MT
Description:	Mining timbers are round red cedar logs with the bark removed. They are used as support structures in mines. Props and caps are somewhat smaller pieces used in conjunction with the heavier timbers. They are an end product and are not to be classified as mining timbers, props or caps if they will not be used for their described purpose.
Dimensions:	The top diameters range from 10 cm to a maximum of 38 cm. Lengths range from 1.4 m to a maximum of 2.4 m.
Scale Method(s):	The B.C. Metric Scale is used.

8.2.15 Orchard Props

Product Code:	OP
Description:	Orchard props are split or round logs used to support fruit tree branches. Although not necessarily debarked, they are an end product and may not be used for a purpose other than their described purpose.
Dimensions:	The top diameters range from 7 cm to a maximum of 10 cm. The lengths can reach a maximum of 2.5 m.
Scale Method(s):	The Piece Sampling method is preferred if the pieces are round and well sorted into size classes, and the Stacked method is used if the pieces are split and/or not sorted into size classes.

8.2.16 Pickets and Palings

Product Code: PI

Description: Pickets and palings are split, bark free boards and stakes (usually red cedar), used in fence construction. All four faces are usually split, although the edges may be sawn. The faces are never sawn. They are typically rounded or pointed on the top and are considered to be a finished product. They may not be classified as a picket or paling if intended for another purpose or for further manufacturing.

Dimensions: Thicknesses range from 1 to 2.5 cm and widths range from 7 to 13 cm. Picket lengths range up to 1.2 m but palings tend to be longer, as in a stockade type fence, up to 2.5 m. Restrictions may apply if export is contemplated, particularly if the tops are not finished.

Scale Method(s): The Stacked Special Forest Product method is preferred as pickets and palings are split products.

8.2.17 Poles and Pilings

Product Code: PP

Description: Poles are round peeled logs used to support electric or telephone wires. Timber pilings are round peeled logs used in marine structures and as foundation support for buildings. As with building logs, these products less commonly manufactured on the harvest site and are more often selected from mill sorts. They are therefore scaled as logs prior to the selection process. Further scaling and classification as a pole or piling is used primarily in marketing and transport. Most poles and pilings are treated with chemicals to inhibit decay, but do not have to be treated to be classified as a special forest product.

Dimensions: Top diameters must be less than 28 cm to be classed as a pole or piling.

Scale Method(s): In all cases, poles and pilings are piece scaled or weight scaled as logs using the B. C. Metric Scale, described in Chapter 5.

8.2.18 Shake Bolts, Blocks and Blanks

Product Code: SB

Description: Shake bolts and blocks are usually bark free segments cut from logs or slabs, usually of red cedar but increasingly from other species used for the manufacture of shakes. Although they are commonly marketed at this stage, bolts and blocks are only a "partially manufactured" product, and may not be sold for a use other than their described use. Shake blanks are split from blocks, from which two "taper sawn" shakes are made from each blank.

Dimensions: Shake bolts are cut into lengths of approximately 1.4 or 1.45 m from which shake blocks are cut into the standard lengths of 46 cm (called "eighteens"), and 61 cm (called "twenty fours").

Scale Method(s): Because blocks and blanks are typically close piled onto very uniform 1.5 cord pallets for shipping and marketing, it is practical to use the stacked method of scaling after the blocks are loaded on pallets. An air space factor of 0.7 is used if the blocks are not debarked and a factor of 0.8 is used if they are debarked.

8.2.19 Shakes

Product Code: SK

Description: Shakes are split from blocks or are taper sawn from blanks and are usually of red cedar, but increasingly of other species. Shakes are a finished or end product and are marketed as such. There are no export restrictions.

Dimensions: Shakes are variable in width and thickness according to grade but do not usually exceed 2.5 cm in thickness. They are almost always tapered. Lengths are in the standard lengths of 46 cm (called "eighteens") and 61 cm (called "twenty fours").

Scale Method(s): Because shakes are typically close piled onto very uniform 1.5 cord pallets for shipping and marketing, it is practical to use the Stacked method of scaling after the blocks are palletized. If this is the case, it is permissible to count the number of cords and convert to cubic metres by multiplying the number of cords by 3.62457. This provides the enclosed volume in cubic metres. Multiply this volume by a solid wood conversion factor of 0.8 to obtain the solid wood volume in cubic metres. The formula is:

$$\text{Volume}(\text{m}^3) = \text{cords} \times 3.62457 \times \text{solid wood factor}(0.8)$$

8.2.20 Shingle Bolts or Blocks

Product Code: LB

Description: As with shake bolts and blocks, shingle bolts and blocks are usually debarked segments cut from logs or slabs, usually of red cedar but increasingly from other species, used in the manufacture of shingles. The only difference is that they can be shorter and smaller than shake bolts. Although they are commonly marketed at this stage, bolts and blocks are a partially manufactured product, and may not be sold for another purpose other than their described purpose.

Dimensions: Shingle bolts are cut into lengths of approximately 1.3 and 1.45 m from which Shingle blocks are cut into standard lengths of 41 cm (called "sixteens"), 46 cm (called "eighteens"), and a maximum of 61 cm (called "twenty fours").

Scale Method(s): Because the blocks are typically close piled onto very uniform 1.5 cord pallets for shipping and marketing, it is therefore practical to use the stacked method of scaling after the blocks are palletized, as described for shake bolts and blocks.

8.2.21 Stakes and Stocks (Sticks)

Product Code: SS

Description: Stakes and stocks can be any product with or without bark and a large end diameter of less than 10 cm. Typical products are tepee poles, bulldoze sticks, spears, movie props and other special purpose products that are not defined elsewhere in this manual.

Dimensions: The large end diameter of the product must be less than 10 cm. There are no restrictions on length, but because of the diversity of possible end products in this classification of special forest products, producers should not make any assumptions that individual products will be exportable without exemption.

Scale Method(s): Any of the scaling methods may be chosen, including the B. C. Metric Scale described in Chapter 5, the Piece Sampling method or the Stacked method, depending on practicality. A Forest Service scaling representative will assist the scaler in determining that practicality.

8.3 Botanical Forest Products

Increasingly, non-timber products are coming into commercial use. At present, the Ministry of Forests does not regulate the harvest of the vast majority of botanical Forest Products, but because they are related to the forest industry and affect forest management decisions and policy, these products will inevitably enter the scaling field. Measurement and recording of these products will become increasingly important to these processes as they evolve.

A current total of 222 recognized botanical forest products are harvested in B.C. These products can be grouped into eight general categories:

- medicinal and pharmaceutical products,
- wild edible mushrooms,
- floral and greenery products,
- wild berries and fruit,
- herb and vegetable products,
- landscaping products,
- craft products, and
- miscellaneous botanical forest products.

The following descriptions are for only the most common products.

8.3.1 Medicinal and Pharmaceutical Products

Product Codes: None

Description: Many plants and fungi produce compounds with medicinal value. Some of these products have long-established markets and represents a continuing economic opportunity. Medicinal plants used for herbal and alternative health products are marketed primarily through small buying houses which process and package the products for the retail market. Practically no information is available on the harvesting of these products except for cascara and western yew.

Extract of cascara bark is recognized as a useful tonic laxative and yew bark is the source of the drug Taxol, an important cancer therapy.

Scale Method(s): There is no requirement that harvesters or collectors of medicinal products to make payments to the Crown at this time. However, with respect to yew bark, it is a requirement to report the amount harvested in kilograms, specified in either dry weight or wet weight. If logs are removed, the logs must be scaled and reported in the same manner as any other commercial timber. Reporting details are available in the *Policy on Yew Bark Harvesting and Collection*.

8.3.2 Wild Edible Mushrooms

Product Codes: None

Description: Forest lands, particularly lodgepole pine forests, are a prime habitat for the Pine mushroom, one of the preferred species for texture and flavour among many groups. Because of its increasing importance as a commercial product, it is necessary to plan the harvesting process to ensure the long term survival of both the forest and the mushroom crop. Chanterelles and Morels are also important commercial species.

Dimensions: The Pine mushroom is sorted into six different grades by maturity, with the Grade 1 "button" being the most valuable, and the Grade 6 "over-mature" being the least valuable. Mushrooms classified in each grade are then weighed.

Scale Method(s): Mushrooms are not scaled or recorded at this time. If trees are removed or damaged, the logs must be scaled and reported in the same manner as any other commercial timber.

8.3.3 Floral and Greenery Products

Product Code: None

Description: The forest contains a huge inventory of plant species, providing many opportunities for craftspersons to design, manufacture and market decorative products such as wreaths and floral arrangements. These products can be grouped into five different categories:

- greenery
- conifer boughs
- essential oils
- basketry fillers
- fresh or dried flowers

Salal, cedar boughs and various ferns are the most prominent of the decorative vegetations at this time.

Dimensions: These products are usually not measured by weight.

Scale Method(s): Cedar foliage harvest is recorded by weight according to agreements between harvesters and district managers. Most other products do not yet require recording. If trees are removed or damaged, the logs must be scaled and reported in the same manner as any other commercial timber.

8.3.4 Wild Berries and Fruit

Product Code: None

Description: At present, little information is available about the commercial harvest of wild berries and fruits. All regions in the province report extensive personal use of local fruits and berries, and is considered to have high recreational value. Thirty-four species are collected on a personal basis and seven species are harvested commercially. The most well known of such plants are the wild blueberry, wild blackberry and wild strawberry. Other popular berries include cranberries, huckleberries, salmonberries and thimbleberries.

8.3.5 Herb and Vegetable Products

Product Code: None

Description: Many plant species in British Columbia's forests have market potential for use as vegetables or food seasoning. There are about twenty-three plants used for these products and there is an increasing interest in their use as food products, both commercial and personally. Although such wild herbs and vegetables not only add variety to diets, but also can provide food substitutes for people with acute allergies. There is little information on this industry.

8.3.6 Landscaping Products

Product Code: None

Description: Use of native plants for landscaping is an increasing part of the botanical forest product industry. Entire trees, shrubs or herbs may be collected for personal landscaping or for commercial sale to nurseries and garden centres. Landscaping with native species is a preferred alternative to using cultivated species because these plants are naturally adapted to local conditions.

About fifty-three native plant species used for landscaping in British Columbia have been identified, both for individual use and for commercial harvesting supplying nurseries and garden centres.

Scale Method(s): As the industry evolves, methods of determining volumes will be established according to agreements between the harvesters and District Managers.

8.3.7 Craft Products

Product Code: None

Description: North Americans have a growing interest in craft products made from native plant species. Although the commercial potential for these types of craft products is increasing, relatively little data on the industry is available. Participants report that whole plants, leaves, bark, roots or wood may be used to manufacture craft products and about twenty-four different species are popular.

Dimensions: Highly variable.

Scale Method(s): Many of the products manufactured from wood fall into the classification of stakes and stocks (sticks) described in Section 8.2.2.1. Other wood products, if over 10 cm in diameter, are scales as logs. Any trees felled or damaged in the process of gathering craft products are scaled using the B.C. Metric Scale.

8.3.8 Miscellaneous Botanical Forest Products

Description: Several botanical forest products do not fit into any of the previous categories. These products include honey, beeswax, syrup, and smoke woods. At present, little is know about the commercial use of these products.

Scale Method(s): Smoke woods, commonly mountain alder and red alder, are scaled as stakes and stocks (sticks) described in Section 8.2.2.1. Pieces exceeding the diameters for sticks are scaled as logs.

8.4 Other Product Descriptions

Other products, not classified as Special Forest Products or botanical products, will enter the field of scaling as these products become commercially viable. This section introduces these products and suggests approaches for measuring and recording them where appropriate.

8.4.1 Wood Chips

Wood chips are not considered to be Special Forest Products for scaling purposes. Their measurement, however, may be the responsibility of the scaler.

Recent developments in chipping technology have seen the introduction of portable debarkers and chippers, which operate at roadsides, on a landing, or at a central processing yard. Under these circumstances, the scaler's responsibility is one of determining the volume, grade and timber mark of all timber processed by the chipper.

While the most reliable methods of accounting for timber processed by the chipper are through either piece scaling or weight scaling all logs prior to chipping, these methods are not often feasible. The scaler's task then is one of either weighing or measuring the compacted volume of all chips produced and then determining the volume of the timber required to produce the chips, while remembering that the species, grade(s) and timber mark(s) must also be accounted for.

The volume of timber required to produce the chips is known as a solid wood equivalent. It is estimated by using a sampling method or use of standard conversion factors. Standard conversion factors generally do not satisfy ministry requirements on three accounts:

1. All timber must be accounted for by species,
2. All timber must be graded because:
 - stumpage is determined on the basis of grade,
 - some grades are free of stumpage, and
 - some grades do not contribute to cut control volumes,
3. Chip moisture content (hence density) varies considerably.

As such, a sampling approach may be required. The basic components of a sampling approach include:

1. Randomly select truck or grapple loads for each timber mark,
2. Scale the load accounting for volume, grade and species,
3. Process the same load through the chipper,
4. Weigh the chip production,
5. Calculate the round wood volume/green chip weight conversion factor for each sample,
6. From all the samples taken, calculate the average factor (using the sum of all the sample weights and the sum of all the sample volumes), and
7. Calculate the firm wood volumes for each mark for billing purposes by applying the factor to the total production weight for a given period.

For example:

1. From all samples scaled, 57 m³ of round wood produced 35 tonnes (35 000 kg) of green chips,
2. The conversion factor derived from dividing the volume by the weight, $(57 \text{ m}^3/35 \text{ t}) = 1.6285 \text{ m}^3$ of firm wood per tonne of chips, and
3. If during the month 1 200 tonnes of chips are produced, the round wood (or firm wood) volume for stumpage billing and cut control purposes is calculated as,
 $1\,200 \text{ t} \times 1.6285 = 1,954.2 \text{ m}^3$.

The above example is greatly simplified for conceptual purposes. In reality, because log grades and species must be accounted for, separate ratios must be developed for each species/grade combination. For example, using the same sample, if 20 m³ of the sample is HE grade Z and 37 m³ is HE grade X, the ratios are calculated as follows:

- HE Z ratio = $20 \text{ m}^3/35 \text{ t} = 0.5714 \text{ m}^3/\text{tonne}$, and
- HE X ratio = $37 \text{ m}^3/35 \text{ t} = 1.0571 \text{ m}^3/\text{tonne}$.

For recording and billing purposes, if 1 200 tonnes of chips were produced in a month from a mark, the volume would be calculated as follows:

- HE Z volume = $0.5714 \text{ m}^3/\text{t} \times 1\,200 \text{ t} = 685.7 \text{ m}^3$, and
- HE X volume = $1.0571 \text{ m}^3/\text{t} \times 1\,200 \text{ t} = 1,268.5 \text{ m}^3$,

for a total volume of 1 954.2 m³.

As remote chipping grows in prominence, more standardized scaling and recording procedures will likely be implemented throughout the ministry.

8.5 General Requirements

8.5.1 Timber Marking

The timber marking requirements for Special Forest Products are the same as for timber. That is, all products must be conspicuously marked on the area of origin prior to any transportation off the area in accordance with the *Timber Marking & Transportation Policy* (see Chapter 2 for more detail on marking requirements). Exemptions to the marking requirements may be granted where practical, depending on the:

- type of forest product (i.e., is marking feasible or will the marking adversely effect the quality of the product?),
- the designated scale site (i.e., does the scale site receive products from several marks?),
- the geographic area (i.e., is there a risk of theft if the site is readily accessible?),
- the form of transport (i.e., will the product be water-borne?), and
- the type of licence (i.e., is it a cash sale licence or is it stumpage bearing).

Exemptions will not be issued if timber will be water-borne, subject to export, or transported out of a jurisdiction unless a different level of marking is approved by the receiving jurisdiction.

8.5.2 Scaling

All special forest products removed from Crown or private land are required to be scaled and recorded in a proper manner by an authorized scaler (see Chapter 11 for more information on scaling authorizations). Scaling may be performed at the harvest site or at another authorized scale site. If the product is transported off the harvest site prior to being manufactured into a special forest product, that is in log form, it must be scaled in log form and graded accordingly.

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

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

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

Each method is described under Section 8.6.

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

8.5.3 Recording the Scale

Recording the scale is a three step process:

- the scale results are recorded to a scaler's tally sheet,
- the tallies are summarized to a scale summary, and
- the documents are submitted to the ministry (see Chapter 7 for detailed information on forms completion and submission).

8.5.4 Transport Documentation

Anyone transporting timber, Special Forest Products, recognized botanical products, and other forest products is required to carry documentation describing the product being transported. Every load must carry a manifest or bill of lading, which is provided for on the Christmas Tree Return (FS 200), the Record of Purchase of Special Forest Products (FS 222), or the Load Description Slip (FS 649) for products scaled in log form.

The purchaser of timber is responsible for obtaining and retaining documentation on proof of scale for material received at the purchaser's site. The purchaser may be responsible for payment of stumpage and any associated charges where the purchaser cannot prove that the timber was scaled previously.

8.5.5 Document Handling for Special Forest Products

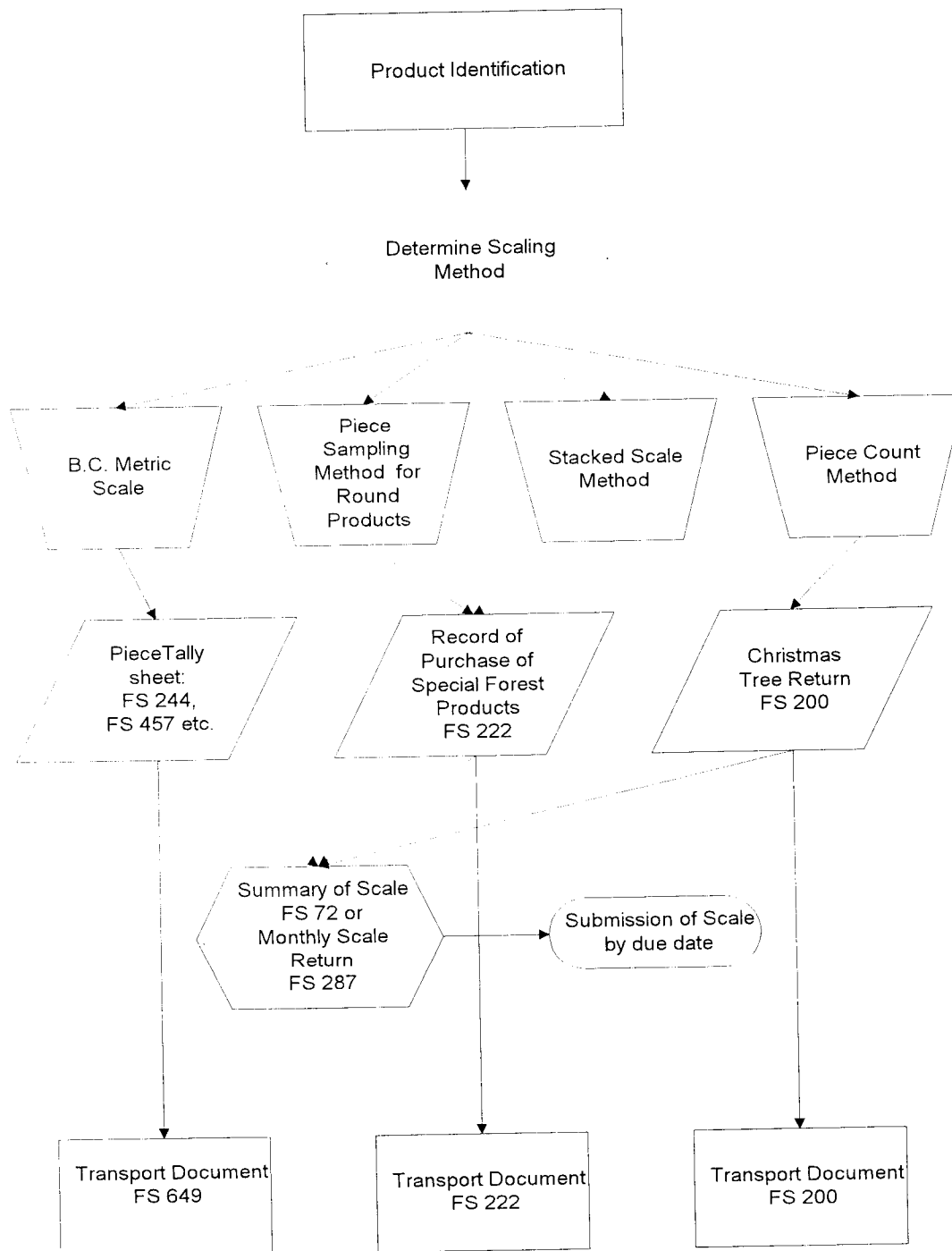


Figure 8.1 Flow diagram outlining selection of scaling methods and forms.

8.6 Special Forest Product Scaling Methods

When choosing a method of scaling Special Forest Products, the scaler (in consultation with a Forest Service scaling representative), must decide on a method to use to suit the product and the site conditions. Although method(s) are recommended in the product descriptions section for each product, it may be more practical to choose another method. Some guidelines are:

The Piece Sampling method is best for:

- uneven piles,
- product lengths exceeding 5 m,
- well sorted size classes,
- large numbers of smaller pieces, and
- round products, for example, round fence posts.

The Stacked method is best for:

- even piles,
- product lengths of 5 m or less,
- difficult to sort size classes,
- large numbers of very small pieces, and
- irregular shapes, for example, shake and shingle blocks.

The Piece Count is used only for Christmas trees.

The B.C. Metric Piece Scale is used for poles, pilings, and building logs, and where:

- material is not piled into units for sampling or stacked methods,
- material is not sorted into size, species and quality class, and
- another scaling method has not been authorized.

In consultation with the operator and scaler, the Forest Service will authorize the use of a method most accurate and practical for the site. Once a method is determined, it must be applied consistently, and may not be changed without a change to the scale site and scaler authorizations.

8.6.1 Round Piece Sampling Method

This method of determining the net volume of a Special Forest Product is used for scaling round small diameter special forest products such as round fence posts, round rails, grape stakes, orchard props, and sticks. Section 7 of the *Scaling Regulation* requires that sufficient samples be taken to achieve statistical reliability by ensuring a sampling error objective of $\pm 1\%$ in 19 out of 20 samples taken. Chapters 9 and 10 provide a comprehensive overview of sampling techniques used in weight scaling, and the piece sampling process is similar. Section 8.6.5 illustrates the way to determine the number of samples required for a given group or population.

The steps are:

1. Sort the product to be scaled into species, standard length classes (increments of 0.1 m), and top size (increments of one rad class). Normally, most products will be sorted into dimension classes as part of the marketing process. If this sort includes dimensions exceeding the above increments, more samples will have to be taken to achieve an accurate scale.
2. Scale a number of representative pieces using the B.C. Metric Scale described in Chapter 5. A sufficient quantity of pieces must be scaled to establish an average volume with confidence. For example, if all of the pieces are nearly identical in length and diameter, fewer pieces would be sampled, but as the size variation increases within a pile, more samples are required. In any case, a minimum of 10 samples must be taken.
3. Determine the average net volume per piece or the "volume factor" (to five significant figures) for each bundle or pile by dividing the total volume of the scaled pieces by the piece count of the scaled pieces.
4. Count the number of pieces in the bundle or pile.
5. Multiply the number of pieces in each bundle or pile by the volume factor to determine the net cubic volume of the bundle or pile.

8.6.1.1 Calculation of the Piece Sampling Method

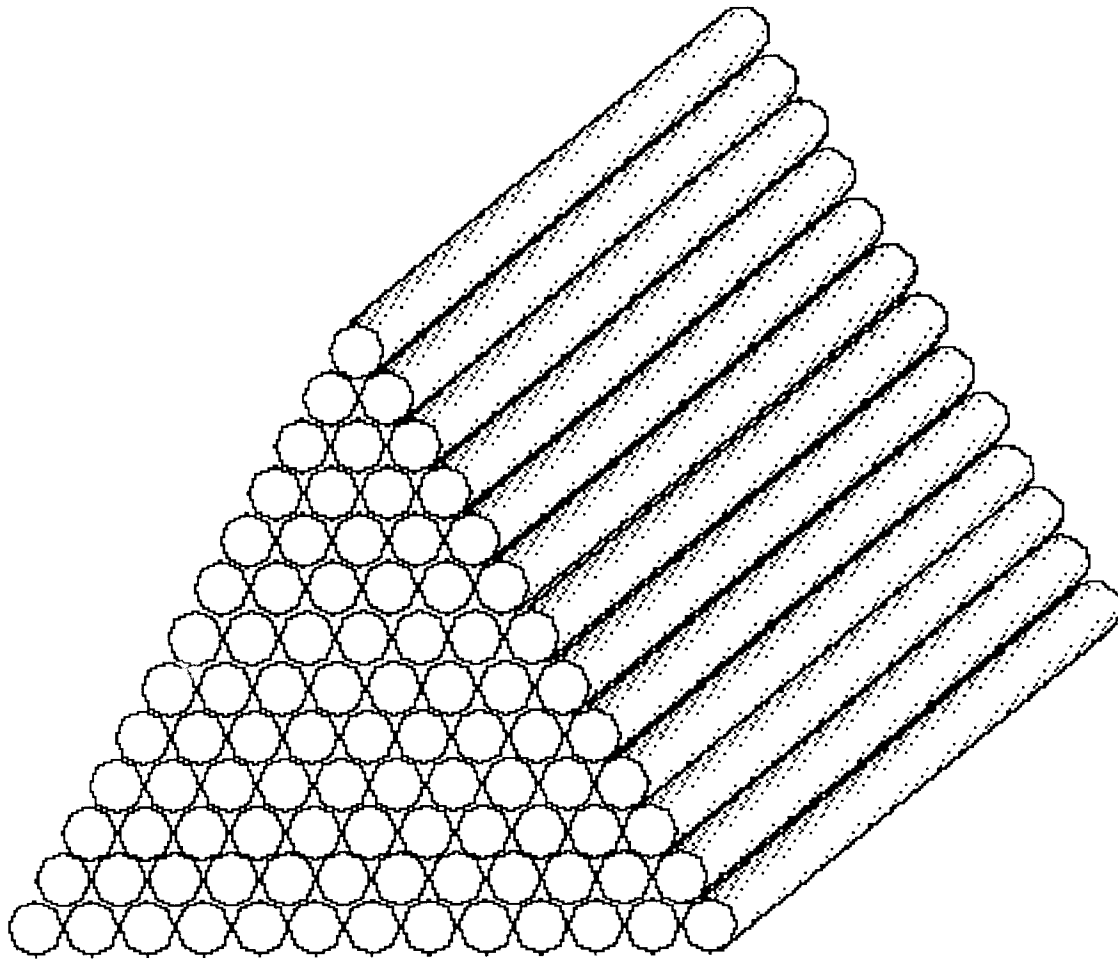


Figure 8.2 A pile of posts sorted to size classes and ready for sampling.

In determining the volume for 100 round fence posts 12 cm in diameter and 2.4 m long, five sample posts were measured.

Post Number	Length	Top	Butt	Volume (dm ³)
1	2.4	6	7	$14 + 18 = 32$
2	2.4	6	6	$14 + 14 = 28$
3	2.4	6	7	$14 + 18 = 32$
4	2.4	7	7	$18 + 18 = 36$
5	2.4	6	6	<u>$14 + 14 = 28$</u>

Total volume of five posts: 0.156 m^3

Average volume per post (factor): $0.156 \text{ m}^3 \div 5 = 0.0312 \text{ m}^3$.

Total volume of 100 posts: $0.0312 \times 100 = 3.1 \text{ m}^3$

6. The measurements are recorded on the FS 222 in the following manner (Figure 8.3);

On the FS 222, clearly indicate the factor used. Refer to Chapter 7 for more details on completing this form.

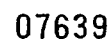
 Province of British Columbia		Ministry of Forests 		TIMBER MARK 33 969		432751	
RECORD OF PURCHASE OF SPECIAL FOREST PRODUCTS				DATE Y M D 95 02 10		PLACE Acerville Wood Products (211)	
PURCHASER Acerville Wood Products				VENDOR Harry Bowls			
DESCRIPTION		LENGTH OR SQUARES	WIDTH OR BUNDLES	HEIGHT OR PIECES	FACTOR	METRES ³	
Lp PR				100	0.0312	3.1	
AMOUNT OF STUMPAGE AND/OR ROYALTY COLLECTED							
SCALER'S SIGNATURE J. Salen 429D				VENDOR OR AGENT'S SIGNATURE Harry Bowls			
PURCHASER'S ADDRESS Box 4000, Acerville, B.C.				VENDOR'S ADDRESS 1049-3rd Ave, Acerville, B.C.			

FS 222 HVA 89/7

DISTRIBUTION: WHITE - VENDOR; CANARY - DISTRICT FORESTER (attached to scale); PINK - PURCHASER

Figure 8.3 Completed FS 222 for 100 round fence posts.

7. At the end of the month of scaling, a Summary of Scale (FS 72) or a Monthly Scale Return (FS 287) is completed and submitted to the appropriate Forest Service district office on or before the prescribed submission time (Figure 8.4).



						Charged on S & R Invoice No																	
Page	Line	Type	Scales Number	Date of the Year																			
0	0	0	429D	Q59																			
						Vendor																	
						HARRY BOWLS.																	
						How Delivered																	
						Truck																	
						Charges Payable by																	
						ACERVILLE WOOD PRODUCTS.																	
Page	Line	Type	Total Pieces	Scaling Station Number	Place of Scaling																		
0	0	1	2	0100211	ACERVILLE WOOD PRODUCTS.																		
						Place of Scaling (Cont.)																	
						YARD.																	
Page	Line	Type	Mark	Number of Pieces	Species	Grade	Product Code	Quantity m	Rate \$	e													
0	0	2	33969	00100	L	P	R	000003:1	.	.													
											Special Forest Product Codes				Compiled from tally sheets or tally book pages numbered								
Name	Grade	Code																					
Burding logs		BL									432751												
Cat stakes		CS																					
Christmas trees > 5m	1	XM																					
3-5m	2	XM																					
< 3m	3	XM																					
Cribbing		CR																					
Fence posts (round)		PR																					
Fence posts (split)		PS																					
Fire wood		FW																					
Grape stakes		GS																					
Hon poles		HP																					
Lagging split		LA																					
Limbs timbers		MT																					
Orchard props		OP																					
Other logs		OL																					
Pickets or piling		PI																					
Piling		PP																					
Poles		PO																					
Rails (round)		RR																					
Rails (split)		RS																					
Shakes		SK																					
Shake bolts or blocks		SB																					
Shingle bolts or blocks		LB																					
Slates and sheets		SS																					
NB leave product code blank when reporting logs																							
											Compiled by												
											J. Scaler												
											Scaler's Signature												
											J. Scaler												
											Client												
											Keyed by												
											Verified by												

June 1, 1995

8.6.2 Stacked Special Forest Products Method

The stacked method of scaling special forest products can be used for either split or round products.

Method

1. Stack the product so all the pieces are of one species and length. The stack should be of uniform length, width, and height.
2. Measure the length, width, and height of the stack to the nearest 0.02 m (2 cm). Refer to Figure 8.5 for the number of height measurements required to establish the average height of the stack.

Pile Length (Metres)	Number of Height Measurements	
	Regular Stacks	Irregular Stacks
2	2	3
3	2	3
5	3	6
10	6	12
15	8	12
20	10	12
25	10	15

Figure 8.5 Table of number of pile heights taken for various lengths.

3. Multiply the measured length, width and average height of the stack to obtain the volume of the stack in cubic metres.
4. Multiply the stacked volume by a factor (Figure 8.6) to eliminate the volume of bark, air space, and defect in the stack and determine the net volume of the stack. The factor can vary depending of the amount of bark, length of material, and the compactness of the stack. Therefore, where appropriate, the scaler may request a Forest Service officer to authorize a more appropriate solid wood conversion factor.

Product	Solid Wood Conversion Factor
Unpeeled round wood products	0.65
Unpeeled split products	0.70
Peeled round wood products	0.75
Peeled split products	0.80

Figure 8.6 Table of solid wood conversion factors by product.

5. The measurements will be recorded on the FS 222 in the following manner:

On the FS 222, clearly indicate the factor used.

 Province of British Columbia		Ministry of Forests 		TIMBER MARK 29J		432753	
RECORD OF PURCHASE OF SPECIAL FOREST PRODUCTS				DATE Y M D 95 02 14		PLACE WESTSIDE CEDAR (64A)	
				PURCHASER JOHN SMITH			
DESCRIPTION		LENGTH OR SQUARES	WIDTH OR BUNDLES	HEIGHT OR PIECES	FACTOR	METRES ³	
CE SB		4.92	2.44	3.24	0.8	31.1	
AMOUNT OF STUMPAGE AND/OR ROYALTY COLLECTED							
SCALER'S SIGNATURE				VENDOR OR AGENT'S SIGNATURE			
 (6110)							
PURCHASER'S ADDRESS				VENDOR'S ADDRESS			
160.93 Kilometre House				Box 25, 160.93 Km House, B.C.			

FS 222 HVA 89/7 DISTRIBUTION: WHITE - VENDOR; CANARY - DISTRICT FORESTER (attached to scale); PINK - PURCHASER

Figure 8.7 A completed FS 222 - with split product.

6. At the end of the month of scaling, a Summary of Scale (FS 72) (Figure 8.8) or a Monthly Scale Return (FS 287) is completed and submitted to the appropriate Forest Service district office on or before the prescribed submission time.

PAGE		SEQ.	TYPE	SCALER'S NUMBER	RETURN NUMBER	PREDOMINANT MARK	NUMBER OF CHAINS	CAMP BOOM NUMBER												
0	0	0	0	6110018				TOM BROWN												
1	2	4	5																	
TO BE COMPLETED BY THE SCALER TO SUMMARIZE A TALLY SHEET (FS 36) OR BY A CLERK TO CONSOLIDATE A RECORD OF PURCHASE..... (FS 222) AND FORWARDED FOR PROCESSING. SEE 8.13 OF MANUAL.																				
<table border="1"> <tr> <th>NO. OF SECTIONS</th> <th>DATE OF SCALING</th> <th>PAYABLE BY</th> <th>SECOND COPY TO</th> <th>EXPENSES</th> <th>TIME CHARGE</th> </tr> <tr> <td>950328</td> <td>YR. MO. DAY</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>									NO. OF SECTIONS	DATE OF SCALING	PAYABLE BY	SECOND COPY TO	EXPENSES	TIME CHARGE	950328	YR. MO. DAY				
NO. OF SECTIONS	DATE OF SCALING	PAYABLE BY	SECOND COPY TO	EXPENSES	TIME CHARGE															
950328	YR. MO. DAY																			
SCALER'S SIGNATURE Tom Brown																				
VENDOR Westside Cedar																				
PAYABLE BY Westside Cedar																				
EXPENSES BREAKDOWN																				
REMARKS Cedar Shake Bolts. FS 222 #s 432753.																				
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FS 72 HVA 92/1 M28 2854

Figure 8.8 A completed FS 72 - summary of information from the FS 222 in Figure 8.7.

8.6.3 Christmas Tree Piece Count Method

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

Method

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

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

2. A piece count is taken for each species and grade.
3. The piece count is recorded on the FS 200, Christmas-Tree Return, as per the example in Figure 8.9.

The height category (i.e., 1, 2, or 3) is recorded under the grade field on the tally sheet.

Province of
British ColumbiaMinistry of Forests
FOREST SERVICE

40624 c

CHRISTMAS-TREE RETURN*Trees must be scaled on area of origin.*

1. Date of scaling Feb 14/95 Place 14km - Hwy 16 E - McBride
2. Area of origin _____ Sec. _____ Tp. _____ Rge. _____
 _____ Sec. _____ Tp. _____ Rge. _____
 _____ 5302 - Cariboo D67122
(C.T.P. No.) (Lot No., land district) (Timber Mark)
3. Stumpage-owner Tom Brown - Box 219 - Chambers, B.C.
(Name) (Address)
4. Cutter Tom Brown - Box 219 - Chambers, B.C.
(Name) (Address)
5. Scaled for Tom Brown
6. Charges payable by Tomas Brown
(First name) (Second name(s)) (Please print)
Box 219, Clinton, B.C.
(Address)

7. TREES SCALED				
Size	Merch. Tree	No. per Bdl.	No. of Bdl.	Culls
Less than 3 m	350	10	35	
3 m to 5 m				
More than 5 m				
Totals	350			

This return certified correct:

8. Cutter's signature Jim Brown Date Feb 14/95
9. Scaler's signature J. Scaler
10. This manifest covers 1 truck loads
 Trucker's signature Art Gayfinkler
 Truck Licence No. 62-22-TT
11. Destination or shipping point Vancouver, B.C.
12. Date hauled Feb 14/95
- Is cutting completed on area? Yes ☐ No ☒

White Copy - District Manager / Yellow Copy - District Manager
 Blue Copy - Land-owner or cutter / Green Copy - Carried by trucker / Pink Copy - Buyer
 Spoiled return forms must be left in the book with the word "cancelled" written thereon.

FS 200 VAL 0788

Figure 8.9 A completed FS 200 - Christmas tree return.

4. At the end of the month of scaling, a Summary of Scale (FS 72) or a Monthly Scale Return (FS 287) is completed and submitted to the appropriate Forest Service district office on or before the prescribed submission time (Figure 8.10).



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FOREST SERVICE

Monthly Scale Return

07639

Page		Line		Type		Scalers Number		Day of the Year		Charged on S & R Invoice No	
0		0		0		6117		059			
1		2		3		4		5		Vendor	
										Tom Brown	
1		2		3		4		5		How Delivered	
										Truck	
1		2		3		4		5		Charges Payable by	
										Tom Brown	
1		2		3		4		5		Special Forest Product Codes	
										Compiled from tally sheets, or tally book pages numbered	
1		2		3		4		5		Name	
										Grade	
0		2		4		122		350		F13XM	
0		3		4						00	
0		4		4							
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Figure 8.10 A completed FS 287 - Monthly scale return which summarizes the information on the FS 200 in Figure 8.9.

8.6.4 Estimating Volumes of Tree Length Piles

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

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

8.6.4.1 Sampling the Pile and Counting Pieces

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

1. Determine the number of samples required based on the level of information needed about the pile. Recognized sampling techniques are described in Chapters 9 and 10, but are more involved than necessary for this estimation process. For a more practical approach, select a sample area representative of the pile by estimation.
2. Scale every piece in the sample area as in Figure 8.11.

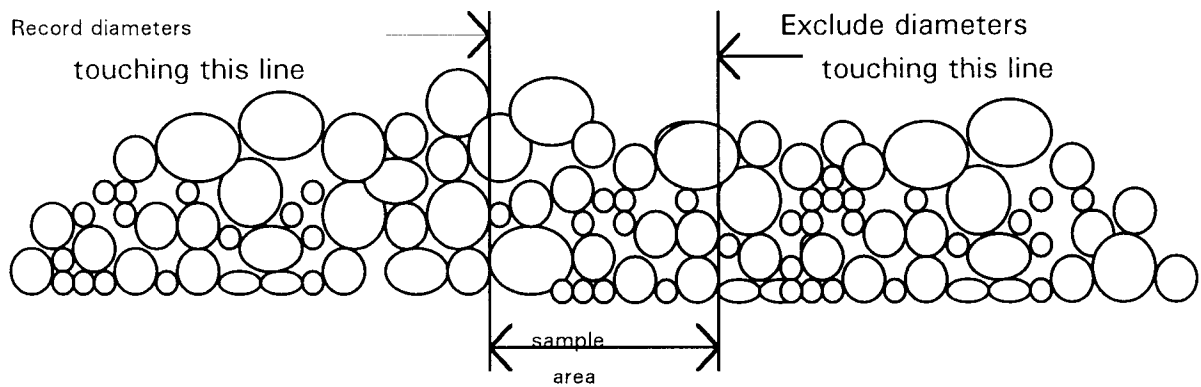


Figure 8.11 Selecting a sample section from a log deck.

3. Count the number of trees in the pile.
4. The frequency of each class in the sample is applied to the total count to determine the distribution of each class in the pile. For example, a sample area includes thirty six pieces. If nine pieces fall into species class BA, 20 pieces are SP and seven pieces are FI, then the BA distribution is $36/9$ or 1 in 4, SP is $36/20$ or 1 in 1.8, and FI is $36/7$ or 1 in 5.1. If there are four hundred and twenty five pieces in the pile, there will be approximately $425/4$ or 106 BA, $425/1.8$ or 236 SP, and $425/5.1$ or 83 FI. The same technique may be used for other classes, such as diameters, lengths, and grades.
5. If the piles can be tied into an existing weight scale population, that is, if it is known that the pile to be measured is from a production run that closely matches wood that has been previously sampled as part of a weight scale strata, the statistical values from that series of weight scale samples will provide a detailed profile of the characteristics of the pile. For example, an operator is delivering timber to a weight scale that is taking all production from that mark through stratum X of the mill's population. A deck of logs is left at a landing site because a bridge washed out, and the operator wishes to advance a payment to the contractor based on a good estimate of the volume left on the landing. The sample data gathered from all previously delivered loads through stratum X will provide enough information to apply previously derived factors to a piece count of that deck. In this case, there does not need to be any sampling done on the deck itself. If the piles cannot be tied to a weight scale population, cruise data may provide enough information.

8.6.4.2 Measuring the Pile and Applying a Factor

This method will represent a volume with reasonable satisfaction but may not provide enough detail for species and grade combinations:

1. Measure the height of the pile at 2 m intervals within 0.1 m. If the pile contains lengths exceeding 5 m or is predominately sorted with butts one way, it is necessary to take height measurements down both sides of the pile. Height measurements and length measurements are related. (See item 3 and Figure 8.12).
2. Find the average height of the pile by dividing the sum of the pile measurements by the number of measurements.
3. Measure the length of the pile within 0.1 m. Length measurements and height measurements are related, (Figure 8.12). If the total length of the pile is measured, the heights must be taken throughout the full length of the pile. When the length measurement is less than full length, (i.e., "squaring up" the pile, Figure 8.14), height measurements are taken only inside the square.

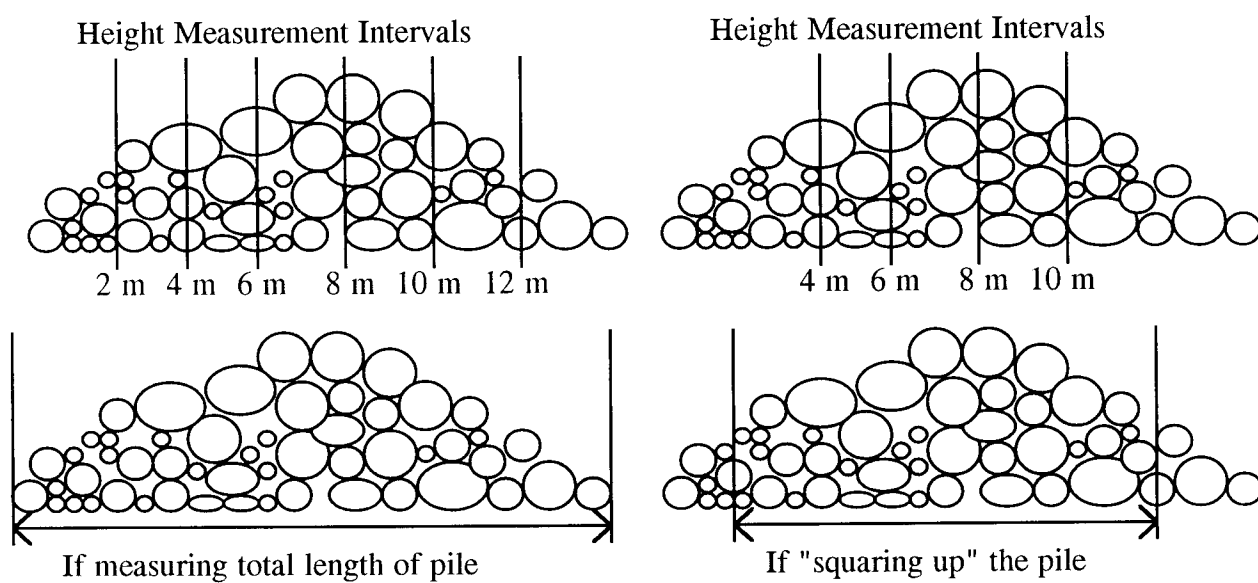


Figure 8.12 Two methods of measuring the length and height of a pile.

4. Determine the average width of the pile by taking as many tree length measurements as possible and dividing the sum of the lengths by the number of measurements as in Figure 8.13.

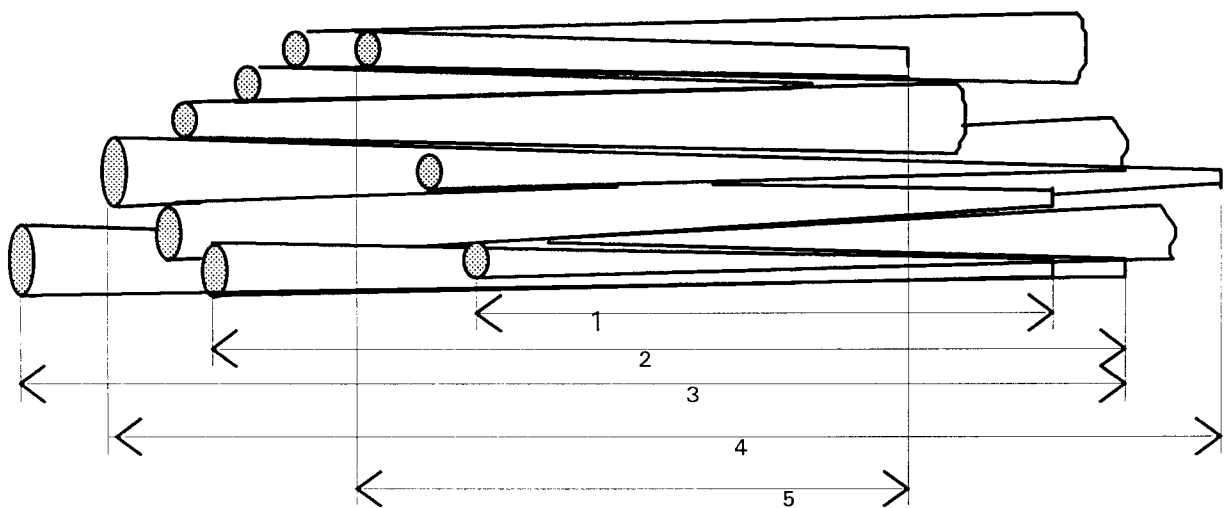


Figure 8.13 Finding the average width of a pile by averaging five representative tree lengths.

5. Multiply the pile height by the pile width by the pile length to arrive at the enclosed volume of the pile.
6. Multiply the enclosed volume by a factor of 0.65 to arrive at the estimated firmwood volume of the pile.

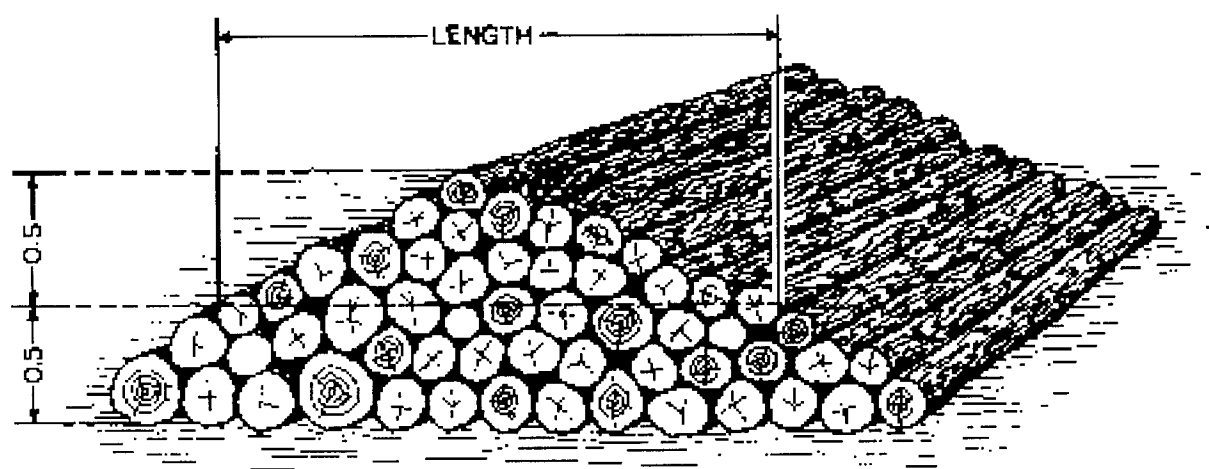


Figure 8.14 Squaring up a pile by taking length measurement at exactly one-half the height of the pile.

8.6.5 Finding Piece Sample Requirements

Where a sampling method is authorized under Section 7 of the *Scaling Regulation*, use the following method to determine the number of samples required to meet the required sampling error of $\pm 1\%$, 19 times out of 20. From this calculation, the scaler will know with certainty how many pieces must be scaled in a group to achieve statistical reliability.

Assuming a producer is planning to take an estimated 5 000 lodgepole pine fence posts from an operating area. This is the "population" to be sampled, and the scaler will determine the sampling requirements as follows:

1. Scale a number of representative pieces to come up with an average volume per piece, for example,

Post Number	Length	Top	Butt	Volume (dm ³)
1	2.4	6	7	14 + 18 = 32
2	2.4	6	6	14 + 14 = 28
3	2.4	6	7	14 + 18 = 32
4	2.4	7	7	18 + 18 = 36
5	2.4	6	6	14 + 14 = 28
Total volume of five posts:				0.156 m ³
Average volume per post (factor):				0.156 m ³ ÷ 5 = 0.0312 m ³

2. Find the sample with the highest volume, in this case, 0.036 m³.
3. Find the standard deviation *SD* of the samples by subtracting the average piece volume from the piece with the highest volume and dividing by three,

$$SD = \frac{0.036 - 0.0312}{3} = 0.0016.$$

4. Find the relative variance *RV* by dividing the square of the standard deviation by the square of the average piece volume,

$$RV = \frac{0.0016^2}{0.0312^2} = \frac{0.0000025}{0.0009734} = 0.0025683.$$

5. From the total number of estimated pieces *N* (5 000) and the relative variance *C*, apply the formula described in Chapter 9 to arrive at the sample size *n*,

$$n = \frac{N \times 2^2 \times RV}{(N \times 0.0001) + (4 \times RV)} = \frac{5000 \times 4 \times 0.0025683}{0.5 + 0.01027} = \frac{51.366}{0.51027} = 100.7.$$

6. Divide the total number of estimated pieces N by the sample size n to find the sampling intensity SI ,

$$SI = \frac{N}{n} = \frac{5000}{101} = 49.5 = 50(\text{rounded}).$$

7. Scale every 50th piece and add it to the sum of the volumes of all of the samples.
8. At the end of the sampling period, divide the total volume of all of the samples V_s by the total number of samples n to arrive at the average volume per piece A . The total number of samples will differ from the sample size calculation in step 5 because the actual production will not likely match the estimated production,

$$A = \frac{V_s}{n} = \frac{3.151}{101} = 0.0312.$$

9. Multiply the actual piece count by the average volume per piece to find the total volume for the population,

$$\text{Volume} = 5\,000 \times 0.0312 = 156\text{ m}^3.$$

10. Prepare a final scale return. Because the sampling term will usually be longer than the required frequency of scale submissions (every month), it is necessary to make adjustments to the final billing. For example, if it takes a period of three months to produce the 5 000 fence posts, returns are prepared based on the average volume per piece available at the time,

	Production	Average Volume/Piece	Volume for month
Month 1	2000 posts	0.03202	64.04 m ³
Month 2	1800 posts	0.0309	55.62 m ³
Month 3	1200 posts	0.0312	37.44 m ³ (unadjusted)
<hr/>			
Total	5000 posts		157.10 m ³

The total volume in the final return must be adjusted to compensate for the use of an interim average volume per piece. Therefore, the sum of the first two interim monthly returns is subtracted from the total volume found in step 9 to arrive at the volume in the final return.

$$\text{Final return volume} = 156.00 - 64.04 - 55.62 = 36.34\text{ m}^3.$$

8.7 Factors and Tables

8.7.1 Table of Special Forest Products Scaled 1992 - 1994

Code	Description
<blank>	Logs
BL	Building Logs
CA	Waney Cypress Cants
CS	Car Stakes
FW	Fire Wood
GS	Grape Stakes
HP	Hop Poles
LB	Shingle Bolts and Blocks
MT	Mining Timbers
OP	Orchard Props
PI	Pickets and Paling
PP	Poles and Piling
PR	Fence Posts (Round)
PS	Fence Posts (Split)
RR	Rails (Round)
RS	Rails (Split)
SB	Shake Bolts and Blocks
SK	Shakes
SS	Stakes and Stocks
XM	Christmas Trees

8.7.2 Stacked Special Forest Products Factors

The solid wood conversion factors in the following table have been developed from many years of experience. Although the factors may be accurate in the average manufacturing process, they may not always be appropriate, due to diverging methods, equipment, and/or raw materials. Therefore, the scaler may request a Forest Service officer to authorize a more appropriate solid wood conversion factor.

Product	Solid wood conversion factor
Unpeeled round wood products	0.65
Unpeeled split products	0.70
Peeled round wood products	0.75
Peeled split products	0.80

8.7.3 Condensed Table of Half Volumes

This table of half volumes is for the convenience of scalers and compilers to obtain volumes when other means are not available.

Volumes are expressed in cubic decimetres to avoid the use of a decimal point in the tables. All volumes may be readily changed from cubic decimetres to cubic metres by dividing by 1 000.

The half volumes are used rather than the full volumes of cylinders are used to simplify computation.

8.7.3.1 Application of the Table

To determine the volume of a log from this table, find the half volumes for the following dimensions:

- Top diameter in rads and the length, and
- Butt diameter in rads and the length.

The sum of the half volumes will equal the volume of the log in dm^3 and division by 1 000 will give the volume in m^3 .

Only lengths in increments of 1 to 10 m are shown;

- To find the volume of a fraction of a metre, move the decimal place to the left by one point. For example, the volume for a length of 0.4 m is found by using the values in the 4 m column divided by 10.
- To find the volume of a log longer than 10 m, add the values in applicable columns. For example, for a 14 m log, add the 10 m half volumes to the 4 m half volumes for the given diameters.
- In combination, the volume of any length of log can be compiled. For example, the volume of a 14.4 m log is found by adding the half volumes of a 10 m log, the half volumes of a 4 m log, and for the 0.4 m, 1/10th of the half volumes of a 4 m log.

Table 8.1 Table of Half Volumes of Cylinders in dm³

Diameter rads	Length in Metres									
	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
1	0	0	0	0	0	0	1	1	1	2
2	0	1	2	3	3	4	4	5	6	6
3	1	3	4	6	7	8	10	11	13	14
4	3	5	8	10	13	15	18	20	23	25
5	4	8	12	16	20	24	27	31	35	39
6	6	11	17	23	28	34	40	45	51	57
7	8	15	23	31	38	46	54	62	69	77
8	10	20	30	40	50	60	70	80	90	101
9	13	25	38	51	64	76	89	102	115	127
10	16	31	47	63	79	94	110	126	141	157
11	19	38	57	76	95	114	133	152	171	190
12	23	45	68	90	113	136	158	181	204	226
13	27	53	80	106	133	159	186	212	239	265
14	31	62	92	123	154	185	216	246	277	308
15	35	71	106	141	177	212	247	283	318	353
16	40	80	121	161	201	241	281	322	362	402
17	45	91	136	182	227	272	318	363	409	454
18	51	102	153	204	254	305	356	407	458	509
19	57	113	170	227	284	340	397	454	510	567
20	63	126	188	251	314	377	440	503	565	628
21	69	139	208	277	346	416	485	554	623	693
22	76	152	228	304	380	456	532	608	684	760
23	83	166	249	332	415	499	582	665	748	831
24	90	181	271	362	452	543	633	724	814	905
25	98	196	295	393	491	589	687	785	884	982
26	106	212	319	425	531	637	743	849	956	1062
27	115	229	344	458	573	687	802	916	1031	1145
28	123	246	369	493	616	739	862	985	1108	1232
29	132	264	396	528	661	793	925	1057	1189	1321
30	141	283	424	565	707	848	990	1131	1272	1414
31	151	302	453	604	755	906	1057	1208	1359	1510
32	161	322	483	643	804	965	1126	1287	1448	1608
33	171	342	513	684	855	1026	1197	1368	1540	1711
34	182	363	545	726	908	1090	1271	1453	1634	1816
35	192	385	577	770	962	1155	1347	1539	1732	1924
36	204	407	611	814	1018	1221	1425	1629	1832	2036
37	215	430	645	860	1075	1290	1505	1720	1935	2150
38	227	454	680	907	1134	1361	1588	1815	2041	2268
39	239	478	717	956	1195	1434	1672	1911	2150	2389
40	251	503	754	1005	1257	1508	1759	2011	2262	2513
41	264	528	792	1056	1320	1584	1848	2112	2376	2641
42	277	554	831	1108	1385	1663	1940	2217	2494	2771
43	290	581	871	1162	1452	1743	2033	2324	2614	2904
44	304	608	912	1216	1521	1825	2129	2433	2737	3041
45	318	636	954	1272	1590	1909	2227	2545	2863	3181

Diameter rads	Length in Metres									
	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
46	332	665	997	1330	1662	1994	2327	2659	2991	3324
47	347	694	1041	1388	1735	2082	2429	2776	3123	3470
48	362	724	1086	1448	1810	2171	2533	2895	3257	3619
49	377	754	1131	1509	1886	2263	2640	3017	3394	3771
50	393	785	1178	1571	1963	2356	2749	3142	3534	3927
51	409	817	1226	1634	2043	2451	2860	3269	3677	4086
52	425	849	1274	1699	2124	2548	2973	3398	3823	4247
53	441	882	1324	1765	2206	2647	3089	3530	3971	4412
54	458	916	1374	1832	2290	2748	3206	3664	4122	4580
55	475	950	1425	1901	2376	2851	3326	3801	4276	4752
56	493	985	1478	1970	2463	2956	3448	3941	4433	4926
57	510	1021	1531	2041	2552	3062	3572	4083	4593	5104
58	528	1057	1585	2114	2642	3170	3699	4227	4756	5284
59	547	1094	1640	2187	2734	3281	3828	4374	4921	5468
60	565	1131	1696	2262	2827	3393	3958	4524	5089	5655
61	584	1169	1753	2338	2922	3507	4091	4676	5260	5845
62	604	1208	1811	2415	3019	3623	4227	4831	5434	6038
63	623	1247	1870	2494	3117	3741	4364	4988	5611	6234
64	643	1287	1930	2574	3217	3860	4504	5147	5791	6434
65	664	1327	1991	2655	3318	3982	4646	5309	5973	6637
66	684	1368	2053	2737	3421	4105	4790	5474	6158	6842
67	705	1410	2115	2821	3526	4231	4936	5641	6346	7051
68	726	1453	2179	2905	3632	4358	5084	5811	6537	7263
69	748	1496	2244	2991	3739	4487	5235	5983	6731	7479
70	770	1539	2309	3079	3848	4618	5388	6158	6927	7697
71	792	1584	2376	3167	3959	4751	5543	6335	7127	7918
72	814	1629	2443	3257	4072	4886	5700	6514	7329	8143
73	837	1674	2511	3348	4185	5022	5860	6697	7534	8371
74	860	1720	2581	3441	4301	5161	6021	6881	7742	8602
75	884	1767	2651	3534	4418	5301	6185	7069	7952	8836
76	907	1815	2722	3629	4536	5444	6351	7258	8166	9073
77	931	1863	2794	3725	4657	5588	6519	7451	8382	9313
78	956	1911	2867	3823	4778	5734	6690	7645	8601	9557
79	980	1961	2941	3921	4902	5882	6862	7843	8823	9803
80	1005	2011	3016	4021	5027	6032	7037	8042	9048	10053
81	1031	2061	3092	4122	5153	6184	7214	8245	9275	10306
82	1056	2112	3169	4225	5281	6337	7393	8450	9506	10562
83	1082	2164	3246	4328	5411	6493	7575	8657	9739	10821
84	1108	2217	3325	4433	5542	6650	7758	8867	9975	11084
85	1135	2270	3405	4540	5675	6809	7944	9079	10214	11349
86	1162	2324	3485	4647	5809	6971	8132	9294	10456	11618
87	1189	2378	3567	4756	5945	7134	8323	9511	10700	11889
88	1216	2433	3649	4866	6082	7299	8515	9731	10948	12164
89	1244	2488	3733	4977	6221	7465	8710	9954	11198	12442
90	1272	2545	3817	5089	6362	7634	8906	10179	11451	12723

Diameter rads	Length in Metres									
	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
91	1301	2602	3902	5203	6504	7805	9105	10406	11707	13008
92	1330	2659	3989	5318	6648	7977	9307	10636	11966	13295
93	1359	2717	4076	5434	6793	8151	9510	10869	12227	13586
94	1388	2776	4164	5552	6940	8328	9716	11104	12492	13880
95	1418	2835	4253	5671	7088	8506	9924	11341	12759	14176
96	1448	2895	4343	5791	7238	8686	10134	11581	13029	14476
97	1478	2956	4434	5912	7390	8868	10346	11824	13302	14780
98	1509	3017	4526	6034	7543	9052	10560	12069	13577	15086
99	1540	3079	4619	6158	7698	9237	10777	12316	13856	15395
100	1571	3142	4712	6283	7854	9425	10996	12566	14137	15708

8.7.4 Table of Full Volumes for Round Fence Posts

The following table is provided for obtaining volumes of round fence posts in a stack or pile. When sampling a stack, it is often very difficult to match the top and butt of inner posts. By measuring only the top diameter and the length of a post, the table will provide the full volume of the post in cubic metres, using known taper curves to accurately estimate the butt diameter. The scaler should sample a number of pieces where both tops and butt can be measured before using this table, so that the validity of the taper factor is proven in a particular application.

Table 8.2 Table of Full Volume (m³) for Top Measured Round Fence Posts

Top Diameter	2	3	4	5	6	7	8	9	10	11
Assumed Taper in rads per Metre 0.500										
Lengths	Vol.	Vol.	Vol.	Vol.	Vol.	Vol.	Vol.	Vol.	Vol.	Vol.
0.1	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.003	0.003	0.004
0.2	0.000	0.000	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.008
0.3	0.000	0.000	0.002	0.002	0.003	0.005	0.006	0.008	0.010	0.012
0.4	0.000	0.001	0.002	0.003	0.005	0.006	0.008	0.010	0.013	0.015
0.5	0.000	0.002	0.003	0.004	0.006	0.008	0.010	0.013	0.016	0.019
0.6	0.000	0.002	0.003	0.005	0.007	0.010	0.013	0.016	0.019	0.023
0.7	0.001	0.002	0.004	0.006	0.008	0.011	0.015	0.019	0.023	0.027
0.8	0.001	0.003	0.004	0.007	0.010	0.013	0.017	0.021	0.026	0.032
0.9	0.001	0.003	0.005	0.008	0.011	0.015	0.019	0.024	0.030	0.036
1.0	0.002	0.003	0.006	0.009	0.012	0.017	0.021	0.027	0.033	0.040
1.1	0.002	0.004	0.006	0.010	0.014	0.018	0.024	0.030	0.037	0.044
1.2	0.002	0.004	0.007	0.011	0.015	0.020	0.026	0.033	0.040	0.048
1.3	0.002	0.005	0.008	0.012	0.016	0.022	0.028	0.036	0.044	0.052
1.4	0.002	0.005	0.008	0.013	0.018	0.024	0.031	0.039	0.047	0.057
1.5	0.003	0.005	0.009	0.014	0.019	0.026	0.033	0.041	0.051	0.061
1.6	0.003	0.006	0.010	0.015	0.021	0.028	0.036	0.044	0.054	0.065
1.7	0.003	0.006	0.011	0.016	0.022	0.030	0.038	0.048	0.058	0.070
1.8	0.004	0.007	0.011	0.017	0.024	0.032	0.040	0.051	0.062	0.074
1.9	0.004	0.007	0.012	0.018	0.025	0.033	0.043	0.054	0.066	0.079
2.0	0.004	0.008	0.013	0.019	0.027	0.035	0.046	0.057	0.069	0.083
2.1	0.004	0.008	0.014	0.020	0.028	0.038	0.048	0.060	0.073	0.088
2.2	0.005	0.009	0.015	0.021	0.030	0.040	0.051	0.063	0.077	0.092
2.3	0.005	0.009	0.015	0.023	0.031	0.042	0.053	0.066	0.081	0.097
2.4	0.005	0.010	0.016	0.024	0.033	0.044	0.056	0.070	0.085	0.102
2.5	0.006	0.011	0.017	0.025	0.035	0.046	0.059	0.073	0.089	0.106
2.6	0.006	0.011	0.018	0.026	0.036	0.048	0.061	0.076	0.093	0.111
2.7	0.006	0.012	0.019	0.028	0.038	0.050	0.064	0.080	0.097	0.116
2.8	0.007	0.012	0.020	0.029	0.040	0.053	0.067	0.083	0.101	0.121
2.9	0.007	0.013	0.021	0.030	0.042	0.055	0.070	0.087	0.105	0.126
3.0	0.008	0.014	0.022	0.032	0.043	0.057	0.073	0.090	0.109	0.131
3.1	0.008	0.014	0.023	0.033	0.045	0.059	0.076	0.094	0.114	0.136
3.2	0.009	0.015	0.024	0.034	0.047	0.062	0.078	0.097	0.118	0.141
3.3	0.009	0.016	0.025	0.036	0.049	0.064	0.081	0.101	0.122	0.146
3.4	0.009	0.017	0.026	0.037	0.051	0.067	0.084	0.104	0.127	0.151
3.5	0.010	0.017	0.027	0.039	0.053	0.069	0.087	0.108	0.131	0.156
3.6	0.010	0.018	0.028	0.040	0.055	0.072	0.091	0.112	0.135	0.161
3.7	0.011	0.019	0.029	0.042	0.057	0.074	0.094	0.115	0.140	0.166
3.8	0.011	0.020	0.030	0.043	0.059	0.077	0.097	0.119	0.144	0.172
3.9	0.012	0.021	0.031	0.045	0.061	0.079	0.100	0.123	0.149	0.177
4.0	0.013	0.021	0.033	0.046	0.063	0.082	0.103	0.127	0.153	0.182
4.1	0.013	0.022	0.034	0.048	0.065	0.084	0.106	0.131	0.158	0.188
4.2	0.014	0.023	0.035	0.050	0.067	0.087	0.110	0.135	0.163	0.193
4.3	0.014	0.024	0.036	0.051	0.069	0.090	0.113	0.139	0.167	0.199
4.4	0.015	0.025	0.038	0.053	0.071	0.092	0.116	0.143	0.172	0.204
4.5	0.016	0.026	0.039	0.055	0.074	0.095	0.120	0.147	0.177	0.210

Top Diameter	2	3	4	5	6	7	8	9	10	11
Assumed Taper in rads per Metre 0.500										
4.6	0.016	0.027	0.040	0.057	0.076	0.098	0.123	0.151	0.182	0.215
4.7	0.017	0.028	0.042	0.058	0.078	0.101	0.126	0.155	0.186	0.221
4.8	0.018	0.029	0.043	0.060	0.080	0.104	0.130	0.159	0.191	0.227
4.9	0.018	0.030	0.044	0.062	0.083	0.106	0.133	0.163	0.196	0.232
5.0	0.019	0.031	0.046	0.064	0.085	0.109	0.137	0.167	0.201	0.238
5.1	0.020	0.032	0.047	0.066	0.087	0.112	0.140	0.172	0.206	0.244
5.2	0.021	0.033	0.049	0.068	0.090	0.115	0.144	0.176	0.211	0.250
5.3	0.021	0.034	0.050	0.070	0.092	0.118	0.148	0.180	0.216	0.256
5.4	0.022	0.035	0.052	0.071	0.095	0.121	0.151	0.185	0.222	0.262
5.5	0.023	0.036	0.053	0.073	0.097	0.124	0.155	0.189	0.227	0.268
5.6	0.024	0.038	0.055	0.076	0.100	0.128	0.159	0.194	0.232	0.274
5.7	0.025	0.039	0.056	0.078	0.102	0.131	0.163	0.198	0.237	0.280
5.8	0.026	0.040	0.058	0.080	0.105	0.134	0.167	0.203	0.243	0.286
5.9	0.026	0.041	0.060	0.082	0.108	0.137	0.170	0.207	0.248	0.292
6.0	0.027	0.042	0.061	0.084	0.110	0.140	0.174	0.212	0.254	0.299
6.1	0.028	0.044	0.063	0.086	0.113	0.144	0.178	0.217	0.259	0.305
6.2	0.029	0.045	0.065	0.088	0.116	0.147	0.182	0.221	0.265	0.311
6.3	0.030	0.046	0.066	0.090	0.118	0.150	0.186	0.226	0.270	0.318
6.4	0.031	0.048	0.068	0.093	0.121	0.154	0.190	0.231	0.276	0.324
6.5	0.032	0.049	0.070	0.095	0.124	0.157	0.195	0.236	0.281	0.331
6.6	0.033	0.050	0.072	0.097	0.127	0.161	0.199	0.241	0.287	0.337
6.7	0.034	0.052	0.074	0.100	0.130	0.164	0.203	0.246	0.293	0.344
6.8	0.035	0.053	0.076	0.102	0.133	0.168	0.207	0.251	0.299	0.351
6.9	0.037	0.055	0.077	0.104	0.136	0.171	0.211	0.256	0.304	0.357
7.0	0.038	0.056	0.079	0.107	0.139	0.175	0.216	0.261	0.310	0.364
7.1	0.039	0.058	0.081	0.109	0.142	0.179	0.220	0.266	0.316	0.371
7.2	0.040	0.059	0.083	0.112	0.145	0.182	0.225	0.271	0.322	0.378
7.3	0.041	0.061	0.085	0.114	0.148	0.186	0.229	0.276	0.328	0.385
7.4	0.042	0.063	0.088	0.117	0.151	0.190	0.234	0.282	0.334	0.392
7.5	0.044	0.064	0.090	0.120	0.154	0.194	0.238	0.287	0.341	0.399
7.6	0.045	0.066	0.092	0.122	0.158	0.198	0.243	0.292	0.347	0.406
7.7	0.046	0.068	0.094	0.125	0.161	0.202	0.247	0.298	0.353	0.413
7.8	0.048	0.069	0.096	0.128	0.164	0.206	0.252	0.303	0.359	0.420
7.9	0.049	0.071	0.098	0.130	0.168	0.210	0.257	0.309	0.366	0.428
8.0	0.050	0.073	0.101	0.133	0.171	0.214	0.261	0.314	0.372	0.435
8.1	0.052	0.075	0.103	0.136	0.174	0.218	0.266	0.320	0.378	0.442
8.2	0.053	0.077	0.105	0.139	0.178	0.222	0.271	0.325	0.385	0.450
8.3	0.055	0.078	0.107	0.142	0.181	0.226	0.276	0.331	0.391	0.457
8.4	0.056	0.080	0.110	0.145	0.185	0.230	0.281	0.337	0.398	0.465
8.5	0.057	0.082	0.112	0.148	0.188	0.234	0.286	0.343	0.405	0.472
8.6	0.059	0.084	0.115	0.151	0.192	0.239	0.291	0.348	0.411	0.480
8.7	0.061	0.086	0.117	0.154	0.196	0.243	0.296	0.354	0.418	0.487
8.8	0.062	0.088	0.120	0.157	0.199	0.247	0.301	0.360	0.425	0.495
8.9	0.064	0.090	0.122	0.160	0.203	0.252	0.306	0.366	0.432	0.503
9.0	0.065	0.092	0.125	0.163	0.207	0.256	0.311	0.372	0.439	0.511
9.1	0.067	0.094	0.127	0.166	0.211	0.261	0.317	0.378	0.446	0.519
9.2	0.069	0.096	0.130	0.169	0.214	0.265	0.322	0.384	0.453	0.527
9.3	0.070	0.099	0.133	0.173	0.218	0.270	0.327	0.391	0.460	0.535
9.4	0.072	0.101	0.135	0.176	0.222	0.274	0.333	0.397	0.467	0.543

Top Diameter	2	3	4	5	6	7	8	9	10	11
Assumed Taper in rads per Metre 0.500										
9.5	0.074	0.103	0.138	0.179	0.226	0.279	0.338	0.403	0.474	0.551
9.6	0.076	0.105	0.141	0.183	0.230	0.284	0.344	0.409	0.481	0.559
9.7	0.078	0.108	0.144	0.186	0.234	0.289	0.349	0.416	0.488	0.567
9.8	0.079	0.110	0.147	0.189	0.238	0.293	0.355	0.422	0.496	0.575
9.9	0.081	0.112	0.149	0.193	0.242	0.298	0.360	0.429	0.503	0.584
10.0	0.083	0.115	0.152	0.196	0.247	0.303	0.366	0.435	0.511	0.592
10.1	0.085	0.117	0.155	0.200	0.251	0.308	0.372	0.442	0.518	0.601
10.2	0.087	0.120	0.158	0.203	0.255	0.313	0.377	0.448	0.526	0.609
10.3	0.089	0.122	0.161	0.207	0.259	0.318	0.383	0.455	0.533	0.618
10.4	0.091	0.125	0.164	0.211	0.264	0.323	0.389	0.462	0.541	0.626
10.5	0.093	0.127	0.168	0.215	0.268	0.328	0.395	0.469	0.549	0.635
10.6	0.095	0.130	0.171	0.218	0.273	0.333	0.401	0.475	0.556	0.644
10.7	0.098	0.132	0.174	0.222	0.277	0.339	0.407	0.482	0.564	0.653
10.8	0.100	0.135	0.177	0.226	0.282	0.344	0.413	0.489	0.572	0.662
10.9	0.102	0.138	0.180	0.230	0.286	0.349	0.419	0.496	0.580	0.670
11.0	0.104	0.140	0.184	0.234	0.291	0.355	0.425	0.503	0.588	0.679
11.1	0.106	0.143	0.187	0.238	0.295	0.360	0.432	0.510	0.596	0.689
11.2	0.109	0.146	0.190	0.242	0.300	0.366	0.438	0.518	0.604	0.698
11.3	0.111	0.149	0.194	0.246	0.305	0.371	0.444	0.525	0.612	0.707
11.4	0.113	0.152	0.197	0.250	0.310	0.377	0.451	0.532	0.620	0.716
11.5	0.116	0.155	0.201	0.254	0.314	0.382	0.457	0.539	0.629	0.725
11.6	0.118	0.158	0.204	0.258	0.319	0.388	0.464	0.547	0.637	0.735
11.7	0.121	0.160	0.208	0.262	0.324	0.394	0.470	0.554	0.645	0.744
11.8	0.123	0.164	0.211	0.267	0.329	0.399	0.477	0.562	0.654	0.754
11.9	0.126	0.167	0.215	0.271	0.334	0.405	0.483	0.569	0.662	0.763
12.0	0.128	0.170	0.219	0.275	0.339	0.411	0.490	0.577	0.671	0.773

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The Weight Scale System

9

Unlike piece scaling where all logs are measured, weight scaling is a sampling method where only a portion of the total production is measured or sampled. Based on the sample results, an estimate is made of the total production. This chapter provides an overview of the Weight Scale System and an introduction to the statistical concepts that underlie the system. A more detailed discussion on how these concepts are applied to satisfy the data needs of industry and government follows in Chapter 10.



Figure 9.1 A loaded logging truck on a platform scale.

9.1 Weight Scaling - Overview of the System

9.1.1 Background

Weight scaling was introduced in the B.C. Interior in the early 1960s as a cost effective and reliable alternative to measuring every log to be scaled. The introduction of weight scaling corresponded with the rapid growth of the Interior forest industry fueled by the construction of pulp mills and the resultant demand for sawmill residues. The 1960s also saw the introduction of close utilization harvesting practices, which resulted in greatly increased truck piece counts and reduced average piece sizes. In 1992, some 95% of the Interior harvest was scaled with the weight scale system.

On the Coast, because of less homogenous forest types, more complex grading, sorting and marketing needs and more complex transportation and log handling opportunities, weight scaling plays a much less prominent role. In 1992, some 15% of the coastal harvest was weight scaled.

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

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

9.1.2 Estimating Volumes Under Weight Scaling

Under weight scaling, all truckloads are weighed and samples are selected at random and scaled for volume and grade. All logs on each truckload must carry the same timber mark. Conceptually, volumes are estimated by summing the total weight or mass of the total production and multiplying this sum by the volume/weight ratio derived from the samples, as shown in the following formula (Figure 9.2).

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

Figure 9.2 Conceptual formula for estimating volumes.

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

9.1.3 Objectives of the Weight Scale System

The reliability of the estimate you wish to achieve is known as the sampling error objective and is set under the *Scaling Regulation* at 1% for the weight scale population. In general terms, this implies that 95% of the time, the total estimated volume in one year will be within 1% of the actual volume (which is the same as within 1% of the volume you would determine if you scaled every piece).

In addition to this objective, data users including the Forest Service and the forest industry, may set other objectives to meet their respective data needs.

To reduce the total number of samples required and to better meet other data needs, weight scale populations are subdivided into groups of truckloads that have similar qualities (e.g., timber mark, stumpage value, and ownership or quality). These groups are known as strata and the process of identifying and subdividing the population into strata is known as stratification. The term "stratum" is singular for strata.

9.1.4 Elements of Weight Scaling

9.1.4.1 Agreement

Prior to commencing weight scaling, the Forest Service and weight scale operator (usually a licensee), must enter into an agreement to use weight scaling for a given population. The population typically includes the company's own production as well as any purchase or trade volumes delivered to the scale over a 12-month period. This 12-month period is known as the cyclic billing period. Included under the agreement is provision for the physical weight scale site, the weighing of loads, the selection of samples, spreading and scaling sample loads, staffing, as well as documentation and reporting requirements.

In all cases, the scale and weighing equipment is owned and operated by the scale holder. The Forest Service is responsible for:

- preparing and monitoring the sampling plan,
- ensuring satisfactory data and processing controls are in place, and
- ensuring scaling and processing standards are maintained.

9.1.4.2 The Weight Scale Sample Plan

Central to weight scaling is the sample plan that comprises the strategy to sample the population to meet the population and other sampling objectives. This plan is prepared by the Forest Service largely from the scale holder's production forecast that is comprised of an estimate of the timber to be scaled for the cyclic billing period.

9.1.4.3 Sampling Frequency

The sampling frequency sets the rate of sampling in each stratum required to meet the sampling objectives. Under weight scaling, only those loads selected as samples are physically scaled. Sample selection is a computerized process and is a program function of the scale holder's weight scale hardware. The Forest Service is responsible for ensuring that all sampling is fully random (i.e., all loads have an equal opportunity of being selected), and for programming sampling frequencies into the scale holder's weight scale computer.

9.1.4.4 Weighing Loads and Processing Samples

The scale holder is responsible for weighing all loads and ensuring loads selected as samples are scaled and reported to the Forest Service for processing.

All weighing and weighing equipment must conform to standards set and regulated by the Weights and Measure Branch of the Federal Department of Industry Canada.

9.1.4.5 Compilation and Reporting Requirements

At month end, the scale holder submits a return to the Forest Service for processing. This return is a statement of all loads going over the scale during the month summarized by weight and number of loads by timber mark and stratum. Sample load details are compiled and reported as they are scaled.

Electronic reporting of month-end results is available to scale holders (see Chapter 7).

9.2 Statistics Underlying the Weight Scale System

Because weight scaling is a sampling approach, its theoretical foundation lies in statistical sampling convention. Statistics provide answers to some basic questions in weight scale sampling:

1. How many samples do we need to take to provide reliable results?
2. How can we conduct sampling to avoid biased results?
3. How can we achieve more efficient sampling (i.e., acceptable results at lower cost)?
4. How good are our results?

While the formulae underlying weight scaling are complex for most users, it is most important to concentrate on their significance rather than the details of each calculation. This chapter attempts to provide only a basic introduction to the statistics and statistical conventions relating to weight scaling. The detailed statistical formulae that are used in weight scaling are summarized in Appendix 9A.

9.2.1 Statistical Concepts

9.2.1.1 An Overview of Estimating Using Statistics

In weight scaling our chief objective is to estimate the total volume delivered over the weight scale in a year (cyclic billing year). In determining an estimate, we could simply use historic data, take some samples, or use some other estimating approach. While such an estimate may suffice for some purposes, the importance placed on scale data by government and industry requires that our estimates be reliable and it be known how reliable they are. This assurance can only be achieved by introducing statistics into our estimates.

As discussed under Section 9.1.2, weight scale estimates are made using a sampling method. To ensure we achieve reliable data instead of simply taking a couple of samples, our starting point must be to determine how many samples we must take. The required number of samples (n), is dependent upon two things:

1. How much do our samples vary from truckload to truckload? (this is measured by the standard deviation (SD)).
2. How good do we wish our results to be? (this is set by regulation at one percent and is called the sampling error objective (SE)).

If all the individual truckloads in our population were similar, we could make some very accurate conclusions about the population where taking only a few samples. If, on the other hand, individual truckloads differed greatly from load to load, we would have to take many more samples to draw the same conclusions.

Similarly, the better we wish our results to be, the more samples we require. And, conversely, if we are willing to accept the risk associated with less reliable results, we will require fewer samples.

After we have determined how many samples we require, we can commence sampling. Under statistical sampling, we must ensure all truckloads have an equal opportunity of being selected as a sample (i.e., samples must be selected at random). We do this to avoid bias.

At the end of the year, after we have taken all our samples and all loads have been weighed, we must do some calculations to determine how successful our sampling was (i.e., how reliable are our volume estimates). To do this, we must answer the question: "Did we achieve our sampling objectives?"

Figure 9.3 shows the relationships between the basic questions we must ask at the start and end of the year as well as their related statistical relationship. Before proceeding, attempt to relate the foregoing discussion to the diagram. If you have difficulty, ask someone who can help to explain it. This overview is the conceptual essence of weight scale sampling.

The next sections cover each component of sampling in more detail.

A. Start of the Cyclic Billing Year

Basic question: How many samples do we require?

Basic statistical relationship:

$$n = \frac{SD}{SE} \quad \text{Where: } n = \text{the total number of samples required}$$

SD = standard deviation = a measure of how much samples ratios vary from truck to truck.

SE = sampling error = a measure of how reliable we wish our year end volume estimates to be (this is our sampling objective).

B. During the Year

Weigh all loads and scale randomly selected samples.

C. At the End of the Cyclic Billing Year

Basic questions: How reliable are our estimates?

Did we meet our sampling objective?

Basic statistical relationship:

$$SE = \frac{SD}{n}$$

Where: SE = sampling error = a measure of how reliable our estimates are. Compared with the sampling objective, we can answer the basic questions - Did we meet our sampling objective? How reliable are our estimated volumes?

SD = standard deviation = at the year end, this is a measure of how much the ratios actually varied from truck to truck.

n = the number of samples we actually took.

Figure 9.3 Conceptual overview of weight scale sampling.

9.2.1.2 Population, Units and Samples

Sampling is undertaken to make reliable estimates about a population without having to measure the entire population. In weight scaling, the population is the aggregate of all truckloads weighed in a given period. The truckload is known as the unit. Sample units are those truckloads that are selected as samples and measured. The chief objective of weight scaling is to estimate the total volume for the population.

To ensure the volumes we estimate are free from bias (i.e., ensure results are not systematically high or low) statistical convention requires that all samples be selected at random. Random sampling is only achieved where all truckloads in the population have an equal chance of being selected as a sample.

9.2.1.3 Parameters and Statistics

Constants that describe population characteristics are referred to as parameters. Constants that describe sample characteristics are referred to as statistics. In weight scaling, the average weight of all harvested truckloads is a parameter (because it is calculated from the population). On the other hand, the average weight of all sampled truckloads is a statistic (because it is calculated from the sample, not the population).

The following parameters are important for weight scaling:

- Mean volume of all truckloads,
- Mean weight of all truckloads,
- Ratio of total volume to total weight for all truckloads (this is the population ratio), and
- Variance of the ratios of individual truckloads from the ratio for all truckloads.

The following statistics are important for Weight Scaling:

- Mean volume of all sampled truckloads,
- Mean weight of all sampled truckloads,
- Ratio of mean volume to mean weight of all sampled truckloads, and
- Variance of the ratios of individual, sampled truckloads.

Note that the population ratio remains exactly the same whether we divide total volume by total weight, or we divide mean volume by mean weight. The same applies for the ratio of the sampled loads.

9.2.1.4 The Ratio and the Means

Under weight scaling every load in the population is weighed and only loads selected as samples are stick scaled for volume. Volumes under weight scaling are estimated using the weight of loads and the volume to weight relationship (or ratio), established through sampling.

The ratio establishes the relationship between volume and weight and may be calculated for each sample or the entire population (or strata as we will see later).

Ratios are expressed in terms of cubic metre per kilogram (m^3/kg) m/tonne or cubic metres per tonne.

The ratio for a sample is simply:

$$r = \frac{y}{m}$$

Where: r = the volume to weight ratio (m^3/kg)

y = the volume for a given sample (m^3)

m = the weight of the same sample (kg)

To calculate volumes under weight scaling, you simply multiply the ratio times the weight:

ratio x weight = volume, at the sample level this is:

$$r \times m = y (\text{m}^3)$$

To confirm the calculation:

$$\frac{\text{m}^3}{\text{kg}} \times \text{kg} = \text{m}^3$$

Using the same relationship, we can also determine the mean ratio and the mean volume for the population.

The mean ratio or the ratio for the population is an estimate and is calculated as:

$$R = \frac{Y}{M} = \frac{\sum y}{\sum m}$$

Where: R = the volume to weight ratio for the population (m^3/kg)

Y = the total volume estimated for all truckloads in the population (m^3)

M = the total weight of all truckloads in the population (kg)

Similarly, the mean volume is calculated. It is the average truckload volume of all loads in the population.

Because we weigh all loads and scale only sample loads, the mean volume is an estimate calculated from the total weight of all loads in the population and the ratio we establish through sampling. It is the ratio for the population multiplied by the average weight per truckload. The formula for the mean volume is estimated as:

$$\bar{Y} = \frac{\sum y}{\sum m} * \frac{M}{N}$$

where the variables are defined as:

$\bar{Y}$ = Estimated population Mean (average volume of a truckload in the population). (Note: the bar above the variable, i.e., is the mathematical convention for a mean)

y = the volume of a sampled truckload (m^3)

m = the weight of a sampled truckload (kg)

$\sum y$ = the total volume of all sampled truckloads (m^3). (Note: $\sum$ is the mathematical convention for the sum of)

$\sum m$ = the total weight of all sampled truckloads (kg)

$\frac{\sum y}{\sum m}$ = the ratio calculated from all sample volumes and weights

M = the total weight of all truckloads in the population (kg)

N = the total number of all truckloads in the population (whole number)

In addition to calculating weight scale volumes, means also play an important part in statistical calculations.

9.2.1.5 The Standard Deviation and the Normal Distribution

9.2.1.5.1 Standard Deviation

The standard deviation is an important parameter because it provides an insight into the population we are sampling. Standard deviation allows us to determine how many samples we will have to take to meet our sampling objectives. The standard deviation of a population is a measure of the dispersion of individual values around the population mean. It tells us how spread out the numbers are that we are dealing with. If one population has a larger standard deviation than another population, that tells us that the first population has a higher dispersion or spread around the population mean than does the second population.

For weight scaling the standard deviation provides a measure of how much truck ratios (calculated from the samples) vary from the mean ratio for the population.

This point is demonstrated in Figure 9.3, which plots two populations of ratios (i.e. a plot of sample volumes over sample weights). Both populations are comprised of 24 samples and each has the same mean ratio, represented by the solid line going through the approximate middle of the data.

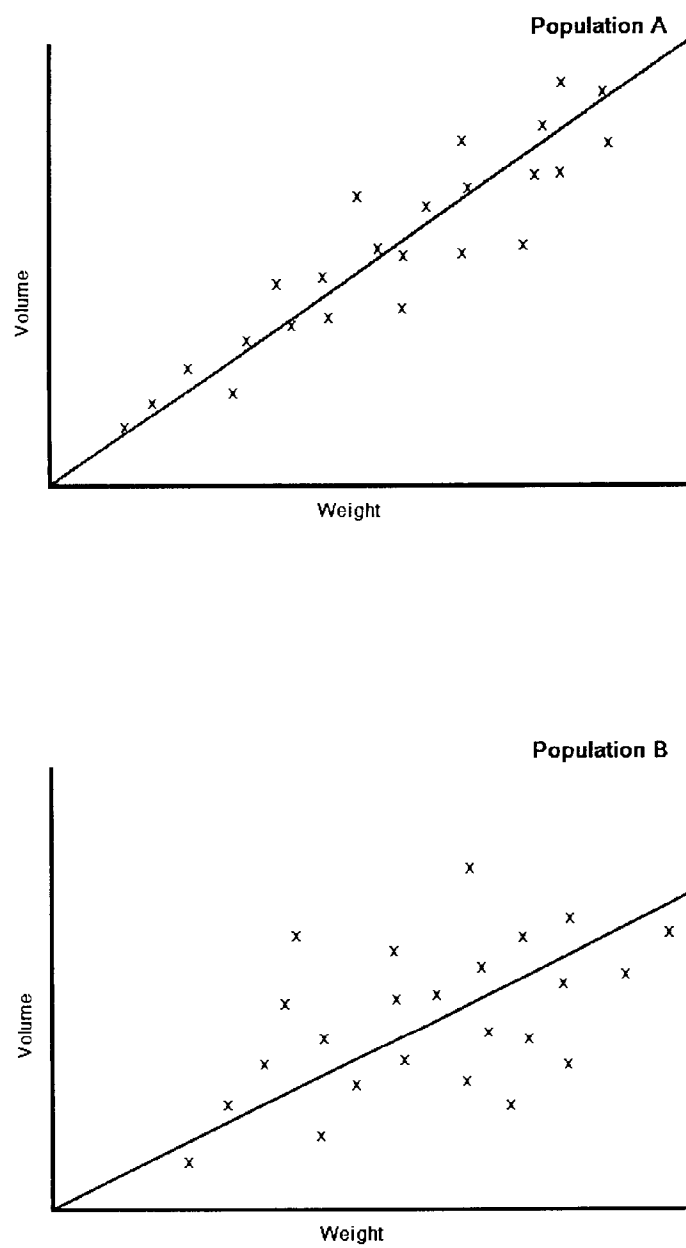


Figure 9.4 Graph of ratios for populations A and B.

Figure 9.4 illustration population A is clustered about its mean, whereas population B is spread out about its mean. Population B is said to be more variable than population A, and will similarly have a higher standard deviation than population A. If we wished to make some estimates from population B, we would have to take more samples, because there is more variation between individual ratios. This point will be explained further under Section 9.2.1.5.2.

Instead of calculating standard deviations in terms of the ratio (i.e., m³/kg) standard deviations are expressed in terms of volume/load or m³/load.

Often the variance is referred to by statisticians. The standard deviation is simply the square root of the variance. For example a population of truckloads may have a mean of 35 m³ per load and a standard deviation of 3 m³ (the Variance would be 9 m⁶).

In summary, Variance = SD² and SD = $\sqrt{\text{variance}}$

See the appendix for calculating the standard deviation. Many pocket calculators have a standard deviation calculation built into them, though the calculation used for weight scaling is more complex and not generally available on a calculator.

The next sections on the normal distribution help explain the relationship of how sample means are distributed around the population mean and the significance of the standard deviation.

9.2.1.5.2 The Normal Distribution

An understanding of the normal distribution or "bell curve" is useful as it helps explain several concepts. While not all populations conform to a normal distribution, sample averages such as sample ratios (expressed in m³/load) always conform to a normal distribution. This provides us with information that helps us to understand our population, define our sampling needs and ultimately evaluate our sampling results (Figure 9.5).

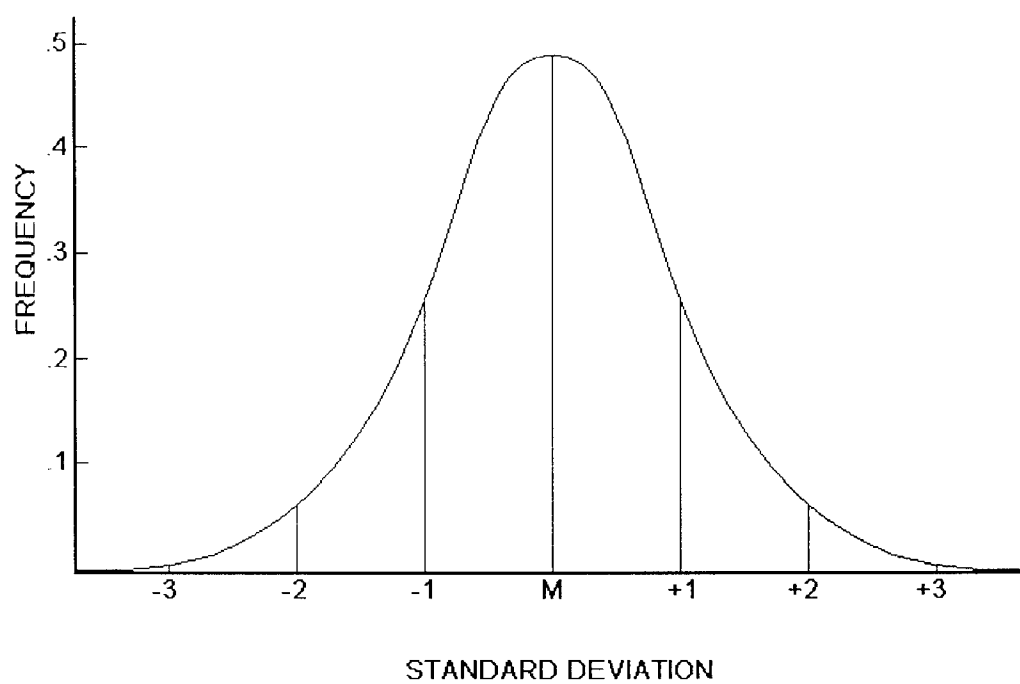


Figure 9.5 Shows a normal distribution curve.

In the case of weight scaling, we must think of the normal distribution curve as representing a population of sample ratios (expressed in m^3). The population mean (m) is the average of all the ratios devised from all loads sampled. The standard deviation of the population is a measure of the dispersion of the individual ratios around the population mean. By the shape of the normal curve, you can see the dispersion of individual ratios around the mean is uniform, with the same number of ratios greater than the mean as there are values less than the mean (the mean and the median are equal).

There is also a strong relationship between the Standard Deviation (SD) and the Normal Distribution. We can make the following statements about every population of weight scale ratios:

1. There is perfect balance above and below the mean (the mean and the median also coincide) (i.e., 50 percent of the sample ratios are below the mean and 50 percent of the samples ratios are above it).
2. 68.3% of all ratios will be within plus and minus one standard deviation of the mean. Similarly, 95.4% of all observations (unit values) will be within ± 2 standard deviations of the mean. This corresponds to 95.4% of the area under the curve (the entire curve area is 1, or 100%, as 100% of the sample ratios are represented by the curve).

For example, if a load average for a given population is 35 m^3 and the standard deviation is 3 m^3 , you can say the following about the population:

- 50% of the loads will be greater than and another 50% will be less than the mean,
- 68.3% (or approximately 2 out of 3) of the loads will be between 32 and 38 m^3 (i.e., $35 \text{ m}^3 \pm 3 \text{ m}^3$),
- 95.4% (or 19 out of 20) will be between 29 and 41 m^3 (i.e., $35 \text{ m}^3 \pm 6 \text{ m}^3$ or $35 \text{ m}^3 \pm 2 \text{ SDs}$), and
- 99.7% will be between 26 and 44 m^3 (or $35 \text{ m}^3 \pm 3 \text{ SDs}$).

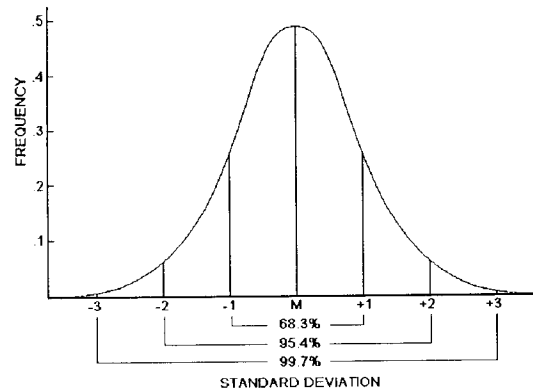


Figure 9.6 Relationship between the standard deviation and the intervals defined by the mean plus and minus 1, 2, and 3 standard deviations.

68.3% of the ratios will be between the mean + and - 1 SD
 95.4% of the ratios will be between the mean + and - 2 SDs
 99.7% of the ratios will be between the mean + and - 3 SDs

In the same sense, the area under the curve corresponds to each interval (i.e., 68% of the area under the curve), or 68% of the ratios will be within plus and minus 1 SD of the mean.

Every population of ratios conforms to the bell shape. Populations that are more variable (or heterogeneous), however, will be more spread out than populations that are less variable (or more homogeneous). Figure 9.7, for example, shows three populations with the same mean.

Population A is much more variable than populations B and C, as it is more spread out about the population mean. Population A can be described as heterogeneous compared to Population C, which is more homogeneous and more clustered around its mean. Population A would have a higher standard deviation than B or C.

In looking at a different population of truckloads, a larger standard deviation means there is a higher variation between load ratios and the mean, and the distribution is more widely spread. If, on the other hand, the standard deviation is smaller, it means there is less variation between truckload ratios, and the distribution curve would be steeper with more loads located closer to the mean.

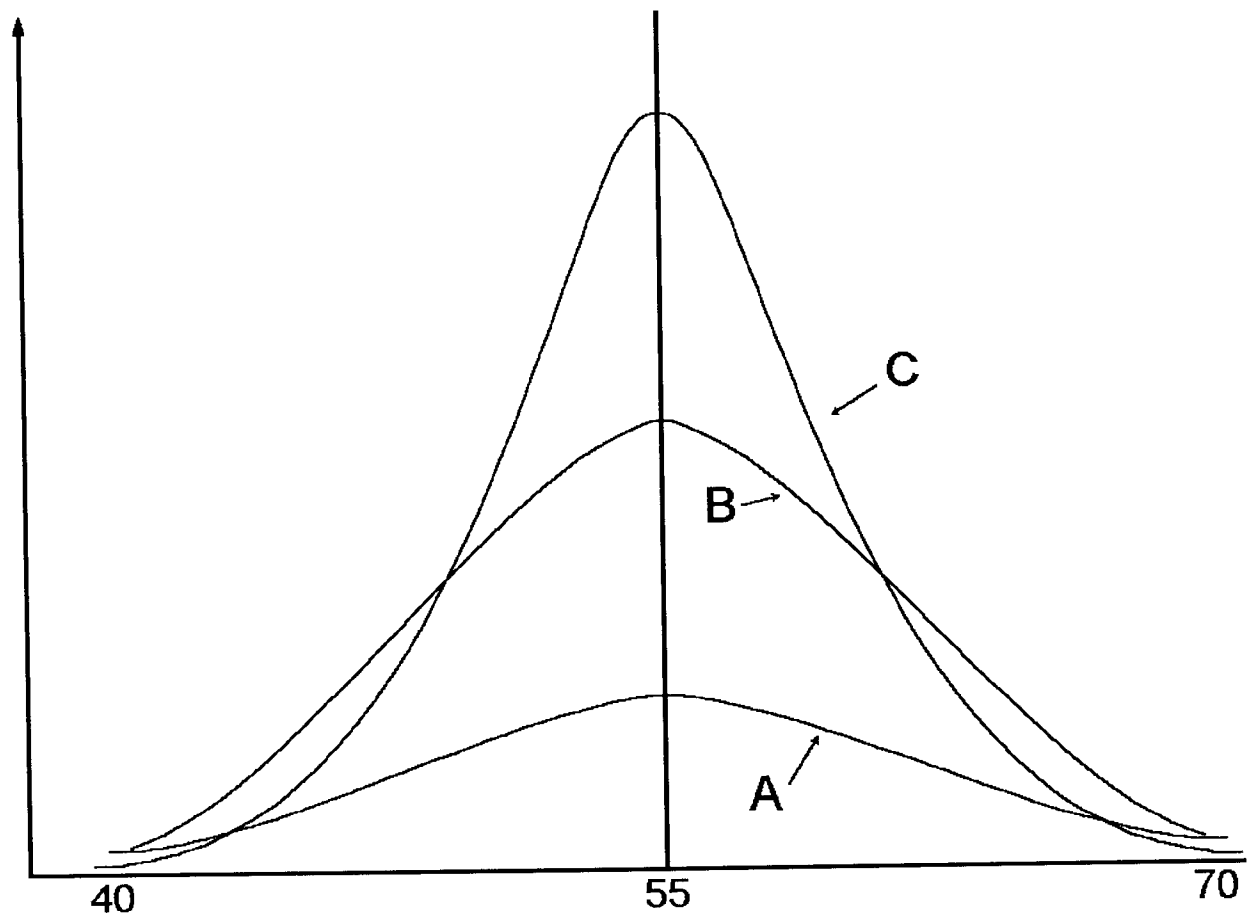


Figure 9.7 Three normal curves with different variances but the same mean.

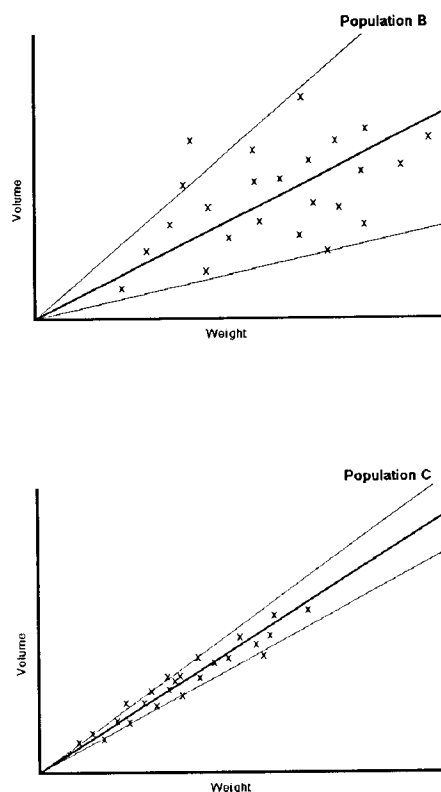


Figure 9.8 Populations B and C in graph form.

Figure 9.8 is a graphical presentation of the same populations B and C as in Figure 9.7. The middle line represents the mean ratio and the line generally enclosing the data represents ± 2 standard deviations from the mean. Note that some data points, known as *Outliers*, reside outside the limits of the 2 standard deviation line. By definition, some 5% of data points will be classified as outliers.

The significance of the characteristics of the normal distribution is discussed further in the sections on stratification (Section 9.2.1.10) and sampling precision (Section 9.7.1.8).

9.2.1.6 Coefficient of Variation

Closely related to the standard deviation is the coefficient of variation (CV) and the relative variance. The CV is simply the SD expressed either as a decimal or % of the population mean. This enables a comparison of the variability of one population relative to another population. So, if one population has a higher CV than another population, then this means that the population with the higher CV has greater dispersion.

The formulae for CV are:

$$CV = \left(\frac{SD}{\text{Average volume per load}} \right)$$

Where the variables are defined as:

CV = coefficient of variation.

SD = standard deviation for the population.

To calculate the CV in %, multiply this decimal by 100.

Example: given a standard deviation = 3.5 m³ and an average load size of 40 m³...

$$\text{the CV} = \frac{3.5 \text{ m}^3}{40 \text{ m}^3}$$

$$= .0875$$

$$\text{as a \%} = .0875 \times 100$$

$$= 8.75\%$$

Where the denominator (e.g., in this case the average volume per load) varies a lot between populations, the CV provides more reliable comparisons than just the SD. In weight scaling, truckload sizes are usually quite similar, and as such, we can usually compare SDs directly and don't have to calculate CV values.

Timber cruisers often refer to the CV because the average stand volume can vary significantly from stand to stand.

In addition to CV, there is another closely related statistic that is often referred to: the Relative Variance. Just as the variance is the square of standard deviation, similarly the relative variance is the square of the CV. Once again, one can refer to the CV or the RV, it does not really matter since they refer to the same property of a population.

$$RV = CV^2$$

e.g. Using our previous example, if

$$CV = .0875$$

$$RV = CV^2 = .0875^2 = .007656$$

These statistics are used in weight scaling for the purposes of determining how many samples are required for the population and how the sampling effort should be divided. This will be discussed further in Section 9.2.1.10

9.2.1.7 The Sampling Error

Until now, we have focused on the dispersion of individual measurements about a population mean and on related statistical tools for explaining these observations (i.e., the normal distribution, the mean, the standard deviation, and the coefficient of variation). These statistics are largely used in determining how many samples we should take to sample the population and make our estimates. The Sampling Error is used to tell us how reliable (or precise) our sample estimates are. The sampling error may also be referred to as the standard error of the mean, the standard error of the estimate, or the standard error. We will refer to it as the sampling error or the SE.

The sampling error is a very useful statistic because it provides us with an understanding of the reliability of our estimate. For example, we could estimate that in a particular population, the average volume per load was 35 m³. This estimate, however, is not very useful until we have some idea of how precise it is. The sampling error might tell us this estimate was accurate to plus or minus 1 m³, which might make the estimate accurate enough for our purposes.

In reviewing the overview in Figure 9.3, you will note the sampling error is significant on two accounts. At the start of the year, it is the sampling objective (i.e., $\pm 1\%$ at the population level) and defines how reliable we wish our estimates to be at the end of the year.

This in turn impacts the number of samples we must take to achieve that objective. (Remember that the other factor affecting the required number of samples is the standard deviation.)

At the end of the year, the sampling error is calculated from our sample results and tells us how reliable our estimated volumes are and whether or not we met the sampling error objective we set at the start of our sampling year.

Like the individual units in a population, sample estimates are also subject to variation. For example, the mean load size estimated from a sample comprised of three loads will seldom be the same as the estimate obtained from another sample of three loads. We expect some variation because each sample selected contains different individual units (i.e., the ratios vary). If all units were the same, we probably would not be sampling in the first place. We sample to make estimates about the population.

Remember the volumes we calculate for weight scaling (i.e., weight x ratio) are estimates of the actual volume. The actual volume is never known unless we piece scale every load. The sampling error tells us how good our estimates are.

Just as the standard deviation is a measure of the dispersion of individual truckload ratios around the mean ratio of all samples, the sampling error is a measure of the dispersion of the mean ratio of sampled truckloads around the mean ratio of all truckloads. Because we would not know the true mean of all truckloads unless we sample scaled every load, the mean ratio for the population is an estimate as are the other volumes we calculate for the population.

Just like the standard deviation, the sampling error has the same characteristics with respect to the normal distribution, which enable us to make very specific statements about our estimates.

Using the example of the total volume estimated for the weight scale we can say:

- There is a probability of 68.3% (or 68.3% of the time) that the volume calculated for the population (i.e., total weight multiplied by the ratio) will be within 1 SE (or confidence limits) of the actual volume.
- There is a probability of 95.4% (or 19 times out of 20 chance) that the estimated volume will be within plus and minus 2 SEs (or 2 confidence limits) of the actual volume.

The concept of probability is introduced in these statements.

Frequent convention in forestry sees SEs compiled to the 95% limit (in Appendix 9A the 95% limit is referred to as the 95% quintile).

All weight scale reports generated by the Forest Service report SEs to the 95% confidence limit.

For the detailed calculation see the appendix.

Usually, to be meaningful, the SE is calculated as a percent of the quantity we are trying to estimate. In the case of the total volume in the weight scale population the SE percent is calculated as:

$$SE\% = \left(\frac{SE}{\text{Total Volume}} \right) * 100\%$$

Review this concept through this example:

Given a total volume estimate of 50 000 m³ for population XYZ and a reported sampling error 1.0%, what can be said about our estimate?

There is a 95% probability (or 19 times out of 20 chance) that the total volume determined for the population through sampling will be within 1.0% of the actual volume. There is a 95% probability the actual volume will be between 49 500 and 50 500 m³.

The 2 SEs for the 95% limit are a convention. The area under the normal curve for ± 2 SEs (and SDs) is 95.3% and not 95.0%, and usually 1.96 is used instead of 2 SE's. Detailed calculations usually use a Students t Distribution to set this value.

In sampling any population, we set the sampling error at the start of the year as the level of precision we wish to achieve for our year-end estimates. We refer to this as our sampling error objective.

At the end of the year, we calculate the sampling error to evaluate how good our results are and ask the basic question: How does the sampling error achieved compare with our sampling error objective?

9.2.1.8 Accuracy and Precision

When we ask ourselves how accurate our results are we are really asking ourselves how close our estimates calculated from our samples are to the actual quantity or value. For weight scaling, we often refer to the sample means that are the ratios (remember ratio $\times$ weight = volume). In discussing accuracy, we ask ourselves how close is the sample mean to the unknown population mean. In sampling, because we do not measure all units, we never really know the actual mean and, as such, we never really know how accurate our estimate is. We do, however, have some understanding through the standard error of how close our sample ratio is to the unknown population ratio. This estimate (i.e., the SE) is referred to as precision. The smaller the sampling error, the higher the precision. The sampling error is 0 when all units in the population are measured (i.e., $n = N$).

Statisticians often refer to *Bias* of an estimate. Bias is a distortion of results arising from an incorrect method of sampling. Figure 9.9 shows a dartboard example of bias as well, the difference between precision and accuracy. Note that the darts show good precision (i.e., the darts are clustered together), but they reflect an inaccurate result, which is biased.

Bias in weight scale sampling is avoided by ensuring sample selection is completely random, (i.e., every truckload has an equal opportunity of being selected as a sample). This concept will be explained further in the next chapter.

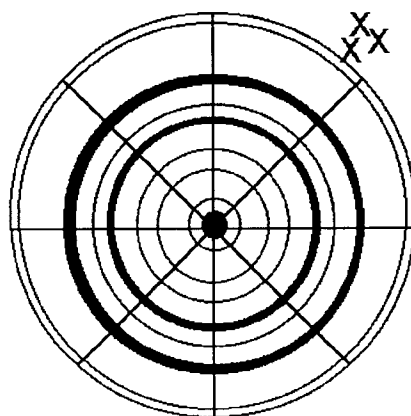


Figure 9.9 In this dartboard example, the 3 darts (x) are precise but inaccurate and biased.

9.2.1.9 Determining the Sample Size

In the previous sections we have discussed the concepts of standard deviation and the sampling error.

The standard deviation is a characteristic of the population that reflects the variation between individual truckload ratios. The sampling error on the other hand, provides us with a measure of how precise our sampling results are at the end of sampling. At the beginning of the sampling year we use the sampling error as the precision (or sampling error objective) we wish to achieve through the sampling. The actual number of samples we require to meet the sampling error objectives is known as the sample size.

While the formula for the sample size is complex, you should understand the relationship between the standard deviation, the sampling error, and the sample size. Functionally it can be presented as the following:

$$n = \frac{SD}{SE}$$

You can conclude from this relationship a couple of things:

- the more the truckload ratios vary (i.e., the higher the SD) the more samples you require;
- the greater the precision (i.e., lower the value of SE) you wish to achieve, the more samples you require;
- similarly, the corollaries of each of these is true, i.e.:
- the less the truckload ratios vary (i.e., the lower the SD) the fewer samples you require; and
- the lower the precision (i.e., higher value of SE) you wish to achieve, the fewer samples you require.

Once the sample size has been established, you must determine the rate of sampling or the sampling frequency. In the case of weight scaling, if a population of 5 000 loads requires 100 samples to meet the sampling objective, the sampling rate is equal to 1 in 50 truckloads (presented as 1:50 or simply sample rate = 50).

In terms of weight scaling, this means 1 sample out of every 50 loads must be randomly selected as a sample and sticks scaled for volume and grade. In statistical jargon, this is known as *Block Sampling*. In this example, the Block Size = 50.

The next sections further explore the basic relationships presented in the previous sections.

9.2.1.10 Stratified Random Sampling

If a population was comprised of a single species, all trees were of equal quality, equal stumpage value, and under a single timber mark (i.e., homogeneous in terms of species, quality, value, and markholder), sampling of the entire population, as a single unit, would probably provide satisfactory results and sampling costs would be within reason. The normal situation, however, sees weight scale populations as variable in composition or heterogeneous. Most weight scale populations are comprised of multiple species and grade combinations, multiple timber marks, small business, major licensee and purchase volumes, salvage timber volumes, along with other variables. Sampling such populations as single units would result in volume estimates of low precision and sampling costs would be prohibitive.

The reasons for low precision and high costs lie in the conceptual relationship between the sampling error, the standard deviation, and the number of samples (sample size).

$$\text{i.e.} \quad SE = \frac{SD}{n} \quad \text{or} \quad n = \frac{SD}{SE}$$

If a low SE is required and you are confronted with a high variation among sample units, your only option under this approach would be to increase n (i.e., take more samples).

To overcome these deficiencies, Stratified Random Sampling is employed for sampling most forest populations. Under stratified sampling, units of the population are grouped together on the basis of similarity of some characteristic (e.g., species, value, quality, timber mark or volume-mass ratio). These groupings are referred to as strata (stratum for singular) or subpopulations. Each stratum is then sampled and stratum estimates (e.g., volume/stratum) are combined to give a population estimate (e.g., volume for the population).

Stratified random sampling provides several advantages over simple random sampling.

- it provides more meaningful data about the population as well as an estimate of precision for each stratum,
- provides for better segregation of scale data,
- population estimates may be more precise with the same number of samples, and
- the required number of samples is often reduced.

Going back to our basic relationship, we can deduce that if through stratification we can reduce the variation (SD) among sample units within strata to less than that which occurred if we did not stratify, then our estimates will be more precise (i.e., a lower SE). One can also expect an increased precision at the stratum level if we, in fact, did reduce the SD within each stratum.

Stratification can be demonstrated through a graph of sample ratios. Figure 9.10 shows a graph of ratios for Population XYZ. This population was stratified into Z strata (1 and 2).

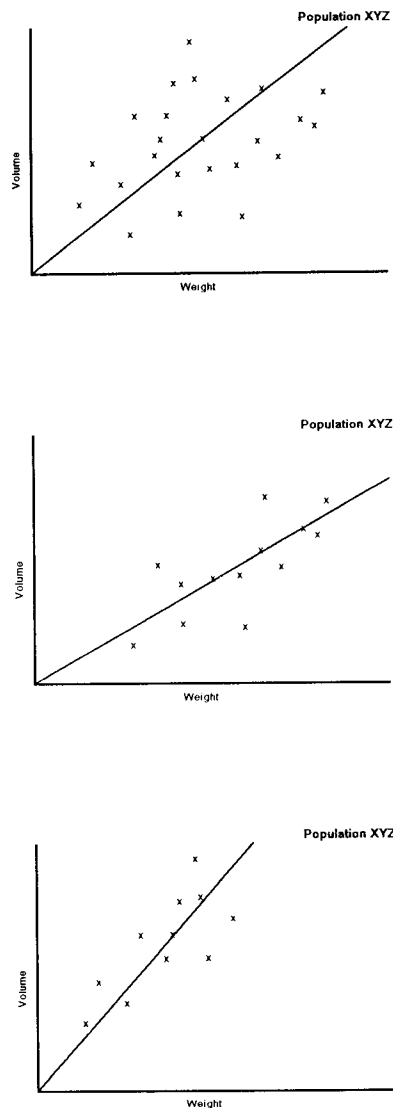


Figure 9.10 *Graphs to show the impact of stratification.*

From this example you can see stratification resulted in better clustering of data in each of the strata. In terms of variation in truck ratios, this means there is less truck-to-truck variation in ratios within each stratum than there is variation between truck-to-truck ratios for the population. In other words, the standard deviation for each of the strata is less than the standard deviation for the population. This will likely reduce the total sample size for the population. Because stratum data are more clustered, we can likely expect data for each stratum to be more meaningful.

Stratification is a very important step to achieving more reliable scale results and will be discussed more thoroughly in the next chapter.

9.2.1.10.1 Steps for Determining the Sample Size for Stratified Random Sampling

For stratified random sampling, there are several basic steps in determining the sample size.

1. Estimate the variability inherent of the population (i.e., determine the standard deviation). If you do not have an SD from a previous year, borrow one from a similar population.
2. Calculate the relative variance for the population (i.e. $RV = \frac{SD^2}{\overline{Y}^2}$)

Where $\overline{Y}$ = average volume/load

3. Calculate the sample size for the population given your sampling error objective, assume 1% at the 95% confidence interval. For the actual formula, refer Appendix 9A.

The functional relationship for this formula is:

$$n = \frac{RVxtxN}{E}$$

Where n = estimated sample size

N = estimated total number of units in the population
(e.g., total number of truckloads)

RV= relative variance

E = sampling error objective (the SE)

t = student t value (for 95% confidence level use 2)

Use Figure 9.11 for an approximate number. To use this table, you must estimate the total number of truckloads (N) in your population as well as a relative variance.

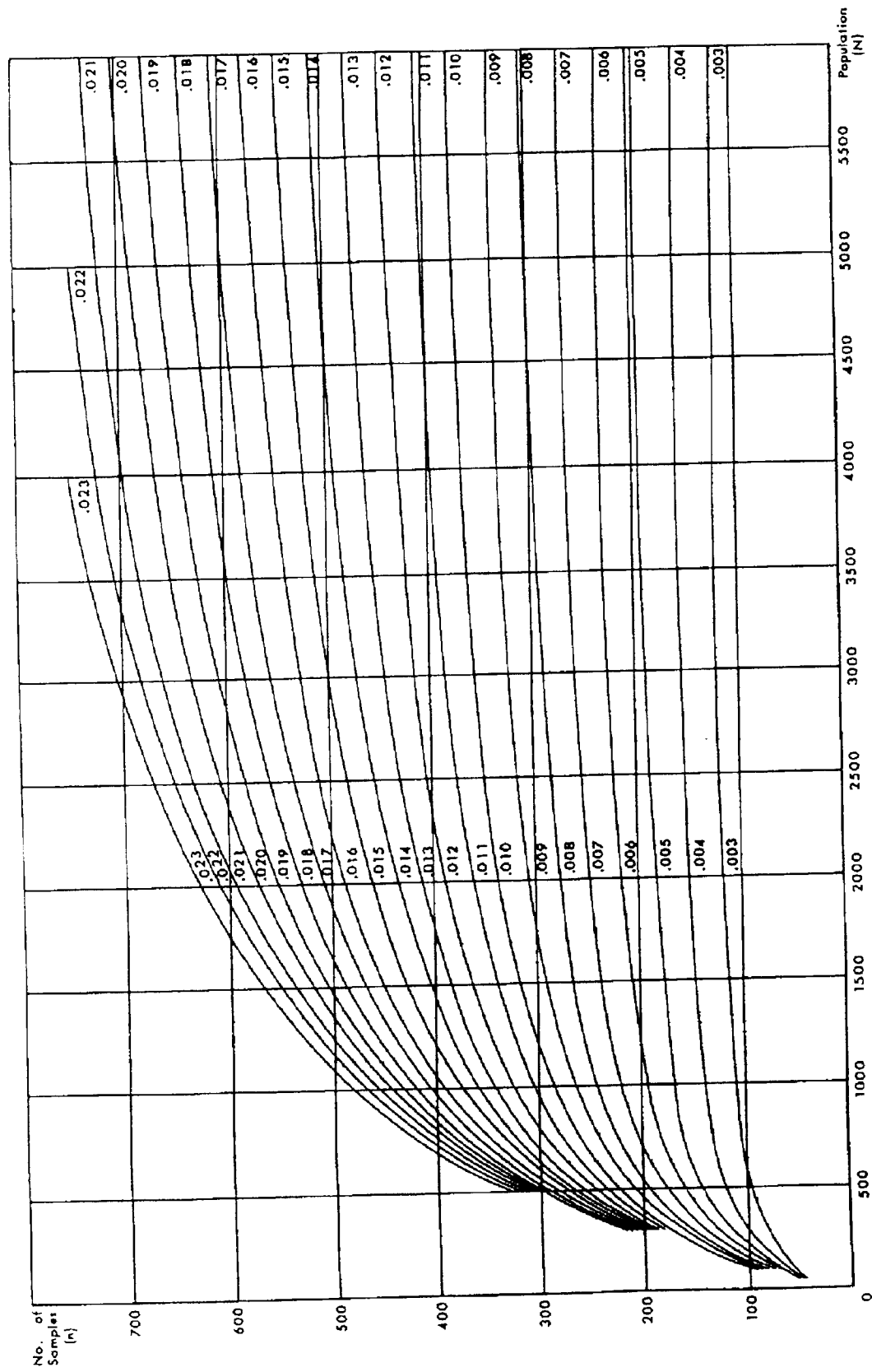


Figure 9.11 Sample size requirements of populations by relative variance for accuracy of $1 = 1\% 19/20$.

4. Allocation of Samples by Strata

Once you know the number of samples required to meet the sampling error objective for the population, you must allocate the total sample size to determine how many samples are required in each stratum. This can be done by simply allocating samples based on the estimated number of units (e.g., truckloads) in each stratum. This is referred to as proportional allocation. In weight scaling, the sampling effort is allocated on the basis of the relative variation represented by each stratum. This approach sees sampling more heavily in strata having a larger variation (i.e., higher standard deviations). This approach, referred to as the optimum allocation, attempts to achieve the smallest sampling error for each stratum.

To allocate samples by strata using the optimum allocation method requires an estimated standard deviation for each stratum, estimates of the number of truckloads in each stratum, as well as estimated volumes by strata and population. If you have sampling experience for a given stratum, you can simply borrow the standard deviation from the past. If you do not have previous sampling data, borrow the data from a similar stratum of another population. If you have no data for a population, you can go through the same procedure borrowing data from several populations if needed.

Rather than doing manual calculations, PC based software is provided by the Ministry of Forests, and is available to both ministry and industrial users. This software provides much flexibility and enables users to allocate the sampling effort to ensure scale results are both reliable and meaningful. This software is described in further detail in the next chapter.

9.2.1.11 Standard Deviations and Sampling Errors at the Stratum Levels

Standard deviations and sampling errors are also calculated for each stratum as well as the population. At the stratum level they mean essentially the same.

e.g.: a precision of 1.7% at the stratum level means:

There is a 95% probability that the total volume calculated for the stratum (i.e., stratum weight multiplied by the stratum ratio) will be within $\pm 1.7\%$ of the actual volume.

The year-end standard deviation calculated at the stratum level is usually used for allocating the sample size when the next sampling plan is being prepared.

One big caution applies. Precision calculations at the stratum level may be unreliable if too few samples are measured under the stratum. The minimum sample requirements for weight scale statistics will be further discussed in the next chapter.

9.2.1.12 The Weight Scale Sampling Plan

The Weight Scale Sampling Plan comprises a comprehensive plan to sample the weight scale population. It requires a clear definition of data needs and sampling objectives, and requires estimates of production and standard deviations on a stratum and population basis. The sampling plan provides the foundation for sampling. The sampling plans and procedures to monitor sampling plan progress are documented thoroughly in the next chapter.

9.2.1.13 Chapter Summary

This chapter has discussed in very general terms the statistics and related relationships behind the weight scale system. To use weight scaling as detailed in the next chapter, all calculations are heavily systematized eliminating the need for long calculations.

While you may wish to never see some of this material again, it is most important that you understand some basic relationships and concepts discussed in this chapter.

You should be equipped to answer some basic questions:

- What is random sampling, and why is it important to weight scale sample selection?
- The normal distribution curve and its relationship to the standard deviation and sampling error? How do they relate to confidence limits?
- Given a standard deviation - what does it really mean?
- Given a sampling error - what does it mean in terms of the population and stratum volume estimates?
- What is the relationship between the standard deviation, the sampling error, and the sample size?
- Why do we stratify populations? What are the benefits of stratification?
- How do we allocate the sample size to individual strata?
- What is the relationship between precision, accuracy, and bias?

The next chapter on weight scale sampling assumes a basic understanding of these concepts.

Appendix 9A Summary of Statistical Formulae in Weight Scaling

This Appendix summarizes the statistical formulae that underlie weight scaling. The terminology assumes that readers are familiar with basic statistics.

9A.1 Ratio of a Stratum

$$r_k = \left(\frac{\sum_{i=1}^{n_k} y_i}{\sum_{i=1}^{n_k} m_i} \right) = \left(\frac{n_k \cdot \bar{y}_k}{n_k \cdot \bar{m}_k} \right) = \left(\frac{\bar{y}_k}{\bar{m}_k} \right)$$

where: y_i denotes the volume of the i -th sampled load from stratum k ,

m_i denotes the weight of the i -th sampled load from stratum k ,

n_k denotes the number of samples in stratum k , and

r_k denotes the ratio of stratum k .

The ratio, r_k , is used to estimate the total volume harvested from a stratum.

9A.2 Estimate of Total Volume in a Stratum

$$\hat{Y}_k = r_k \cdot \left(\sum_{i=1}^{N_k} m_i \right) = r_k N_k \bar{M}_k$$

where: m_i denotes the weight of the i -th load from stratum k ,

N_k denotes the number of loads in stratum k ,

$\bar{M}_k$ denotes the average weight of a load in stratum k ,

r_k denotes the ratio of stratum k , and

$\hat{Y}_k$ denotes the estimated total volume of stratum k .

9A.3 Estimate of Variance of Total Volume in a Stratum

$$\text{var}(\hat{Y}_k) = \left(\frac{N_k^2 (1 - f_k)}{n_k} \right) \cdot \left\{ \frac{\sum_{i=1}^{n_k} (y_i - r_k m_i)^2}{n_k - 1} - \left(\frac{\sum_{i=1}^{n_k} [(y_i - r_k m_i)^2 \cdot (m_i - \bar{m}_k)]}{\sum_{i=1}^{n_k} (m_i - \bar{m}_k)^2} \right) \cdot (\bar{m}_k - \bar{M}_k) \right\}$$

- where: n_k denotes the number of samples in stratum k ,
- N_k denotes the number of loads in stratum k ,
- $f_k = \left(\frac{n_k}{N_k} \right)$ denotes the sampling ratio of stratum k ,
- y_i denotes the volume of the i -th sampled load from stratum k ,
- m_i denotes the weight of the i -th sampled load from stratum k ,
- $\overline{m}_k$ denotes the average weight of sampled loads in stratum k ,
- $\overline{M}_k$ denotes the average weight of all loads in stratum k ,
- r_k denotes the ratio of stratum k , and
- $\text{var}(\hat{Y}_k)$ denotes the estimated variance of estimated total volume of stratum k .

The Estimate/Variance calculated above is used later in calculating the precision achieved in a stratum.

9A.4 Estimate of Variance of a Stratum

$$s_k^2 = \left(\frac{1}{\overline{M}_k^2} \right) \cdot \left\{ \frac{\sum_{i=1}^{n_k} (y_i - r_k m_i)^2}{n_k - 1} - \left(\frac{\sum_{i=1}^{n_k} [(y_i - r_k m_i)^2 \cdot (m_i - \overline{m}_k)]}{\sum_{i=1}^{n_k} (m_i - \overline{m}_k)^2} \right) \cdot (\overline{m}_k - \overline{M}_k) \right\}$$

- where: n_k denotes the number of samples in stratum k ,
- y_i denotes the volume of the i -th sampled load from stratum k ,
- m_i denotes the weight of the i -th sampled load from stratum k ,
- $\overline{m}_k$ denotes the average weight of sampled loads in stratum k ,
- $\overline{M}_k$ denotes the average weight of all loads in stratum k ,
- r_k denotes the ratio of stratum k , and
- s_k^2 denotes the estimated variance of the load ratios of stratum k .

This figure estimates the inherent variability of the load ratios within a stratum. It differs from the previously calculated variance A9.2.3 in the following manner: A9.2.3 estimates the variance of the estimated total volume, while this formulae estimates the variance of the individual load ratios. Thus, if additional samples were drawn, the variance in 9.2.3 would decrease while the variance above would not (except, of course, for random variation due to new samples). This can be seen from the presence of n_k in the denominator of the first term of 9.2.3 and from its absence above.

9A.5 Precision of the Estimated Volume of a Stratum

$$\hat{E}_k = \left(\frac{\sqrt{\text{var}(\hat{Y}_k)} \cdot t_{.95, n-1}}{\hat{Y}_k} \right) \cdot 100\%$$

where: $\text{var}(\hat{Y}_k)$ denotes the estimated variance of estimated total volume of stratum k,

$\hat{Y}_k$ denotes the estimated total volume of stratum k,

n_k denotes the number of samples in stratum k,

$t_{.95, n-1}$ denotes the two-sided, 95% quintile of the Student's t distribution with $(n_k - 1)$ degrees of freedom, and

$\hat{E}_k$ denotes the (estimated) precision achieved for stratum k.

The above figure is the precision of a stratum, not the population. Though scaling regulations require that precision of a population must be at least 1%, 19 times out of 20, they do not specify a target precision for a stratum. In practice, the precision of a stratum will often vary from about 1 to 5%.

9A.6 Estimate of Total Volume in a Population

$$\hat{Y} = \sum_{j=1}^m (\hat{Y}_j)$$

where: $\hat{Y}_j$ denotes the estimated total volume of the j-th stratum, and

m denotes the total number of strata in the population.

9A.7 Estimate of Variance of Total Volume in a Population

$$\text{var}(\hat{Y}) = \sum_{j=1}^m [\text{var}(\hat{Y}_j)]$$

where: $\text{var}(\hat{Y}_j)$ denotes the estimated variance of total volume in the j-th stratum

m denotes the total number of strata in the population, and

$\text{var}(\hat{Y})$ denotes the estimated variance of the estimated total volume in the population.

9A.8 Precision of the Estimated Total Volume in a Population

$$\hat{E} = \left(\frac{\sqrt{\text{var}(\hat{Y})} \cdot t_{.95, n-m}}{\hat{Y}} \right) \cdot 100\%$$

- where: $\text{var}(\hat{Y})$ denotes the estimated variance of total volume in the population,
- m denotes the total number of strata in the population,
- $\hat{Y}$ denotes the estimated total volume in the population,
- $t_{.95, n-m}$ denotes the two-sided, 95% quintile of the Student's t distribution with approximately $\left[\left(\sum_{j=1}^m n_j \right) - m \right]$ degrees of freedom, and
- $\hat{E}$ denotes the precision achieved in the population.

Scaling regulations require that the above precision be estimated to at least 1%, at a confidence level of 95%.

To estimate volumes and precisions for sub-groups such as species and grades within a stratum, the preceding formulae can still be employed. However, in such instances, the ratios from sampled loads will need to be re-defined as follows: the numerator is defined as the volume of the species and grade of interest, while the denominator remains as the total weight of the sampled load.

9A.9 Sample Size

9A.9.1 Required for the Population

$$\tilde{n} = \left\{ \frac{\left(\sum_{j=1}^m W_j s_j \right) \cdot \left(\sum_{j=1}^m \left(\frac{s_j N_j^2}{W_j} \right) \right)}{\left(\frac{E^2 Y^2}{t_{.95, n-m}^2} \right) + \left(\sum_{j=1}^m N_j s_j^2 \right)} \right\}$$

where: m	denotes the number of strata in the population,
$W_j = \left(\frac{N_j}{N} \right)$	denotes the proportion of total loads in stratum j ,
N_j	denotes the number of loads in stratum j ,
N	denotes the number of loads in the population,
s_j	denotes the standard deviation of load ratios from stratum j ,
E	denotes the desired precision (usually set at 0.01),
Y	denotes the anticipated total volume in the population,
$t_{.95, 9 \cdot m}$	denotes the two-sided, 95% quintile from the Student's t distribution with a minimum of $(9 \cdot m)$ and a maximum of $(\tilde{n} - m)$ degrees of freedom, and
$\tilde{n}$	denotes the number of samples required from the entire population.

9A.9.2 A Stratum Containing a Pre-specified Precision

If a stratum contains a target precision, use formula A9.2.9.1 to estimate sample sizes for that stratum. In this instance, the number of strata in the population will be one, and the formula reduces to the following:

$$\tilde{n} = \left\{ \frac{(s_j^2 \cdot N_j^2)}{\left(\frac{E^2 Y^2}{t_{.95, 9}^2} \right) + (N_j s_j^2)} \right\}$$

where: N_j	denotes the number of loads in the stratum of interest,
s_j	denotes the standard deviation of load ratios in the stratum,
E	denotes the desired precision for that stratum,
Y	denotes the anticipated total volume in that stratum,

$t_{.95,9}$ denotes the two-sided, 95% quintile from the Student's t distribution with a minimum of 9 and a maximum of $(\tilde{n} - 1)$ degrees of freedom, and

$\tilde{n}$ denotes the number of samples required from that stratum.

9A.9.3 Sample Size for a Population Containing Some Pre-specified Strata

If some strata contain precision targets while others do not, use the following formula to estimate the sample sizes for the strata without precision targets:

$$\tilde{n} = \left\{ \frac{\left(\sum_{j=1}^{\tilde{m}} W_j s_j \right) \cdot \left(\sum_{j=1}^{\tilde{m}} \left(\frac{s_j N_j^2}{W_j} \right) \right)}{\left(\frac{E^2 Y^2}{t_{.95,9-m}^2} \right) - \text{var}(\hat{Y}_p) + \left(\sum_{j=1}^{\tilde{m}} N_j s_j^2 \right)} \right\}$$

where: $\tilde{m}$ denotes the number of free strata in the population ("free" refers to strata without precision targets; summation is over the free strata),

m denotes the number of strata in the entire population,

$W_j = \left(\frac{N_j}{\tilde{N}} \right)$ denotes the proportion of total loads in stratum j,

N_j denotes the number of loads in stratum j,

$\tilde{N}$ denotes the total number of loads in the free strata,

s_j denotes the standard deviation of load ratios from stratum j,

E denotes the desired precision of the entire population (usually set at 0.01),

Y denotes the anticipated total volume in the entire population,

$\text{var}(\hat{Y}_p)$ denotes the variance of the estimated total volume in the non-free (that is, the pre-specified) strata,

$t_{.95,9-m}$ denotes the two-sided, 95% quintile from the Student's t distribution with a minimum of $(9 \cdot m)$ and a maximum of $(\tilde{n} - m)$ degrees of freedom, and

$\tilde{n}$ denotes the number of samples required from the free strata.

9A.10 Sample Size Required for Stratum

$$n_i = \max \left\{ \tilde{n} \cdot \left(\frac{W_i s_i}{\sum_{j=1}^m (W_j s_j)} \right) 10 \right\}$$

where: m denotes the number of strata in the population (or the number of free strata in a constrained population),

$W_j = \left(\frac{N_j}{N} \right)$ denotes the proportion of total loads in stratum j ,

N_j denotes the number of loads in stratum j ,

N denotes the number of loads in the population (or in the free strata),

s_j denotes the standard deviation of the ratio in stratum j ,

$\tilde{n}$ denotes the number of samples required from the entire population (or the free strata), and

n_j denotes the number of samples required from stratum j .

In our notation, $\tilde{n}$ represents the estimated sample size to be drawn from a population, while the actual sample size to be drawn is $n = \sum_{j=1}^m n_j$. In other words, n will be larger than $\tilde{n}$ because some strata may have their sample sizes increased to the minimum of 10 samples per stratum, while in other cases a non-integer valued sample size will be rounded-up to an integral-valued sample size.

9A.11 Relative Variance of a Stratum

$$C_k = (s_k^2) \cdot \left(\frac{\hat{Y}_k}{N_k} \right)^{-2} = \left(\frac{N_k^2 \cdot s_k^2}{\hat{Y}_k^2} \right)$$

where: s_k^2 denotes the variance of the load ratios of stratum k (formulae A9.2.4),

$\hat{Y}_k$ denotes the estimated total volume in stratum k ,

N_k denotes the total number of loads harvested from stratum k , and

C_k denotes the relative variance of stratum k .

The relative variance relates the inherent dispersion of a stratum to its average volume, so it is not affected by the number of samples.

Note: One could argue that the relative variance should be based on ratios and not, as is the case here, on volumes. However, differences between the two are likely to be negligible.

9A.12 Relative Variance of a Population

$$C = \left(\frac{n}{N^2(1-f)} \cdot \frac{1}{\bar{M}^2} \cdot \text{var}(\hat{Y}) \right) \cdot \left(\frac{\hat{Y}}{N} \right)^{-2} = \left(\frac{n \cdot \text{var}(\hat{Y})}{(1-f) \cdot \bar{M}^2 \cdot \hat{Y}^2} \right)$$

where: n denotes the total number of samples from the population,

$f = \left(\frac{n}{N} \right)$ denotes the sampling ratio of the population,

$\text{var}(\hat{Y})$ denotes the variance of the estimated total volume harvested from the population (formulae 9.2.7),

$\hat{Y}$ denotes the estimated total volume in the population,

N denotes the total number of loads harvested from the population,

$\bar{M}$ denotes the average weight of all loads in the population, and

C denotes the relative variance of the population.

9A.13 Amalgamation of Strata

The amalgamation of two strata, j and k , should be recommended if:

$$\text{var}(\hat{Y}_{jk}) < \alpha \cdot \{ \text{var}(\hat{Y}_j) + \text{var}(\hat{Y}_k) \}$$

where $\text{var}(\hat{Y}_{jk})$ denotes the variance (formulae 9.2.3) of total volume of the combined stratum formed from the amalgamation of strata j and k ,

$\text{var}(\hat{Y}_j)$ denotes the variance of total volume of stratum j ,

$\text{var}(\hat{Y}_k)$ denotes the variance of total volume of stratum k , and

α denotes an empirically derived constant (set at 0.95).

Two strata should be recommended for amalgamation if their combined variance is less (by a factor that accounts for random variation in the variances) than the sum of their separate variances.

We have selected the α based upon our experience. We have found that lower values result in rare recommendations of amalgamation, while higher values result in common recommendations of amalgamation. The value of 0.95 produces recommendations that are neither too strict nor too lax, producing recommendations of amalgamation when experience also suggests amalgamation.

9A.14 Separation of Strata (also referred to as Splitting of Strata)

The statistical algorithm that recommends splitting operates as follows: first, calculate the locations at which splitting would be optimal; then, calculate whether splitting (at these optimal locations) would be beneficial (i.e., would reduce overall variance).

First, an explanation of the technique for calculating the locations at which a stratum should be split.

9A.14.1 Identifying Location of Stratum Splits

Let the points, $B_0 < B_1 < \dots < B_L$, denote the recommended, optimal splitting points to form L new strata from the single stratum under consideration. The points B_0 and B_L are defined as the minimum and maximum load ratios in the sample. Then, if C_L is known, the points $B_1, \dots, B_{L-1}$ can be calculated using the following condition:

$$P_i(B_i - B_{i-1}) = C_L \quad \text{for } i = 1, 2, \dots, L,$$

where P_i is the density between the points B_{i-1} and B_i . It is defined as $P_i = \int_{B_{i-1}}^{B_i} f(t)dt$

for continuous distributions, and as $\left(\frac{1}{n} \cdot \sum_{j=1}^n I(B_{i-1} < r_j \leq B_i) \right)$ (where I is the standard indicator function) for discrete distributions. Note that the distribution under consideration is the distribution of the load ratios.

The constant C_L can be approximated iteratively; that is, C_L can be found once C_{L-1} has been found. C_2 may be found empirically. C_1 is undefined.

Let $C_L^{(j)}$ denote the j -th approximation to C_L . Then, the initial value of C_L ,

$$C_L^{(1)} = \left\{ \left(\frac{n-1}{n} \right)^2 \cdot C_{L-1} \right\}$$

can be used to obtain successive approximations to C_L :

$$C_L^{(j)} = \left\{ \frac{(L-1) \cdot C_L^{(j-1)} + (B_L^{(j-1)} - B_{L-1}^{(j-1)}) \cdot P_L^{(j-1)}}{L} \right\}$$

where $B_L^{(j-1)}$ and $P_L^{(j-1)}$ are obtained from $C_L^{(j-1)}$.

9A.14.2 Deciding to Split a Stratum

Stratification almost always reduces the variance, even when it is not necessary to stratify the population. However, reduction in variance is greater when stratification is applied to a population that requires it rather than when it is applied to a population that does not require it. This principle is exploited by the splitting algorithm through the use of Critical Values.

Critical values are used to ensure that the population being stratified produces genuine decreases in variance and not decreases due to the above principle only. That is, critical values are used to ensure that a stratum does indeed require stratification. The statistic that is compared to the critical values is the ratio of the following population estimates: the variance under stratification, and the variance without stratification (more detail below).

However, note that this method will tend to over-estimate the benefits of stratification since the recommended strata (which are inferred from the observed data) have no overlaps, while in practice they are likely to contain overlaps.

To decide whether a stratum should be split, calculate three variances, one for each of the following scenarios:

- two sub-strata are created,
- three sub-strata are created, and
- four sub-strata are created.

The scenario whose variance reduction is greatest, when compared to its corresponding critical value, is recommended. If no scenario has a variance less than its corresponding critical value, then splitting is not recommended.

The following critical values are based upon the assumption that load ratios are normally distributed, and are calculated as the ratio of the following: variance of the population total when stratification (as per the Dalenius-Ekman technique described previously) is applied; and in the denominator, the variance of the population total when no stratification is applied.

Number of strata created	Ratio of expected variances	Critical value
2	0.3633802	$0.90 * 0.3633802$
3	0.1824846	$0.90 * 0.1824846$
4	0.1092403	$0.90 * 0.1092403$

For example, the first ratio indicates that when a normally distributed population is stratified into two strata, the population-level variance is reduced to about 36% of its non-stratified level. (This is an approximation since the ratio of expected values will not be exactly the same as the expected value of the ratios.) Therefore, when a population is stratified into two strata and this stratification produces a greater than 64% reduction in variance (i.e., ratio is less than 36%), we may infer that the population should indeed be stratified.

Since the reduction in variance is random, we have selected (arbitrarily) some lower limits to account for this random variation. Our experience with ministry populations suggests that critical values should be set at about 90% of the expected variance though, ideally, this figure should be estimated via empirical analysis so that α and β can be set rigorously.

9A.15 Amalgamation of Strata

The combined algorithm operates as follows: if a stratum is relatively homogeneous, it undergoes the amalgamation test; if it is relatively heterogeneous, it undergoes the splitting test. A stratum is not considered for both splitting and amalgamation. Heterogeneity is defined as any stratum with an infinite population variance of 9.0 or greater.

9A.15.1 Some Final Points of Explanation

We look at infinite population variance so that the finite population correction will not affect the test since, otherwise, the sample size of a stratum will affect its classification into the hetero- or homogeneous groups. And, heterogeneous strata are not considered for amalgamation because a heterogeneous stratum often can be combined with another heterogeneous stratum to achieve gains in precision, though these gains would be due to a larger sample size and not due to similarity of the strata under consideration; and, in practice, larger than necessary sample sizes will be reduced.

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Weight Scale Sampling

10

This chapter applies some of the statistical principles and procedures discussed in the previous chapter to the Weight Scale Program. Sampling under Weight Scaling is divided into four main functions:

1. Setting up the sampling plan,
2. Monitoring sampling plan progress,
3. Managing the sampling plan, and
4. Maintaining the integrity of weight scaling and the sampling plan.

10.1 Setting Up the Sampling Plan

The Weight Scale Sampling Plan is a comprehensive plan to ensure the weight scale population and data needs are defined and sampling is undertaken to meet some predetermined precision requirements. As such, the sampling plan provides the foundation for weight scale sampling. Its basic components are:

1. Defining the weight scale population - the Production Estimate.
2. Setting the sampling objectives.
3. Stratification to meet the sampling objectives.
4. Finalizing the Sampling Plan.
5. Selecting and processing samples.

A discussion of each component follows:

10.1.1 Defining the Weight Scale Population

In the earlier days of weight scaling, the weight scale population was simply viewed as the timber cut from an operation in a one-year period. The evolution of the forest industry and the growth of small operators, harvesting on private land, log trading, and other developments now see the weight scale population more correctly defined as follows:

The aggregate of all loads of timber to be sampled in a 12-month period for which you wish to estimate volumes.

Under this definition, populations may comprise a licensee's own production as well as any purchase or trade volumes and may include any volumes scaled on another party's behalf. Under weight scaling, the population is sampled over a 12-month period referred to as the Cyclic Billing Period. The cyclic billing period places a time parameter on the definition.

Under some circumstances the cyclic billing period may be less than or exceed 12 months.

While there are no limiting policies, the Interior cyclic billing period is usually from break-up to break-up or May 1 - April 30. Coastal cyclic billing periods traditionally follow the calendar year.

Weight Scaling or Piece Scaling Small Populations:

While the merits of each situation vary, it is generally considered that acceptable scaling costs under weight scaling for most timber profiles will not be realized unless the annual production going over a weight scale exceeds 1500 truckloads. Similarly, the specific data needs of data users may not be met if the annual production is insufficient. On this basis, licensee's applications to operate a weight scale may be rejected by the Forest Service.

Each population and stratum carry a unique eight digit identity:

R	PPP	SS	YY
Forest region	Population no.	Stratum	The year in which the cyclic billing period ends
1. Vancouver			
2. Prince Rupert			
3. Kamloops			
4. Prince George			
5. Nelson			
6. Cariboo			

e.g., Stratum 03 of Population 777 in the Cariboo Forest Region with the cyclic billing period ending March 31, 1994, will be identified as: 6/777/03/94

This identity is an essential part of all data collected under the weight scale system. Data is meaningless without it.

10.1.1.1 Production Forecast

The production forecast prepared by the weight scale holder is an estimate of all loads to be weighed under the population for the specified cyclic billing period. This estimate, based on the company's forecast of log deliveries from all sources, requires:

- company's proposed stratification along with definition of proposed strata (e.g., composition by species/grade, stumpage level),
- number of loads under each stratum,
- estimated volume for each stratum, and
- estimated standard deviation for each stratum.

Figure 10.1 describes a basic production forecast form. This form is submitted to the Ministry of Forests at least six weeks in advance of the end of each cyclic billing period or as directed by the ministry.

Weight Scale Production Estimate

Name of company:

Name/Location of weight scales:

Production period:

Stratum	Stratum Description	Operating Area	Timber Marks	Species/Grade Composition By %	Predicted Production	
					m ³	No. of Loads

Figure 10.1 *An example of a basic production estimate form to be submitted by the weight scale licensee.*

The production estimate is an integral part of the sampling plan that is approved by the ministry. In finalizing the sampling plan, the ministry may request the scale holder to submit additional information.

Responsibility for Reliable Production Forecasts:

The weight scale holder has sole responsibility for reliable production estimates and is responsible for ensuring the ministry is advised, as soon as possible, of any changes to the forecast during the year.

10.1.2 Setting the Sampling Objectives

10.1.2.1 Sampling Objectives

The primary objective of sampling is to satisfy the data needs of the ministry. Secondary to these needs are those of the weight scale holders. General ministry data needs include:

- volumes by species, grade, and timber mark for stumpage and royalty billing and stumpage appraisals, and
- volumes by grade for cut control.

The scale holder's data needs may vary from ministry requirements but may be accommodated through wise stratification.

10.1.2.2 Precision Requirements

Currently, the only precision requirement for weight scaling is set under the *Scaling Regulation*.

Precision is set at the population level as $\pm 1\%$ at the 95% confidence interval.

What does this mean?

This requires that we must sample the population to ensure there is a 95% probability the total volume we estimate for the population will be within $\pm 1\%$ of the actual volume.

While there are no precision requirements set on a stratum basis by regulation, they may be required at the discretion of the ministry. Working within the confines of the 1% population objective and defining some stratum objectives enables sampling to be focused on strata where greater precision may be desirable. Similarly, it enables sampling to be relaxed where data needs can be fulfilled with lower precision such as strata comprised of salvage timber appraised at minimum stumpage rates, or private timber.

The Ministry of Forests' Scaling Policy provides some guidance in setting precision requirements at the stratum level. In addition, this topic is discussed further under the section on stratification.

10.1.3 Stratification to Meet the Sampling Objectives

10.1.3.1 Why Do We Stratify

As defined in the preceding chapter, stratification is the grouping of components of the population on the basis of similarity of one or more characteristics (e.g., species, similar value, grade, timber mark, volume mass ratio, utilization level).

Under weight scaling, stratification serves two objectives:

1. Reduce sampling costs by reducing the sample size.
2. Provide more meaningful answers about the population.

In the earlier days of weight scaling with low stumpage rates, little grading in the Interior and little differences between stumpage rates, the first objective of reducing the sampling requirement prevailed. With higher stumpage rates, an Interior grading system introduced in the late 1980s, more complex log marketing arrangements, and growth of the small business sector, stratification is expected to serve both objectives. Therein lies the challenge of stratification.

Objectives of Weight Scale Stratification

Group units of the weight scale population into strata that provide meaningful data with acceptable precision at the stratum and population level and at an acceptable sampling cost.

10.1.3.2 How are the Objectives of Stratification Met

10.1.3.2.1 Reducing the Sample Size

The simple relationship between the sample size, the standard deviation, and the sampling error provide some insight into why we stratify and also what happens to the sample size (n) with changes in the standard deviation (SD) and the sampling error (SE).

Note: This is a shortened functional equation suitable only for conceptual purposes.

$$SE = \frac{SD}{n} \quad \text{or} \quad n = \frac{SD}{SE}$$

From this simple relationship, one can see:

1. n (the sample size) increases with increases (i.e., is proportionate) in the standard deviation and conversely decreases with decreases in the standard deviation.
2. SE (the sampling error) increases with increases in the standard deviation and decreases with increases in the number of samples taken.

Following these relationships, one can appreciate how the objectives of stratification can be realized (i.e., grouping of components of the population with similar traits may reduce the variance between units within that group and thereby reduce the standard deviation. This may in turn reduce the SE or require fewer samples to meet the same SE objective).

Weight scale statistics revolve around the relationship between the scaled volume and the weight (i.e., the ratio). As such, the standard deviation is reduced only where you stratify the population into strata that have similar ratios.

To minimize the standard deviations requires an understanding of factors that impact the ratios. These factors may vary considerably from population to population, and are best understood through experience. Common factors include:

1. Species: wood density varies by species, with red cedar wood significantly lighter and hemlock wood significantly heavier than average.
2. Growth rate: fast grown coniferous trees on good sites (lower elevation, fertile, moist, warm) are heavier than slower grown trees of the same species on poorer sites (higher elevation, infertile, dry or water logged, cold).
3. Age: young trees with a high proportion of sapwood are heavier than older trees with a smaller proportion of sapwood. Similarly, wood density varies by location in each tree.

4. Moisture content: a tree stem starts to lose moisture after it is dead and such moisture loss decreases the mass. The rate of loss is greater in dry weather than in wet weather. Logs from fire, or insect killed trees are usually light, as are logs left decked for a few weeks.
5. Defect: defect volumes are excluded from the scale and defect in a log will decrease the volume/mass ratio.
6. Foreign matter: dirt, ice and snow are often weighed with the load and decrease the volume/mass ratio.
7. Utilization level: different utilization levels in the same stand will yield a different grade profile arriving at the scale and as such will result in different ratios.

Sole recognition of only these factors in preparation of the sampling plan coupled with local knowledge will likely optimize sampling costs but may not satisfy other important data needs.

10.1.3.2.2 Providing More Meaningful Answers

The most important role played by stratification is in providing more meaningful information for data users. This includes ensuring the data needs for billing stumpage and royalty, cut control, and stumpage reappraisals are satisfied.

These objectives are met through stratification by:

- Clear and restrictive definition of loads going into each stratum, and
- Assigning precision levels for certain strata.

1. Stratum Definition

The chief means of ensuring data are meaningful and reflect user needs is through clearly defining each stratum. The Stratum Definition prescribes the makeup of loads that may be included under a given stratum. Through this definition, one is able to ensure loads within a stratum have similar traits. The specific definition is predicated by the traits that the stratum should reflect. For example, the definition for a sawlog stratum would likely prescribe a mandatory percent of sawlogs in each load, such as a 90% requirement (e.g., stratum 1 = all loads having greater than a 90% sawlog content). For data processing conventions, strata are identified by a 2-digit numeric field and a 16-digit descriptive field.

Stratum 1 = 01

Name = 90%_S/LG

a. Factors limiting the stratum definition

Stratum definitions may be limited and influenced by a number of considerations:

- the ability to sort logs prior to transport,
- the ability of the loader operator or weighmasters to classify loads according to desired stratum definitions, and
- the production forecast.

Each topic is discussed as follows:

i. The ability to sort logs prior to transport.

Sorting of logs on the cut block prior to loading provides the ability to control the content of each truckload being weighed, and as such, minimizes the variation between loads in each stratum and enables the more correct classification of loads. Logs can be sorted on the basis of traits the loader operator can readily observe and physically handle. Usual traits include: species content, log size and to a more limited extent, log condition with the latter confined to differentiating dry from green logs, pulp from sawlogs, or sorting out low grade salvage logs.

While sorting is beneficial from a weight scaling perspective, it is not always feasible from operational or forest site management perspectives.

Where timber is not sorted or sorting is restricted, a few guidelines should be followed:

- stratification plans where strata are assigned according to timber mark are the most reliable in terms of ensuring loads are assigned to the correct stratum,
- where strata definitions refer to species content, the percent requirements should facilitate the stratum decision and avoid overlap,

For example, a spruce stratum may stipulate a 75% spruce content and should avoid standards such as "greater than 50% spruce content",

- because species and grades predicate stumpage value and disposition for cut control timber, which is highly variable in terms of species and/or grade, should not be sampled under the same stratum,
- pure strata should stipulate at least 90% of a given species, and
- dry timber should never be mixed with green timber.

- ii. The ability of the loader operator to stratify loads.

Classifying loads where logs are not sorted prior to transport: the ability to control the content of each truckload is impaired and the correct classification is dependent upon the knowledge and good judgement of the loader operator and the weighmaster. While the loader operator, if adequately trained, may have knowledge of the content of each load, the weighmaster is confronted with a limited view of the external log sides and ends. As such, it is unreasonable to expect the weighmaster to know what is inside the load.

- iii. The production forecaste.

To include any stratum under the sampling plan requires an estimate of the total number of loads in that stratum along with an average load size and a standard deviation for the stratum. While standard deviations can usually be approximated from previous sampling experience, to be meaningful, the production forecast relies on the ability to differentiate the population into the qualities reflected by the stratification. For example, if you wish to stratify on the basis of timber mark, you will require an estimate of truckloads expected for each mark. Other approaches, such as stratifying by grade profile or species composition may require more difficult estimates. If reliable forecasts cannot be made about a stratum, the stratum should be avoided and that material considered for inclusion in another stratum or strata.

Poor production forecasts are the chief cause of under or over sampling.

Small strata are particularly dependent upon reliable production forecasts. Because the statistics underlying the calculation of sample size require at least 10 samples to be reliable, over estimated strata volumes will result in poor precision, and in unreliable statistics about that precision.

Similarly, while the minimum number of samples for the purposes of calculating the standard deviation is 10, highly variable strata will require more than 10 samples to achieve acceptable precision. As such, if the anticipated number of loads is small, the benefit of better information may be outweighed by the costs of sampling and the risk of unsatisfactory results.

2. Assigning Precision Levels for Certain Strata

For some strata such as those containing high value species, high value marks, salvage material, or other traits, it may be in the interest of the user to know that the volume within that stratum was sampled to a given precision.

The objective of sampling for any given stratum may therefore be: to estimate volumes for loads of timber with predefined traits to a set level of precision. At the end of sampling a statement can be made that the total volume of loads of predefined traits was sampled to a given precision (e.g., the volume under Stratum 1 comprised of Douglas-fir and lodgepole pine loads, all grades were sampled to a 2.5% precision).

Although the objectives of stratification may be to better account for a given trait, you can only make a statement about the total volume scaled under that stratum.

10.1.3.3 Common Stratification Methods

To meet the varying objectives of data users, the sampling plan may include one or more stratification methods.

10.1.3.3.1 Stratification by Species

Under this approach, stratum definitions may include single species where timber is sorted, a specified minimum species content by load or groupings of species, which exhibit similar densities, stumpage value, or other characteristics.

Stratum 01- SP/LO - SP, LO with maximum 10% other species,

Stratum 02- SP - minimum 90% SP by volume.

10.1.3.3.2 Stratification by Stumpage Value

Several approaches are available:

1. grouping timber from marks with similar stumpage value under the same stratum:

Stratum 03 - High Value - A099, YK02, 32/9.

2. specifying strata by species and/or grade composition. If the objective is to better account for high value sawlogs, the stratum definition could include a minimal level of sawlog content or a maximum tolerance of lower grades. Similarly, low value timber can be handled in the same way:

Stratum 04 - CY S/L - minimum 90% X & better.

10.1.3.3.3 Stratification by Season

Where the ratio for a given stratum varies significantly from season to season (e.g., $\geq 20\%$) it may be beneficial to divide the stratum into two parts (i.e., 07 = Season A, 08 = Season B).

10.1.3.3.4 Stratification by Timber Mark

It may be feasible to assign separate strata to single timber marks where the timber profile is not similar in other strata or it is desirable to assign precision against a single timber mark. The forecasted production for the stratum may be a limiting factor:

Stratum 05 - 39/2.

10.1.3.3.5 Stratification by Tenure Type

If an objective is to account for the total volume of all marks under a class of tenure to a pre-set precision, all marks under that tenure can be included under a single stratum:

Stratum 09 - Purchase Strata - all purchase marks.

10.1.3.3.6 Stratification by Quality of Timber

Under this approach, timber of similar quality, such as sawlogs, insect damaged or fire killed timber, salvaged volumes, or low grade timber can be included under a single stratum:

Stratum 10 - Fire Kill - 100% grade 3 or 5,

Stratum 11 - Fir S/L - 90% fir, no more than 5% non S/L grades.

The keys to effective stratification are a meaningful and reasonable production forecast and experience. Experience is gained mostly through monitoring sampling results.

Because sampling is in place to serve different objectives, the final sampling plan may provide for several methods of stratification. It should also be clearly understood by all weight scale users that the final stratification strategy will not likely satisfy all objectives for all data users. The section about monitoring sampling results will discuss this aspect in further detail.

10.1.4 Determining and Allocating the Sample Size

This is the final stage of preparing the sampling plan and consists of merging the production forecast with the stratification proposal, finalizing sampling objectives, determining initial sampling frequencies and finally entering the plan on the Harvest Billing System (HBS). Most of these functions are carried out by the planner segment of the Stratification Advisor Program which is a PC based computer program available to both the Ministry of Forests and industrial users. These functions can also be carried out manually with the statistical calculations based on Appendix 10A.

This discussion will focus on the Sample Planner segment of the Stratification Advisor Program.

The Sample Planner comprises one data entry screen (Figure 10.2) and produces a Sampling Plan Report (Figure 10.3). The program is interactive, enabling the user to make different assumptions, set varying precision objectives, and adjust the sample size before finalizing the sampling plan.

Basic functions of the planner include:

- entry of data from the production forecast, and statistical data,
- calculating optimum or unconstrained sample sizes and precisions,
- setting sample size and/or precision constraints, and
- calculating the final precision and sample size targets.

See Table 10.1 for a description of data fields.

[illegible]

Figure 10.2 The initial sample planner screen from the Stratification Advisor Program.

10.1.4.1 Sample Planner Computer Screen

10.1.4.1.1 Explanation of Terms

Company	- (displays 10 digits)	- abbreviated name
Year	- (2 digits)	- the year in which the sample year ends
Population	- (max. 4 digits)	- unique code assigned by the Ministry of Forests
Plan	-	
Plan Name	-	
Stratum ID	-	
No.	- (2 digits max.)	-
Name	- (16 characters maximum)	

Estimates - these are taken from the production forecast and inputted into the programme. These are the key assumptions underlying the plan.

Volume (m ³)	- (max. 6 digits)	- estimated total volume (m ³) by stratum (integer).
Loads	- N/A	- estimated total number of loads by stratum (integer).
Size (m ³)	- N/A	- estimated average load volume by stratum (2 decimal places).
Standard Deviation	- (m ³)	- this is a measure of how much ratios within a situation vary from truck to truck. For the sampling plan these are borrowed from previous sampling results in the stratum or from sampling in strata having similar characteristics. Expressed in terms of volume (m ³) (2 decimal places).
Optimum	- N/A	- these are calculated based on the estimates the user provides for volume, loads, load size and standard deviation.

	- Samples	- the calculated number of samples required (integer).
	- Precision	- the calculated precision based on estimates (2 decimal places).
	- Rate	- the calculated sampling frequency required to achieve the optimum precision. (e.g. a rate of 40 means 1 in every 40 truckloads in that situation must be selected as a sample) (integer).
Constraints	- N/A	- these are modifications made by the user to achieve a greater/lesser number of samples in a stratum or specify a different precision level.
	- Samples	- the stratum sample size may be reduced or increased. this figure reflects the modified number of samples (e.g., if optimum were 15 and user wanted to increase the number of samples by 15, the entry here would be 30) (integer).
	- Precision	- the precision in any stratum can be set by the user. In this case the desired precision is specified (2 decimal places).
Targets	- N/A	- These reflect the final sample plan after incorporating any constraints for sample size and precision.
	- Samples	- the final sample size for each stratum (integer).
	- Precision	- the calculated precision incorporating any constraints (2 decimal places).
0	- Rates	- the final sampling frequency as above (integer).

[illegible]

Figure 10.3 Sample planner computer screen.

To calculate the required number of samples (i.e., the sample size) and expected precision for any stratum requires estimates of the total number of loads, the average load size (m^3) and an estimate of the standard deviation. While the volume estimate (total loads X average load size) is taken directly from the production forecast, the standard deviation requires more judgement to estimate. If the same stratum was sampled in the previous year, the experienced standard deviation may simply be inserted in the new plan. If there is no sampling history in the stratum you may wish to borrow one from a similar strata in the same or a different population. Failing any similar strata, you will have to use your best judgement in estimating a representative standard deviation.

Following entry of the data, the planner calculates the optimum or unrestricted sample sizes and precision for each stratum. This calculation always supports a 1% precision requirement at the population level.

Because the Population Precision Standard is set by regulation at 1%, all calculations on the planner support a 1% precision level for the population. However, to assist in evaluating the impact of different sampling models, the precision for the population can be adjusted to values that are greater or less than 1%.

The allocation of samples is based on the standard deviation of each stratum relative to all other strata. As such, those strata with the highest standard deviation will demand the most intensive sampling.

The optimum allocation represents a calculation based strictly on the production estimates.

Because data users may wish to achieve better sampling results in some strata (e.g., perhaps high value timber) or be willing to accept poorer results in other strata (e.g., perhaps low value salvage timber) the planner enables the user to constrain the calculations. Two options are available:

1. constrain precision, and
2. constrain the sample size.

Constraining precision enables the user to set the precision objective for one or more strata. Where precision on a strata is set, the program re-allocates sampling effort to all other strata, while at the same time ensuring the 1% sampling error objective for the population is maintained.

Similarly, constraining the sample size enables the user to increase or decrease the sample size for one or more strata. As in the event of setting precision levels, setting the sample size sees a reallocation of samples to ensure the 1% population objective is met.

Remember, because precision calculations are not considered reliable unless they are based on at least 10 samples, the minimum number of samples in any stratum is fixed at 10 samples.

It should be noted here that while any given stratum requires a minimum of 10 samples for the precision calculation to be reliable, a high standard deviation will likely result in very unsatisfactory sampling results if the user constrains the sample size to 10. In other words, the 10 sample minimum relates only to the reliability of the precision calculation and is unrelated to the precision you actually achieve.

After setting any precision and/or sample size constraints, the final precision and sample size targets are calculated. These are reviewed and further modifications to the production estimates or constraints may be made before finalizing the sample plan.

It should, similarly, be noted that weight scale calculations revolve around the ratio and reflect statistics about stratum and population volumes. In realizing its sampling objectives, they may require additional samples to better account for other characteristics such as timber mark, species, and grade. In all cases, approval of the final sampling plan rests with the ministry.

Sample Planner												
File Edit Options Help					Wednesday, January 18, 1995, 11:58 AM							
Calculate	Company	Population	Year	Plan	Plan Name	Precision Limit	Sample Floor					
	01009	6001	94	01	94 PLAN	1.00%	10					
Stratum ID		Estimates				Optimums			Constraint	Targets		
No.	Name	Volume	Loads	Size	StdDev	Samp	Prec	Freq	Samples	Samp	Prec	Freq
20	80LOLI	80,840	2,000	40.42	2.91	10	4.45	200		10	4.45	200
22	80WWMX	45,738	1,100	41.58	2.31	10	3.43	110		10	3.43	110
30	80LODB	431,700	10,000	43.17	2.22	38	1.63	263		38	1.63	263
31	80LOWB	256,368	5,600	45.78	2.31	22	2.10	254		22	2.10	254
32	80WWMX	206,750	5,000	41.35	2.05	18	2.29	277		18	2.29	277
33	80FI	49,412	1,250	39.53	1.85	10	2.89	125		10	2.89	125
34	MXBD	34,027	700	48.61	3.10	10	3.92	70		10	3.92	70
35	80FIBB	2,918	80	36.47	2.03	10	3.23	8		10	3.23	8
37	MXCU	4,934	130	37.95	2.56	10	4.02	13		10	4.02	13
70	DP	74,739	2,100	35.59	1.78	10	3.09	210		10	3.09	210
10 Total		1,187,426	27,960	42.47		148	0.95	188		148	0.95	188

Figure 10.4 A final sample plan.

The final sampling plan must be submitted for entry on the Harvest Billing System. For this purpose a code sheet (FS 530) must be completed. Figure 10.5 shows a completed FS 530 based on the final sampling plan described by the previous figure. Submission of the FS 530 enables the sampling plan to be recorded by the HBS so that sample data can be processed and data files can be established for the population along with various reports used for monitoring and reporting sampling results in addition to billing.

**CODING SHEET FOR UPDATING
WEIGHT SCALE STRATUM UPDATES**



Province of
British Columbia



Ministry of
Forests

POPULATION		DISTRICT CODE	COMPANY NAME CODE	STRATUM COMMON NAME	EFFECTIVE DATE Y Y M M D D Y Y M M D D	EXPIRY DATE Y Y M M D D Y Y M M D D	ESTIMATES OF			CONSTRAINTS			DONOR POPULATION (if Merge)	
							LOADS TO BE BILLED	SAMPLE LOAD SIZE (M3/LOAD)	STANDARD DEVIATION (M3/LOAD)	NUMBER OF SAMPLES	PRECISION	FREQ.		
P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
37	37	37	37	37	37	37	37	37	37	37	37	37	37	37
38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
39	39	39	39	39	39	39	39	39	39	39	39	39	39	39
40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
44	44	44	44	44	44	44	44	44	44	44	44	44	44	44
45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
47	47	47	47	47	47	47	47	47	47	47	47	47	47	47
48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
66	66	66	66	66	66	66	66	66	66	66	66	66	66	66
67	67	67	67	67	67	67	67	67	67	67	67	67	67	67
68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
71	71	71	71	71	71	71	71	71	71	71	71	71	71	71
72	72	72	72	72	72	72	72	72	72	72	72	72	72	72
73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
78	78	78	78	78	78	78	78	78	78	78	78	78	78	78
79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
82	82	82	82	82	82	82	82	82	82	82	82	82	82	82
83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
87	87	87	87	87	87	87	87	87	87	87	87	87	87	87
88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
91	91	91	91	91	91	91	91	91	91	91	91	91	91	91
92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
96	96	96	96	96	96	96	96	96	96	96	96	96	96	96
97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Add required **A**

Change required **C**

Delete required **D**

Merge required **M**

< required >

< optional >

< must be blank >

< must be blank >

*Code only one constraining field as specified by MODE (N = none) (F = frequency) (P = precision) (S = number of samples) (blank = none)

b = must be blank

FS530 - 946401

Figure 10.5 The FS 530 code sheet for entering the finalized Sample Plan on the HBS.

10.1.5 Selecting and Processing Samples

Subsequent to finalizing the sampling plan and in advance of weight scale production, the Ministry of Forests is responsible for programming the initial sampling frequencies into the sampling selection portion of the scale holders weight scale computer. Weight scale computers and sample selection routines must conform to standards set by the Ministry of Forests.

Loads selected as samples must be scaled by the scale holder in accordance with the scale site authorization issued for the scale site. The scale details for each sample scaled must be submitted to the ministry in the approved electronic format, in an FS 531 or an approved facsimile.

10.2 Monitoring Sampling Plan Progress and Weight Scale Results

With cyclic billing, sampling results are not finalized until the year end and therefore, ongoing monitoring is required to achieve satisfactory year end results. Monitoring involves periodic review of statistical reports and assessment of the sampling plan. Monitoring may result in periodic changes to the sampling frequency, the estimates contained in the sampling plan and/or the stratification itself.

Administrative tools for monitoring the sampling plan include:

1. Harvest Billing System statistical reports, and
2. The Stratum Monitor segment of the Stratification Advisor Programme.

10.2.1 Harvest Data Base System Statistical Reports

The Ministry of Forests Harvest Billing System (HBS) is the central computer program for all ministry weight scale data. It receives and records sample plans, sample tallies, and monthly returns. It issues sample summaries, ratio reports, sample intensity reports, and scale and royalty invoices.

Key HBS reports for monitoring sampling plan progress and results include:

1. The Sampling Intensity Report (interim and final).

This report is divided into 3 parts:

- | | |
|---------------------|---|
| Sampled data | - includes for each stratum: measured data (loads, volume, weight), and computed data (the ratio, average load volume, and standard deviation). |
| Billed data | - includes for each stratum: billed data (loads billed, total weight), and computed data (total volume and precision achieved). |
| Sample plan targets | - includes for each stratum: production estimates, estimates for standard deviations, sampling precision targets, experience, and targets for sampling frequency. |

Also appended to this report is a summary by species grade (volume and percent) for each stratum.

Data included on this report are all sample data processed and residing on the weight scale statistical file of the HBS and all loads and volumes processed and billed (i.e., an S & R account reflecting them has been issued).

To evaluate sample scale details (i.e., volume, cut, ratio for each load) you must refer to the Sample Summary and Ratio report, which is produced on the HBS on a monthly basis.

An explanation of each data field is included in Table 10.1.

PROGRAM: FULPSINR		DEST: 60HRN		MINISTRY OF FORESTS				PAGE NUMBER: 2											
RUN DATE: 94-NOV-29				HARVEST DATABASE SYSTEM															
RUN TIME: 15:51				WEIGHT SCALE SAMPLE INTENSITY REPORT															
REGION: 6 - CARIBOO		COMPANY: 01009		AINSWORTH LUMBER CO. LTD.				POPULATION: 6001											
DISTRICT: 64 - 100 MILE HOUSE				BOX 67				SAMPLING YEAR: 94											
				100 MILE HOUSE, B.C. CANADA				EFFECTIVE: 93-MAY-01											
				V0K2E0				EXPIRY: 94-APR-30											
-----STRATUM-----		-----SAMPLE DATA-----		-----BILLED DATA-----		-----ESTIMATE-----		-----TARGET-----											
-----MEASURED-----		-----COMPUTED-----		-----MEASURED-----		-----COMPUTED-----													
WEIGHT VOLUME		RATIO SIZE STDV SAMP		WEIGHT VOLUME PREC		TOTAL VOLUME SIZE STDV SAMP		SAMP PREC SAMP											
LOADS (TONNE)		(HS) (HS/T) (HS) (HS) FREQ		LOADS (TONNE) (HS) (%)		LOADS (HS) (HS) (HS) LOADS (%) FREQ													
NO COMMON NAME																			
20 80LOLI		43	1358	1756	1.27955	40.42	2.92	41	1798	56492	72285	2.21	2080	80840	40.42	2.91	10	4.45	280
22 80MMHX		13	428	561	1.26183	41.58	2.31	37	483	15449	19491	3.41	1100	45738	41.58	2.31	10	3.43	110
30 80LODB		107	3937	4614	1.17182	43.12	2.21	91	9794	362340	424598	0.97	10000	431700	43.12	2.22	38	1.63	263
31 80LOMB		31	1169	1419	1.21412	45.78	2.21	6	3307	127746	155099	1.72	5680	256368	45.78	2.31	22	2.10	254
32 80MMHX		49	1687	2026	1.20068	41.34	1.95	97	4793	172446	207052	1.29	5000	206750	41.35	2.05	18	2.29	277
33 80FI		18	637	711	1.11687	39.53	1.86	38	695	23778	26557	2.39	1250	49413	39.53	1.85	10	2.89	125
34 MYBD		20	697	972	1.39536	48.61	3.47	22	450	16325	22779	3.14	700	34027	48.61	3.10	10	3.92	70
35 80FTBB		27	758	954	1.25796	35.33	2.04	3	82	2343	2947	1.84	80	2918	36.48	2.03	10	3.23	8
37 MKCU		38	1234	1441	1.16741	37.92	2.54	3	115	3753	4382	1.79	130	4934	37.95	2.56	10	4.02	13
70 DP		20	620	712	1.14870	35.59	1.78	95	1914	58078	66714	2.38	2100	74739	35.59	1.78	10	3.09	210
POPULATION TOTALS		366	15128		41.33			23631		1001983			27960		42.47		148		188
		12526			1.20768			838750		0.60			1187427				0.95		

Table 10.1 HBS - Sampling Intensity Reports (FVLPWSIR)

Item	Field Name	Explanation of Data Fields for Interim and Final Reports
A	Region/District	Location of population
B	Population holder	Company code, name, and address of the population holder
C	Population/Sampling year	Unique code, sampling year refers to year in which current sampling plan ends.
D	Effective/Expiry date	Begin and end dates of the sampling year.
E	Stratum number-name	Must be numeric, up to 40 strata/pop, positions 5-6 on the FS 530. Name may be up to 16 characters (alpha & numeric)
F	Sample data	Include all sample data which has been processed to date by the HBS.
G	Measured data	Include weights and volumes reported for all sample loads processed to date by HBS.
H	Computed	Includes data compiled from sample data.
I	Ratio	This is year to date ratio by Stratum expressed m^3/Tonne (i.e., 1 Tonne = 1 000 Kg) = sample Volume $\div$ sample Weight.
J	Size	Average Load Size - average volume/truckload from sample data only.
K	STDV	The Standard Deviation - this is calculated from only the sample data and measures the dispersion of individual sample ratios about the average ratio for the stratum (i.e., G). This Standard Deviation is the one often used for determining the sample size in the next sampling plan. It is expressed in terms of the standard deviation of the size of a load of average weight.
L	Sample frequency	The actual rate of sampling (or frequency), i.e. = total truckloads weighed $\div$ number of samples.
M	Billed data	This data reflects all data billed to date on the HBS. This includes Measured and Compiled Data. (e.g., Loads = all loads weighed to date)
N	Volume	This is the total volume billed to date. $V \text{ is } = (\text{Ratio}_{\text{samples}})(\text{Weight}_{\text{AllLoads}})$
O	Precision	Precision or the Sampling Error. These are calculated at the 95% confidence level. A precision of 1.5% at the stratum level means: 95% of the time the total volume calculated for the stratum will be within (i.e., + or -) 1.5% of the actual volume. To calculate Precision %, see the Appendix.
P	Estimate	These are the number of loads, volume, load size, and standard deviations provided as input to the current sample plan.
Q	Target	These are the target number of samples, precisions and sampling frequencies for the current sample plan, computed from the estimates and the constraints.

Effective monitoring of the sample plan requires that some basic questions be answered on an ongoing basis during the sampling year and at year-end.

During the year these include:

- are sample loads being correctly stratified (i.e., compare the stratum definition (e.g., species content) with the actual composition of the sample loads),
- how frequently are sample loads being deleted?

The importance of this question lies in the principle that true random sampling is satisfied only when all loads have an equal opportunity of being selected as samples. Cancellation may represent interference with this principle,

- if current trends continue, will you meet your sampling objectives? Will you get enough samples in each strata, are your production estimates reasonable? and
- how do sample plan results compare with those assumed in the sample plan (e.g., compare standard deviations if you have enough samples (10 is minimal), compare load average).

Monitoring during the year is a periodic function and not to be confused with sample data checks, which are routine. It should always be remembered, some data may not be reliable until several months into the sampling year.

At the end of the year, in addition to the above, you must answer some other basic questions:

- did you meet your sampling objectives on a stratum/population level?
- could you have achieved the same results with fewer samples?
- what were your experienced standard deviations in each stratum?
- how good were the production estimates and other assumptions made under the sampling plan?

Year end results provide the most accurate data about the population and provide the best information available for the next sampling plan if you conclude the wood profile for any given stratum will be the same in the next year.

Data usually taken from the year end report and used for entry into the next sampling plan include:

1. Strata standard deviations, and
2. Average load size.

Because the final year end calculation is not available until after commencement of the new cyclic billing period, it is necessary to borrow year end data from the most recent available report for use in the new sampling. This does not represent a problem unless there are inadequate samples (i.e., less than 10) in a stratum to calculate a reliable standard deviation. Ultimately, good judgement tempered with experience must be used.

10.2.2 Stratification Advisor Programme

The stratum monitor uses data downloaded from the Harvest Billing System and replicates aspects of the Sample Intensity Reports produced by the HBS. Screens produced on the Stratum Monitor include:

- sampling statistics (ratio, volume, precision, standard deviations, samples, loads, by stratum, and population details),
- sample details (scale, ratio detail at sample level),
- graphical display of scale detail by stratum, and
- graphical display of ratios in chronological order.

The Stratification Advisor Programme is available to both ministry and industrial users with the objectives of:

- achieving a better understanding of weight scale results, and
- achieving better weight scale plans and ultimately better sampling results.

This chapter of the manual concentrates on how the various reports can be used to monitor sampling results, amend the sampling plan during the year, and better understand sampling results. Each report is discussed.

10.2.2.1 Sampling Statistics - Stratum Level

This report reflects sampling results based on all data uploaded onto the software and is the most informative Stratification Advisor report for monitoring sample plan progress.

In reviewing this report, the following should be observed:

1. Precision at the stratum level means: there is a 95% probability (or 95% of the time) the total volume calculated for the stratum will be within the precision percent of the actual volume.

In the case of stratum 20, for example, there is a 95% probability that the calculated volume for the stratum will be within 2.21% of the actual.

2. The standard deviation for the stratum: this is a measure of how much truck to truck ratios vary within each stratum. It is reported in cubic metres so strata can be compared. If Stratum A has a standard deviation of 1.5 m³ compared to 6.5 m³ for stratum B, we can conclude stratum B is much more variable than A. One of the underlying objectives of stratification is to minimize the variation between loads in the same stratum and thereby meet sampling objectives with fewer samples. In this case, if strata A and B had the same number of truckloads in them, the more variable situation (i.e., Stratum B) would require much more intensive sampling than stratum A to achieve the same sampling objective.

This standard deviation is used in calculation precision at the stratum level as well as input into the next sampling plan to calculate the sample size.

3. Sampled Loads

This is the number of samples taken to date for each stratum.

4. Precision Within a Stratum

In this case, detail is provided for stratum 31. Species and grade detail is provided only for those species-grade contributing more than 5% to the total stratum/volume (i.e., lodgepole sawlog - 80.4% and spruce sawlogs - 7.5% of the stratum volumes).

This precision percent like that at the stratum level means there is a 95% probability the volume estimated for the species grade combination (i.e., lodgepole sawlog volume) is within some percent of the actual volume for that species grade combination ($\pm 5.49\%$ for the lodgepole sawlog volume).

It must be understood by all users that the basis for calculating precisions at the species grade level is not accurate and the resultant precision is an approximation only. The approximation is reasonable for species grade combinations comprising a high percentage of the stratum volume. The reliability of the approximation however, erodes very quickly as the species-volume declines. Precision percent calculated for species-grade combinations comprising less than 10% of the total stratum volumes must be viewed as unreliable.

Stratum Monitor - Precision View - 94									
File View Display Help									
Monday, November 28, 1994, 04:14 PM									
Company		Population		Year		Navigation		31	
01009		6001		94					
Stratum		Name							
31		80LOWB							
Strata		Sampled Data				Billed Data			
Str	Str Name	Loads	Ratio	Size	StdDev	Loads	Volume	Prec	
20	80LOLI	43	1.27955	40.42	2.92	1,798	72,285	2.21%	
22	80WWMX	13	1.26163	41.58	2.31	483	19,491	3.41%	
30	80LODB	107	1.17182	43.12	2.21	9,794	424,596	0.97%	
31	80LOWB	31	1.21412	45.78	2.21	3,307	155,099	1.72%	
32	80WWMX	49	1.20068	41.34	1.95	4,793	207,052	1.29%	
33	80FI	18	1.11687	39.53	1.86	695	26,558	2.39%	
34	MXBD	20	1.39536	48.61	3.47	450	22,779	3.14%	
35	80FIBB	27	1.25796	35.33	2.04	82	2,947	1.84%	
37	MXCU	38	1.16741	37.92	2.54	115	4,382	1.79%	
70	DP	20	1.14870	35.59	1.78	1,914	66,714	2.38%	
Summary for 10 strata of Population 6001									
Sampled Data					Billed Data				
Loads	Ratio	Size	Loads	Volume	Precision				
366	1.20768	41.33	23,431	1,001,902	0.60%				
Over 5% By Volume									
0%									

Figure 10.7 Stratum Monitor - Precision view screen.

10.2.2.2 Population Precision

This section includes population totals (i.e., total volume all strata, total sampled, and total number of load billed) as well as precision. The precision relates to the entire population.

In this example it means there is a 95% probability the total volume estimate (i.e., 1 001 902 m³) is within .60% (or 6 011 m³) of the actual volume. Remember the actual volume is not known unless you sample scaled all loads (i.e., you piece scaled the entire population).

10.2.2.3 Sampling Statistics - Sample Detail

This report shown in Figure 10.9 provides further detail on a sample by sample basis. In addition, the program further reports each sample by species and grade volume. As such, this report enables the user to pinpoint suspect samples. The column adjacent to the sample number defines whether the sample detail has been added (A) or deleted (D) from the data set. Reports with numerous D transactions should be further investigated to determine the basis for deleting samples.

Ratio detail should also be reviewed to pinpoint possible data problems. Generally, ratios varying by more than 25% from the average ratio for the situation (this average is on the previous report) should be reviewed very closely for errors.

Stratum Monitor - Data View - 94									
File View Display Help									
Monday, November 28, 1994, 04:03 PM									
Company	Population	Year	Navigation				Stratum	Name	
01009	6001	94	31				31	80LOWB	
Tan	Scaler	Return	Station	Mark	Scale	Weight	Volume	Ratio	
1	A	8461	004	601	45312	93/05/18	31.660	43.94	1.38787
2	A	8461	068	601	39995	93/09/08	36.540	43.65	1.19458
3	A	8461	108	601	35495H	93/10/14	35.470	47.21	1.33098
4	A	8461	091	601	39995	93/09/30	36.190	45.05	1.24482
5	A	8461	088	601	39995	93/09/28	36.150	44.84	1.24039
6	A	239A	013	601	39368	93/10/26	38.960	48.69	1.24974
7	A	239A	017	601	39368	93/11/02	39.550	49.40	1.24905
8	A	8461	189	601	39849	93/12/14	36.790	45.54	1.23784
9	A	8461	184	601	ED2155	93/12/09	33.410	38.92	1.16492
10	A	8461	162	601	ED2201	93/11/25	33.060	38.94	1.17786
11	A	8461	167	601	ED2201	93/11/27	43.130	49.87	1.15627
12	A	239A	025	601	39849	93/12/07	34.190	44.27	1.29482
13	A	8461	207	601	39851	94/01/05	35.120	41.25	1.17454
14	A	8461	210	601	YC917	94/01/06	33.870	36.97	1.09153
15	A	8461	206	619	ED2162	94/01/04	40.960	48.85	1.19263
16	A	8461	196	619	ED2162	93/12/20	41.370	45.11	1.09040
17	A	8461	232	601	ED2214	94/01/26	31.690	37.73	1.19060
18	A	8461	252	619	ED2162	94/02/10	48.370	56.68	1.17180
19	A	8461	255	619	ED2162	94/02/11	42.230	52.90	1.25266
20	A	8461	223	619	ED2162	94/01/21	43.670	51.71	1.18411
21	A	8461	212	619	ED2162	94/01/12	42.070	50.55	1.20157
22	A	8461	237	619	ED2162	94/01/31	41.670	52.03	1.24862

Figure 10.8 Stratum Monitor - Sample statistics - sample detail.

10.2.2.4 Graph of Sample Detail by Strata

This is a graphical representation of sample data (volume and weight or mass) and demonstrates how variable the ratios are about the mean (i.e., the mean is the solid line going through 0). The dashed line represents 2 standard deviations from the mean.

Remember by definition 95% of the observations will be within (+ and -) 2 standard deviations of the mean. The sample points outside 2 standard deviations are known as 'outliers'. While expected they may also represent problem data. The program enables placement of the cursor on any sample point and display of sample details for that sample enabling ready review of data.

Remember the closer ratios are aligned to the average ratio line means the more homogenous the stratum. Such strata are characterized by low standard deviations and efficient sampling. Where ratios are more divergent around the average ratio line, they are considered less homogenous (or heterogeneous) and are associated with higher standard deviations and more onerous sampling requirements. Remember homogenous strata for the purposes of comparing standard deviations, are strata with similar ratios. Never assume that similar ratios mean loads within that stratum are similar in terms of species and grades.

This graph may also be used to define potential divisions and merging of strata. This aspect is discussed further under amendments to the sampling plan.

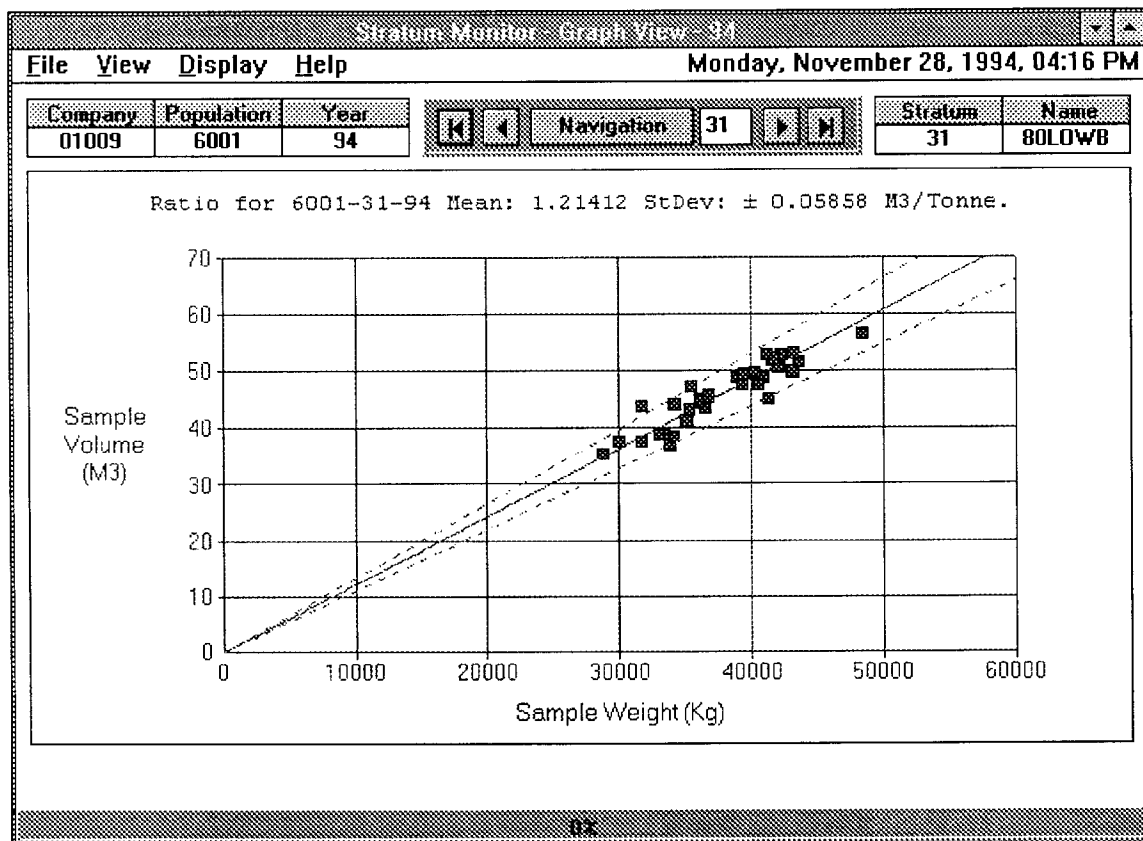


Figure 10.9 Stratum Monitor: Graphical display of sample ratios.

10.2.2.5 Stratification Advisor Report - Chronological Display of Sample Ratios

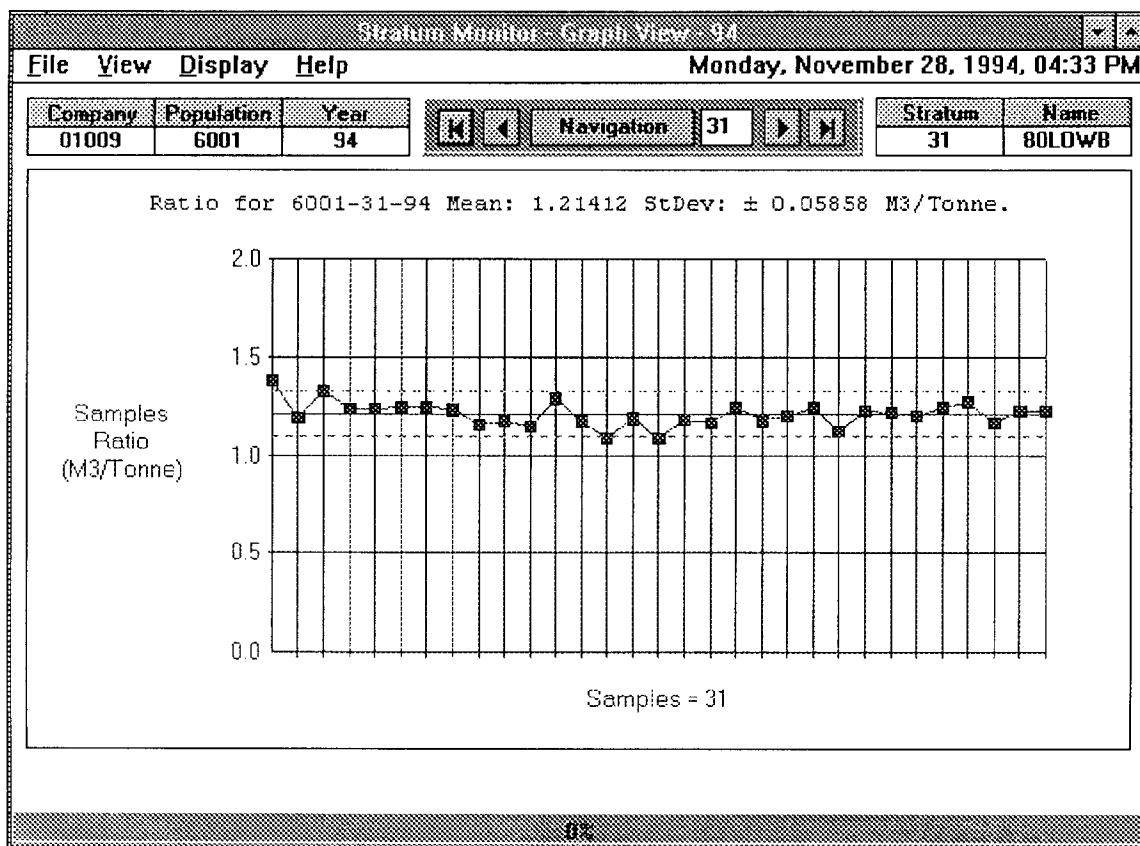


Figure 10.10 Stratum Monitor - Chronological Display of Sample Ratios.

This graph (Figure 10.11) provides a display of ratios in the order in which they are processed by the Harvest Billing System. This display provides another perspective on the spread of ratios about the sample mean ratio (the solid line). The two dashed lines represent 2 standard deviations above and below the mean (i.e., the 95% confidence level).

The Stratification advisor reports are an effective tool for monitoring sampling progress. Drawing any conclusions from them, however, requires a clear understanding of what data is included in the report and what is the significance of each data field.

Some of the questions which may be answered by the Stratification Advisor reports include:

10.2.2.6 During the Sampling Year

- are sample loads being correctly stratified?
(e.g., stratum 31 calls for at least 80% lodgepole, it is currently 80.4%),
- how frequently are sample loads being deleted?
- are there any trends in the data?
- how much do the sampling results compare with those assumed in the sample plan? (e.g., compare standard deviations if you have enough samples, compare load averages), and
- if current trends continue, will you be meeting your sampling objectives, will you get enough samples in each strata, will your production estimates be met?

10.2.2.7 At Year-end

In addition to the above, at year-end, you can also answer some very basic questions:

- did you meet your sampling objectives?
- could you have achieved the same results with fewer samples?
- what were your experienced standard deviations in each stratum?
- how good were the production estimates? and
- how effective was your stratification scheme?

The following sections outline the management of sampling plans in more detail.

10.3 Managing the Sampling Plan

An accurate, well balanced sample plan is critical to obtaining defensible weigh scale data. By legislation, (the Scaling Regulation) a precision of $\pm 1.0\%$ @ 2 SE is required for every population for which a weighing and sampling method of scaling is agreed to between the ministry and the population holder (scale site operator). That means the population must be sampled intensively enough to generate a volume estimate within $\pm 1.0\%$, 19 times out of 20, of the *actual* volume that would have resulted had every piece of timber in the population been individually scaled. Very large amounts of direct revenue are generated by even a relatively small population and care must be taken to ensure that the calculation of the timber volumes is as fair and equitable as possible to both the Crown and the industry. In addition, the scale volumes generated by a sample plan may be used as the basis of trade between buyers and vendors. The methodology of arriving at those volumes must be unbiased and statistically defensible.

10.3.1 Management Responsibility

Maintenance of accurate data and a defensible sampling plan is the responsibility of both the ministry and the population holder. The initial responsibility rests with the population holder, who must ensure the best possible estimate is made of the coming year's production and that a well-planned stratification strategy is prepared. Consultation with company woodland's managers and log buyers, reviews of previous year's sampling results, and ongoing consultation with the ministry's scaling staff will go a long way toward achieving this goal. Use of the Sample Planner/ Advisor software available from the Ministry of Forests is a valuable tool for preparing sample plan proposals.

The ministry's scaling staff are responsible for ensuring that production estimates and stratification plans are carefully evaluated, compared with the operator's previous year's results, and adjusted as required *before* a plan is accepted for implementation.

Once the plan is in place, it becomes the responsibility of both parties to continuously monitor the interim results. It is the duty of the population holder to make the best possible estimate of timber production and profile for the coming year. During the course of the sample year, should unforeseen problems, arising from weather, markets, or other constraints beyond the control of the holder, create significant changes in the projected population size or the strata profile, the holder must inform the ministry scaling staff. A joint review of the changes can then be carried out and a decision reached on how (or if) the sample plan will be revised to reflect the changes. Guidelines for evaluating the effect of production changes and how to proceed, are covered in the following sections.

10.3.2 Revising the Sampling Plan

Where it becomes very clear the production forecast and other assumptions underlying the sampling plan are not being realized it may be necessary to revise the sampling plan during the year. While changes to the sampling plan are the subject of frequent debate, the decision to change or not change a plan must be made in strict compliance with two basic statistical principles.

1. Random Sampling - as discussed in the previous section on statistics underlying the weight scaling, samples must be drawn at random. A random sample is a sample drawn in such a way that all loads in the stratum (i.e., every truckload) have an equal chance of being selected as a sample. If random sampling is not satisfied, biased results may occur.
2. Representative Sampling - samples must be representative of the population (in this instance, the stratum) from which they are drawn. A representative sample is one in which the sampled loads fairly reflect the stratum. For example, if the stratum definition calls for 95% sawlog grade and up to 5% other grades, then a representative sample is one which contains at least 95% sawlogs and the balance in other grades. Random Sampling somewhat ensures samples are representative. There are, however, unavoidable instances where sampling may not be strictly random. In this case, ensuring that samples are representative should be sufficient to maintain integrity of the Weight Scale results.

To ensure representative sampling, you must ensure loads are correctly accounted for under the stratum definition.

Changes to the sampling plan should be made only where you are satisfied that the above basic statistical principles will be complied with.

10.3.3 Sample Plan Revisions

How (or whether) one amends a sample plan will depend on how severe the production changes are going to be and whether they are consistent across all strata, much greater in some strata than others, involve decreases, increases, introduction of entirely new species, grades or mixes, or even new strata. The impact of changes can also hinge on the time period over which the timber involved is expected to be delivered.

For example, wood tends to be heavier in spring than in autumn, because there is more sap present. This is especially true of younger trees and can result in noticeably different volume/weight ratios, depending on when the timber was cut. The change is not so dramatic for mature or over-mature timber. Winter-cut timber, on the other hand, can also generate lower ratios; not because of the wood itself, but because large amounts of mud, ice and snow can stick to the load and add to the gross weight of the truck, while contributing nothing to payload volume. Where harvesting will take place across two or more seasons, changing sample frequencies can cause disproportional sampling and should usually be avoided.

10.3.4 Options

Changes to production estimates can lead to a number of combinations of methods to deal with those changes. It is impractical to give examples of all of them. However, when production estimate amendments are large enough to warrant revisions to the sample plan, there are four possible approaches, and numerous combinations of those approaches, that can be used:

1. close off existing strata and start new ones,
2. amalgamate strata,
3. amend the sampling frequencies of one or more strata, and
4. make no changes.

In order to give some general guidance on what approach to take, a simplified, hypothetical example of a sample plan, descriptions of some changes that can occur and possible remedies for each situation, follow.

Example of a Hypothetical Sample Plan

Stratum	Prod. Estimate	Samples Required	Sample Frequency
01	5 000 loads	100	1/50
02	1 000 loads	50	1/20
03	<u>200 loads</u>	<u>10</u>	1/20
Totals:	6 200 loads	160	

Halfway through the sample year, circumstances force a major change to production by stratum. Projected volume in stratum 01 drops to 2 500 loads, increases to 2 500 loads in stratum 02, and in stratum 03 drops to only 50 loads. With *no change* to sample frequency, the revised production estimate will now generate the following:

Stratum	New Prod. Est.	Sample Frequency	Potential Samples
01	2 500 loads	1/50	50
02	2 500 loads	1/20	125
03	50 loads	1/20	2 (or 3)
Totals:	5 050 loads		177

This is a good time to try some "what-if" recalculations of the sample plan, based on the revised volumes and the best statistical data available. The Sample Planner/Advisor software is ideally suited to this application. You may want to try several scenarios before settling on one, bearing in mind that at least $\pm 1.0\%$ @ 2 S. E. precision for the population is still the objective. Species/grade profiles and overall ratio values of each stratum also need to be analyzed, especially if one is considering strata amalgamation. As well, consider how significantly seasonal variations in ratios may affect sampling. In some cases this alone may be enough reason to not change sampling frequencies.

Let us assume that revised production estimates, current standard deviations, and average load sizes are such that when you calculate a revised sample plan, the number of samples needed for the population remains at "160", and the new distribution of samples by stratum for the scenario you select is:

(Revised Plan)

Stratum	Samples Required	Current Potential Samples
01	75	50
02	75	123
03	10	2 (or 3)
Totals:	160	177

Proportional distribution now requires that stratum 01 and 02 have 75 samples each. The minor stratum, 03, of course remains at 10 samples. If the sampling plan does not change, revised production will generate 17 more samples than needed, even though overall production has dropped by almost 20%. At the same time, sampling by stratum has become unbalanced. Though strata 01 and 02 are now the same size, 01 will only generate 50 samples, while 02 will generate 125. Stratum 03, on the other hand, will only have 2 (or maybe 3) samples, well short of the minimum of 10. Some possible remedies are as follows.

10.3.4.1 Stratum 01

1. If your analysis of the sampling history indicates seasonal variation in ratios will not be significant, simply intensifying the sampling frequency is a viable option.
2. Depending on production to date, another possibility may be to close the current stratum 01 and start an entirely new stratum with a tighter sampling frequency. If, for example, 750 loads had already been received in stratum 01 and 15 samples generated, and a recalculation of the plan indicated 15 samples were sufficient for the 750 loads received to date, it would be in order to shut the stratum down and start an entirely new one to receive the remaining 1 750 loads expected.
3. A final option *may* be to simply accept the sampling shortfall. However, this should only be considered if the quality/value of the timber going into stratum 01 is very low. If purchase timber is put through this stratum, deliberate under-sampling is not a recommended option.

10.3.4.2 Stratum 02

1. If seasonal variation of ratios will not be a problem, reducing sampling frequency can be considered.
2. As with stratum 01, closing the stratum off and starting a new one could be an acceptable option if production and sampling to date would make it a viable "stand-alone" stratum. Sampling frequency in the new stratum could then be reduced to where a more reasonable quantity of samples would be generated.
3. If neither option (1) or (2) are viable, the most favourable approach would be to simply accept the over-sampling. It is not a perfect solution as it will cause some additional sampling cost and will not result in the best-balanced sampling plan, but it will at least ensure defensible sampling for the stratum. This is especially important if the stratum will be used for scaling purchase timber.

10.3.4.3 Stratum 03

1. As with strata 01 and 02, changing sampling frequency is the most practical solution if seasonal ratio variations will not be a problem.
2. The stratum is too small to consider closing it off and starting a new one with a reduced sampling frequency.
3. Though it should not be done without first running the data through the Stratum Advisor program, amalgamating stratum 03 with strata 01 or 02 may be an acceptable solution, providing the species/grade profiles are reasonably similar.

4. If none of the above options seem advisable, you can consider leaving the stratum as is. However, unless it is a very low value stratum, which will *only* be used by the population holder, this is not a recommended option.

If neither options 3 or 4 seem viable, then the best remaining solution will have to be to default back to option 1 and accept the seasonally unbalanced ratio.

10.3.5 Sampling Plan Amendments

One possible production change that has not yet been discussed, is the new stratum, or strata added onto a sampling plan that is already in place. Usually, these are not major strata, do not often require more than the minimum number of samples (10), and will not likely have a significant impact on the rest of the sampling plan. However, if an "added-in" stratum should be large enough to upset the proportional distribution of samples throughout the rest of the population's strata, the possible remedies remain the same as those presented under 'options'.

10.3.6 Standard Deviations

Standard deviations (SD) are one variable that can have a profound effect on sampling requirements without any change to production estimates. These are the mathematical expressions of how widely volume/weight ratios vary from sample to sample. For example, if the variance of ratios in even one stratum (especially a major one) begins to significantly increase, it will not only affect that stratum, but can effect the entire population and thereby require additional samples be taken for *all* strata. Conversely, if the SD of a major stratum should drop, the reverse will occur.

Any number of conditions can contribute to variances between the SDs used to initially calculate a sampling plan, and those actually generated as samples are collected. Seasonal variations and mixing of dry and green timber in the same stratum, are the two most common ones, but ratios can also be affected by errors in scaling, data recording and key punching. The best place to check for unusual changes to SDs is in sample summaries. If you encounter one or more samples with ratios that significantly deviate from historical or anticipated ratios, those samples should be carefully examined and any errors found, corrected.

Whether or not to amend a sampling plan because of unexpected changes to SDs, will depend on how dramatically they alter sampling requirements. As a general rule, if sampling requirements drop because SDs are lower than expected, it is probably best to leave the plan as it is. If SDs increase to the point where one or more strata, or the entire population will fall short of the sampling target, a careful review of potential changes, as discussed under 'Options', will need to be made.

The options of "*closing off existing strata and starting new ones*", "*amending sampling frequencies*", or "*making no changes*", are the most likely ones to consider. It is doubtful that "*amalgamating strata*", would be of much benefit in such a case.

Your best sampling results will be achieved if you comply with basic statistical principles, you learn from previous sampling results and you use your best judgement!

10.4 Operational Procedures to Ensure Sampling Plan Integrity

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

10.4.1 Inspecting Loads Before Weighing

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

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

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

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

10.4.2 Processing the Load

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

10.4.3 Previously Scaled Timber

When timber has been scaled previously, it must be appropriately entered: either into the weigh scale computer, or onto the FS 482 (daily load inventory), and FS 488 (weight slip) if records are being manually kept. Previously scaled timber may be weighed and/or otherwise recorded as directed by the scale site owner/operator.

10.4.4 Unscaled Timber

For unscaled timber, load information is entered into the computer (or onto the FS 488 and FS 482, if keeping manual records). Minimum required data that will be automatically generated by weigh scale computers are date and time of weighing (in and out) and gross, tare, and net weights. Weighpersons must add the balance of information:

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

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

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

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

Once the weighing process is completed and recorded on the weigh slip and daily load inventory, the Weighperson and the truck driver must both sign the weigh slip. One copy is given to the trucker. The others are retained at the scale for distribution later to the Forest Service, the logging contractor, and the weigh scale owner/operator.

10.4.5 Managing Sample Loads

If a load has been selected as a sample, the weighperson must enter it into the sample ledger and it must be noted on the weigh slip and the daily load inventory. Computerized systems usually perform the last two tasks automatically. It must then be visually identified as sample. This may be done with specially coloured tags and ribbon, or other methods as directed by the District Scaling Supervisor. Once the load has been tagged, direct the truck driver to take it to the sampling area. Samples are usually either immediately spread in the sample yard for scaling or secured with a wrapper before being off-loaded, as it is absolutely critical that no pieces be lost from or added to a sample before it is scaled.

Conditions of scale for sample loads are normally spelled out in the scale site authorization letter and may vary from one location to another. As a general rule, they will cover matters relating to spreading, security, and integrity of sample loads, methods of recording, such as using a ministry approved hand-held scaling computer or FS 239 form, or equivalent. Other requirements will focus on leaving the last load for check scale, timely scale, and submission of sample tallies, and other conditions that may be included in the scale authorization letter.

10.4.6 Loads Not Suitable for the Sample Plan

Occasionally a truckload of timber will arrive at a weigh scale that is not suitable for inclusion in any of the regular strata in the sample plan, because the specie content, grade, timber mark or other characteristic does not conform to any of the strata criteria. Depending on the requirements of the scale site authorization, the load will either be weighed through a special stratum specifically set up for the purpose, or more likely will undergo a process called "red-tagging". Red-tag loads are specially flagged as directed by the District Scaling Supervisor, to distinguish them from sample loads. As with a sample, each red tag load is to be identified as such on its weigh slips and in the daily load inventory and entered into a ledger. *Only the gross weight should appear on the daily load inventory* and care must be taken to ensure no net weights from red tag loads are not added in to daily or month-end summaries. Red-tag loads are processed as piece scale loads as per instructions from the District Scaling Supervisor. Red-tag loads should never be entered on any weigh scale summaries, as double billing will result.

Once a red-tag load has been properly documented, the trucker can proceed to the off-load area, where the timber will be secured, spread, scaled, and otherwise dealt with in the same manner as a regular sample load. The only real difference is that it will be scaled for billing rather than sampling purposes, and therefore must be recorded on a piece scale tally form such as the FS 244, or other approved equivalent.

A word of caution: should a weighperson or scaler observe that red-tag loads seem to be occurring more than a few times a month, it can be an indication that the existing sample plan is not adequately accommodating the profile of the timber being delivered. The matter should be brought to the attention of the company and the District Scaling Supervisor, as an amendment to the sample plan may be needed.

10.4.7 Importance of Accurate Stratification

Timber bush-sorted to a single species or stratified by timber mark only, is relatively easy to classify. Often, however, that is not the case and possibly the most challenging task a weighperson faces is the accurate stratification of timber as it arrives at the weigh scale. Light and weather conditions, mud or snow on loads, mixes of species, and/or grades in a truckload only add to the difficulty of evaluating timber for inclusion in the appropriate stratum.

Should subsequent scaling of samples or a check scale indicate they have been assigned to wrong strata (i.e., they have been mistratified), it is the responsibility of both weighpersons and scalers to immediately bring the matter to the attention of the District Scaling Supervisor. Scaling staff will then investigate.

Some stratification criteria depend heavily on the weighperson's skill and ability to judge species-mix percentages and/or grade composition of a truckload. Should a sample be drawn of such a load and its subsequent hand-scale prove that the weigher mis-called the stratum's species/grade criteria, the load must nonetheless remain in the stratum to which it was originally assigned. Be it rightly or wrongly identified, every sample *must* be considered representative of the non-sampled portion of the stratum for which it was drawn. To second guess and move one to some other apparently more appropriate stratum, can introduce a severe sampling bias.

On the other hand, any loads that have been found to be mis-stratified or otherwise mis-identified simply as the result of a data entry error or incorrect timber mark, must be noted and corrected whenever they are discovered.

Mis-stratification should not occur very often. If it does, it will have been the one or both of the following reasons:

1. The weigher either lacks sufficient skill and experience to accurately assess species and/or grades, or is not taking enough care in viewing and evaluating loads, and/or
2. The stratum definition is too vague or complex to be practicably applied to the timber being sampled.

In this first situation, the problem may be remedied through additional training or supervisory direction, if required. In the second, either the bush sorts or the stratum's definition criteria will need to undergo some adjustment.

10.4.8 Testing of Weigh Scales for Accuracy

Regular section tests must be conducted on platform weigh scales. If at all possible, regular tests should also be done on hoist-type scales. Unfortunately, this is not always feasible, as known weights of stable and sufficient mass to do a meaningful test and equipment powerful enough to move the weights in and out of position, are often not available. In those cases, the only testing that can be done is by technicians when load cells are sent away for regular maintenance and calibration.

Specific details of platform scale section testing will be as directed by the District Scaling Supervisor. In general though, the requirements will be:

1. Sections tests will be conducted at least once each work day,
2. The heaviest, shortest wheel-base vehicle available (usually a loader) should be used as a test weight (a minimum test weight of 25-50% of the scale capacity is recommended),
3. Each segment of the scale platform will be tested,
4. Tests will be conducted in both directions across the platform,
5. Each weigh scale must maintain a ledger in which the results of every section test are recorded by time and date and signed off by the Weighperson(s),
6. If any readings vary by more than 0.1% (20 kg when using an average sized loader as a test weight), the Weighperson is personally responsible to immediately inform both the District Scaling Supervisor and the weigh scale owner/operator,
7. The scale owner/operator is responsible to arrange for immediate repairs.

Weights and Measures of the Department of Industry Canada, should be advised of any scale that is not weighing to standard and have requested that their District Managers be informed, whenever such problems are encountered.

10.4.9 Records Management at a Weigh Scale

The weighperson is responsible for producing and maintaining a number of forms at a weigh scale. Some of them, such as weigh slips, daily load inventories, and in some cases month-end returns (FS 493 or equivalent) are produced automatically or on command at weigh scales equipped with computers. Others, such as sample, red-tag, and section test ledgers will have to be manually maintained. At some locations, weighpersons will also have to maintain a diary of loads of scaled timber that are shipped out to other operations as a result of log trading between companies.

Submission requirements for various month-end and other reports may vary from one location to another and will be as directed by the Regional Scaling Manager, the District Scaling Supervisor, and/or the scale site authorization letter.

The detailed procedures describing the completion of all weight scale forms are documented in Chapter 7.

10.4.10 Emergency Procedures

Weight scales are subject to breakdown. If this occurs, responsibilities are as follows:

- weigh person - immediately inform the district scaling supervisor and the weight scale owner/operator,
- weight scale owner/operator - ensure the scale is repaired as soon as possible, and
- District Scaling Supervisor - provide direction in initiating procedures to ensure all production is correctly accounted for during the breakdown.

Appendix 10A outlines emergency procedures to be followed in the event of a breakdown.

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Appendix 10A Emergency Procedures in the Event of a Weight Scale Breakdown

10A.1 Breakdown of the Weighing Device

The following procedures are in place to account for all production in the event of a weigh scale breakdown.

10A.1.1 Conditions

Weigh scale operators are permitted to continue processing loads of timber in the event of scale breakdown, subject to the following conditions:

1. The District Scaling Supervisor must be notified immediately following the breakdown of the scale.
2. The following emergency procedures may be used for estimating load weights for no longer than the period between the time of the breakdown and the end of the day following the breakdown.
3. Where production at the weight scale averages fewer than six loads per day all loads must be red tagged and piece scaled.
4. All scale data collected through the emergency procedures must be submitted to the Forest Service along with the regular submission of scale data.
5. If a weight scale is located within 20 km of the malfunctioning scale, it may be authorized for weighing during the breakdown period subject to approval by the District Scaling Supervisor.

10A.1.2 Procedures

10A.1.2.1 FS 488 / Weigh Scale Load Slip (or other alternate form approved by the Ministry of Forests)

Enter the following information:

1. Place of weighing (Company and Location).
2. Scale site number.
3. Time in.
4. Date.

5. Mark as long or short logs.
6. Load arrival number - Loads processed by emergency procedures must have a unique series of numbers applied to them. These load arrival number shall start at "E01, E02, E03" and continue from there.
7. Remarks - Enter Emergency Procedures.
8. Truck name and/or number.
9. Contractor's name and/or number if applicable.
10. Population/Stratum/Year - (e.g., xxxx/xx/xx).
11. Timber mark.
12. Signatures of both the scaler and the truck driver.
13. Net weight (complete this when it is calculated).

10A.1.2.2 FS 482 / Daily Load Inventory

Transfer the information from the Load Slip to the Daily Load Inventory. Under the "Gross" and "Tare" weight headings enter "Emergency Procedures" followed by the net weight (when calculated).

10A.1.2.3 Load Averaging Ledger (Form 1)

Net load weight averages are calculated for each truck, timber mark and stratum. Where data is available, averages must be calculated from the 10 loads (for each truck; timber mark, and stratum) weighed prior to the breakdown. If data is not available for each truck, mark and stratum it is permissible to use other data combinations. In order of priority, net weight load averages may be calculated using 10 weights as follows:

1. same truck / same stratum / different timber mark.
2. same truck / different stratum / same timber mark.
3. same truck / different stratum / different timber mark.

In all instances sound judgement must prevail:

- the first objective is to account for all production,
- loads which are not typical should not be represented in the averages.

Weight scale software which incorporates a recovery system must follow this convention.

The data used to calculate the average weight, as well as the load information, is to be entered on the Load Averaging Ledger form. Complete one form for each load processed during the weigh scale breakdown. The average weight for each load must then be entered on the Load Slip and the Daily Load Inventory forms.

10A.1.2.4 Summary of Scale (Form 2)

This form requires all loads processed on emergency procedures to be sorted and entered by timber mark and stratum.

After entering all data, add the weight and number of loads under each timber mark, and enter these totals at the bottom. Then total the weight and number of loads in each stratum and enter these totals on the right hand column. Finally, on the bottom right hand corner, enter the grand totals for the weight and the number of loads.

These totals must balance with the vertical and horizontal entries.

10A.1.2.5 FS 493 / Weigh Scale Monthly Return

All entries for each mark and stratum must be entered on the Weigh Scale Monthly Return. In the "Remarks" field, enter "Emergency Procedures". One return is to be used for each different mark and each different stratum in which that mark was used. One Weigh Scale Monthly Return "summary" form must also be completed (enter "summary" in place of "timber mark").

The data on this "Return" must balance with the total in the bottom right hand corner of the Summary of Scale (i.e., Form 2).

10A.1.3 Responsibilities

10A.1.3.1 Company (Population Holder)

1. To ensure that the District Scaling Supervisor is notified immediately following the breakdown of the scale.
2. To ensure that loads are not processed using this procedure after the specified period (see Condition 4.2).

3. To ensure that all data is accurate, all forms (listed in this procedure letter) are completed correctly and that this scale data is submitted to the Ministry of Forests by the deadline as stated in this letter.
4. To circulate copies of this letter to all weigh scalers and other company personnel who will be involved either calculating the average weights, or completing any of the forms.

10A.1.3.2 District Scaling Supervisor

1. To ensure that all scale data is completed as required before submission for billing.
2. To ensure that all scalers are aware of this procedure and instruct them if necessary.

10A.2 Breakdown of the Sample Selector

In the event the sample selector breaks down, the following procedure is in place:

- immediately contact the District Scaling Supervisor for direction, and
- where the selector cannot be fixed within one day, the District Scaling Supervisor may implement a manual sample selection procedure using a table of random numbers.

LOAD AVERAGING LEDGER FOR WEIGH SCALE BREAKDOWN

(one form per load processed by EMERGENCY PROCEDURES)

EMERGENCY PROC. LOAD NO.: _____ LOAD SLIP NO: _____ SPECIES: _____

POP / STR / YR: _____ / _____ / _____ TRUCK NAME/NO: _____

TIMBER MARK: _____ DATE OF BREAKDOWN/HAUL: ____ / ____ / ____

LOADS USED TO CALCULATE AVERAGE WEIGHT					
MONTHLY LOAD #	DATE YY/MM/DD	TRUCK	STR. NO.	TIMBER MARK	WEIGHT KG.
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

TOTAL WEIGHT OF THE 10 LOADS USED TO CALCULATE LOAD AVERAGE —→

TOTAL WEIGHT DIVIDED BY 10 = AVERAGE WEIGHT —————→

--	--	--

DATE OF CALCULATION YY MM DD

SCALER'S SIGNATURE

LICENCE NO.

Figure 10A.1 Load averaging ledger for weigh scale breakdown.

Scaling Administration

11

Chapters 1 to 10 of this manual have documented in detail how timber is scaled and reported. This chapter documents the administrative requirements for scaling and answers a number of basic questions, including:

- What are the roles and responsibilities for scaling?
- What requirements must be met before timber can be transported?
- What requirements must be met before timber can be scaled?
- How are scale sites authorized for scaling?
- How are scalers authorized and/or appointed to scale?
- What are the examination requirements to earn a scaling licence?
- What is the purpose of check scaling and what are the scalers' obligations related to check scaling?

11.1 The Roles and Responsibilities for Scaling

All scaling and submission of scale data in British Columbia, by and large, is the responsibility of the licensee. Scalers may work under the direct employ of licensees or under contract to the licensee. Scaling by ministry employees is confined to relatively minor volumes attributed to trespass, seizures, waste, and other minor transactions.

The ministry's role includes:

1. Designating where timber must be scaled,
2. Authorizing scale sites and setting scale site conditions,
3. Examining and licencing scalers,
4. Authorizing scalers and setting all scaling procedures,
5. Setting scale data computation and control procedures and standards, and
6. Assessing compliance with all procedures and standards.

Most administration surrounding each role is supported by the ministry's Scaling Administration and Control System (SCS).

Each of these roles is discussed under this chapter.

11.2 Designating the Place of Scale

Under the *Forest Act* (Section 73.1) and ministry scaling policy, before timber can be transported from its area of harvesting, the place of scaling (for each timber mark) must be designated to one or more authorized scale sites.

The administrative process of determining the place(s) where timber can be taken to be scaled is commonly referred to as "mark/site designation" (MSD).

Mark/site designation is an essential administrative process to satisfy the requirement that the scaling and transport of all timber take place in an orderly and controlled manner.

11.2.1 Applicant's Responsibilities

To transport timber off any Crown or private land you must first obtain:

1. A timber mark certificate, and
2. A mark/site designation letter.

Chapter 2 of this manual describes timber marks and marking requirements. To obtain a scale site designation letter, contact the local Ministry of Forests office and complete a written application. To apply for a mark/site designation you must be either the licence holder in the case of Crown timber, or the land owner in the case of private timber. Other persons may obtain a mark site designation only when the licence or landowner gives them written authorization to act on their behalf. Figure 11.1 is an example of an application form. This form may vary by region or district, and may be part of a more comprehensive form.

The mark/site designation letter authorizes the transport of timber to one or more authorized scale sites and may contain conditions concerning the transport or scaling at that site.

Transport of timber without a mark/site designation or to a location other than those approved is in contravention of the *Forest Act* and may result in seizure, penalties, and/or summary conviction.

APPLICATION FOR MARK SITE DESIGNATION

Prior to transportation of unscaled timber from the area of origin this form must be completed and signed by an authorized company official and delivered to the District Manager. Once signed as approved by the District Manager or the Scaling Supervisor this document will serve to

1. designate the place of scale pursuant to 73(1) of the Forest Act and Section 3(1) and (2) of the Scaling Regulations.
2. authorize the place(s) of scale for the timber mark.
3. authorize Scaling Company etc. for this site.

Timber Mark _____ /Mark Holder _____ /Payable by _____

Description of Timber _____

Trucker _____

Logging Company _____

Location of
Timber _____

Estimate No. of Truck Loads _____

Date of Transporting From _____ / _____ 19 _____ To _____ / _____ 19 _____
M D Y M D Y

Place of Scale _____

Scaling Company _____

Signature _____ / _____

Approved by _____

Position _____

Mailing Address _____

District Manager
or
Scaling Supervisor

Phone: _____ Fax: _____

Other Requirements: _____

Figure 11.1 Example of an application for a mark site designation.

The ministry's first responsibility is to ensure all prospective persons who will transport timber are clearly aware of ministry requirements.

In processing the application for mark site designation, the ministry must ensure:

- tenures/timber marks are in good standing,
- owner or licensee has given any agents written consent for acting on their behalf,
- sites designated for scaling are authorized and have suitable resources to conduct an accurate scale, and
- other district offices are notified if designated scale sites lie outside the district in which the timber originates.

Applications meeting ministry requirements will receive formal approval in the form of a letter (see Figure 11.2 for an example).

This approval will specify timber marks and the scale site(s) to which the marks have been designated for scaling. Where an application requests more than one scaling location and one or more scale sites are deemed unacceptable, the letter will be restricted to the acceptable scale sites. The scale site designation letter may contain other conditions concerning the scaling or transport of the timber.

To enable tracking of timber movement and scaling mark site, designations are entered on the ministry's Scale Administration and Control System (SCS). This system is also of assistance in assessing compliance with mark/site designations.



Province of
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Ministry of
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TIMBER MARK / SCALE SITE DESIGNATION

Timber Mark..... ED1235
File Number..... 21550-20

Pursuant to the Forest Act and its appurtenant regulations I hereby designate the above noted timber mark held by

WELDWOOD OF CANADA LIMITED, of
100 MILE HOUSE OPERATIONS
BOX 97
100 MILE HOUSE, B.C.
V0K2E0

to be scaled at the following sites:

Site Nmbr	Site Name	Loads	Pop.	Stratum	Term Start
	Site Location	Volume			Term End
604	WELDWOOD, 100 MI. HOUSE				1991-11-01
	WELDWOOD, 100 MI. HOUSE				1995-10-31
614	WELDWOOD WMS LK DIV.				1991-11-01
	WELDWOOD WMS LK DIV.				1995-10-31

The following conditions apply:

1. Direct Transportation.

Timber must be transported directly from the harvesting location to the designated scale site. Transporting anywhere else is an offense.

2. Designation Precedence

This designation supercedes all previous designations for this timber mark.

3. Contact Person for Changes

To change this designation contact the undersigned.

Page 1 of 2

Figure 11.2 Example of a mark site designation - page 1.



Province of
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Forests

TIMBER MARK / SCALE SITE DESIGNATION

Timber Mark..... ED1235
File Number..... 21550-20

4. No Harvesting Authority

This letter does not give any authorization to harvest timber.

Issued At Williams Lake Forest District
925 North 2nd Avenue
WILLIAMS LAKE, BC
V2G4P7

On this 6th day of March, 1995

By

Bryan McNaughton
District Manager
Williams Lake Forest District

Page 2 of 2

Figure 11.2 Example of a mark site designation - page 2.

11.2.2 Scaler and Scale Site Operator's Responsibilities

Scalers and Site Operators are responsible for ensuring that all timber marks received at a scale site have been approved by the ministry for scaling at that site. The approval may be in either of the following forms:

- letter that the vendor presents to the receiving site (usually with the first load delivered), or
- list of designated timber marks, which the district scaling supervisor issues to the scale site operator on a regular basis.

If any timber is delivered to a scale site without the required documentation, it is the responsibility of both the scaler and the scale site operator to ensure that district scaling staff are informed immediately. While specific conditions may vary from district to district, the scalers authorization and the scale site authorization should set instructions on how to process timber that has not been designated to be scaled at a given scale site. Scale site authorizations are discussed in the next section. Additional conditions may also be included in the mark/site designation letters. The district scaling supervisor or check scaler should be contacted if any conditions are not clear.

11.3 Scale Site Authorization

Section 73.1 (1) of the *Forest Act* and Ministry Scaling Policy 14.1, require owners and/or operators of a scale site to acquire a written scale site authorizations from the ministry prior commencing any scaling at that site. Failure to comply with this requirement is an offence under section 159 of the *Forest Act*. Section 73.1 (1) also empowers the ministry to attach conditions to the scale site authorization to ensure a complete and accurate scale.

Scale site authorization helps ensure:

- timber is scaled in an orderly and systematic manner,
- data are correctly captured and submitted to the ministry, and
- all ministry requirements are clearly defined and understood by all persons on the scale site.

11.3.1 Responsibilities

11.3.1.1 Applicants Responsibilities

The owner and/or operator of the proposed operation must apply to the district manager for a scale site authorization. The application must be in writing and include:

- applicant's full name (individual, company, etc.),
- applicant's client number,
- applicant's address and phone number,
- description of the proposed site's location (may need a map or sketch),
- proposed products to be scaled and scaling method,
- period of operation,
- expected volume to be scaled (in total if a short-term site, or annually if a longer-term site), and
- if the plan is to install a weigh scale, the application must include a sketch of the scale's location in relation to the scale site yard, a description of the scale house accommodation, the type and size of the weigh scale to be installed, and the proposed computer hardware and software.

Figure 11.3 shows an example application for a scale site authorization.

The applicant may be required to sign a statement confirming the authorization has been read and conditions understood, before it will be issued.



Province of
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Forests



SCALE SITE APPLICATION

Scale Site Detail

Site Owner Name _____
 Land Owner _____
 Scale Site Name _____
 Scale Site Location _____
 (Attach a map showing area, scaling bays for last loads, and location of scale document copies)

Size (Perimeter) _____ Surface Type _____
 Site Contact _____ Phone _____ Alt. _____
 Site Supervisor _____
 Site Operator _____

Site Owner Mailing Address Information

Site Operation Detail

Timber Handling Logs ☐ Special Forest Products ☐ Mixed ☐
 SB4 in (Y/N) _____ SB4 out (Y/N) _____

Timber Mark(s) _____

Scalers Name	_____	Licence No.	_____
Scalers Name	_____	Licence No.	_____
Scalers Name	_____	Licence No.	_____
Scalers Name	_____	Licence No.	_____
Scalers Name	_____	Licence No.	_____
Scalers Name	_____	Licence No.	_____

Operating Time: Daily _____ Weekly _____ Yearly _____

Other Comments _____

 Owner Signature

Figure 11.3 An example of an application for a scale site authorization.

Once a scale site authorization document has been issued, it is the responsibility of the scale site owner/operator as well as all scalers working on the site, to be fully familiar with the conditions and requirements of the authorization. If any matter needs clarification, contact the district scaling supervisor or the check scaler.

11.3.1.2 Ministry Responsibilities

The ministry will:

- review the application and ensure it is complete before proceeding,
- conduct an examination of the proposed scale site and facilities,
- issue a scale site authorization document, if satisfied a complete and accurate scale can be conducted on that site,
- prior to commencement of operations, discuss all conditions of the authorization with the applicant to ensure they are understood,
- register the site on SCS,
- conduct regular site inspections to ensure site conditions are being complied with, and
- manage the authorization document through amendments, additions, and replacements upon expiry.

A scale site authorization will be denied if the ministry has reasonable grounds to believe the applicant will not comply with the timber marking and scaling provisions of the *Forest Act* and regulations, or with the conditions to be included in the scale site authorization.



Province of
British Columbia

Ministry of
Forests

SCALE SITE AUTHORIZATION

Authorization Num..... 102561
Authorization Date..... June 04, 1991
Scale Site Num..... 410

In accordance with the requirements of B.C. Regulation 563/78(Scaling),

LAKELAND MILLS LTD., of
BOX 1358
PRINCE GEORGE, B.C.
V2L4V4

is herein authorized to operate a Weight Scaling Site, located at

C.N.R. INDUSTRIAL SITE

This authorization is in effect from the authorization date and expires December 31, 2000. Written application for extension must be received by the District Manager before that date.

The following conditions apply:

1. COMPLIANCE WITH FOREST ACT

All scaling shall be conducted in accordance with Part 6 of the Forest act, the Scaling Regulation, the Forest Service Scaling Manual and Ministry policies and procedures.

2. FAILURE TO COMPLY WITH CONDITION

This authorization may be suspended or cancelled by the District Manager for failure to comply with these conditions.

Figure 11.4 An example of a scale site authorization - page 1.



Province of
British Columbia

Ministry of
Forests

SCALE SITE AUTHORIZATION

Authorization Num..... 102561
Authorization Date..... June 04, 1991
Scale Site Num..... 410

Issued At Prince George Forest District
 2000 SOUTH OSPIKA BLVD.
 PRINCE GEORGE, BC
 V2N4W5

On this 6th day of March, 1995

By

District Manager

Page 2 of 2

Figure 11.4 An example of a scale site authorization - page 2.

11.3.2 Content of a Scale Site Authorization

The *Forest Act* empowers the ministry (usually through the district scaling supervisor) to set conditions that will "...ensure a complete and accurate scale." The ministry also has the authority to "...attach, remove, or alter a condition at any time." As such, the ministry has considerable latitude in setting and enforcing conditions that support a reliable scale.

Conditions common to scale site authorization include:

- conditions that provide clear direction on how to process all loads arriving at the site, including how to handle loads that have not been designated to the site and/or fail to meet other requirements such as timber marking,
- a clear statement on when scale returns (in the approved format) are to be completed and received by the ministry,
- conditions that support:
 - an accurate and complete scale,
 - orderly capture reporting and submission of scale data,
 - retention of scale information,
 - check scaling and site monitoring, and
- effective dates (terms are not to exceed five years).

Most site authorization clauses are in a standard format on the SCS. Where these clauses do not satisfy the specific requirements of a given site, custom clauses may be drafted by the system user. A number of considerations govern the issuance of custom clauses. Custom clauses must be:

- reasonable (can the site holder/operator comply without undue hardship?),
- enforceable (can an inspecting officer effectively evaluate compliance?),
- legal (do they conform with legislation in the *Forest Act* and *Regulations*?),
- equitable (do they conform with ministry policy and procedure?),
- compatible (do they conflict with any other clause(s) in the authorization?), and
- coherent (are they written clearly and concisely? Are they readily understood?).

Section 11.6.4 of this manual describes scale site inspections. During the inspection process, scale site authorizations should routinely be reviewed to ensure the clauses are sufficient to ensure ministry needs. While there is considerable latitude in administering scale site clauses, any changes to the authorization document require that:

- an entire new scale site authorization document be issued, clearly stating that it "cancels and replaces the previous one dated _____",
- the changes must be discussed in detail with the site holder/operator, and
- the applicant should sign the statement confirming the new authorization has been read and understood.

Scale site authorizations should not be allowed to lapse.

Section 11.6.4.3 describes actions that may be considered where scale site inspections reveal non-compliance with conditions in the authorization.

11.3.4 Site Registration

All scale sites must be registered on SCS and be given both a site location and name. A unique, three character alpha-numeric identifier code will be assigned on SCS at the time the registration data are entered. The first digit of the identifier code normally refers to the region where the site is located:

1 + 7	=	Vancouver Forest Region
2	=	Prince Rupert Forest Region
3	=	Kamloops Forest Region
4	=	Prince George Forest Region
5	=	Nelson Forest Region
6	=	Cariboo Forest Region

The district scaling supervisors are generally responsible for ensuring that all sites in their jurisdiction are registered on SCS.

11.4 The Training, Examination and Licencing of Scalers

The objective underlying the examination and licencing of scalers is to assure government, industry and all other parties having an interest in the scale that scaling is conducted by qualified and competent scalers. Scaling licences may be issued by the Chief Forester following successful completion of a practical and a written examination conducted by scaling examiners appointed by the Chief Forester.

11.4.1 Scaler Training

The responsibility for scaler training largely rests with colleges, technical schools, and other private institutions. The forest industry is supportive of scaler training in providing facilities for field instruction and examination.

While anyone can challenge a scaling examination, students are encouraged to enrol in a formal scaling course. Courses range from weekend or evening classes to full time courses spanning several months. Scaling by its nature requires not only a good theoretical foundation, but also manual dexterity coupled with sound judgement. Experience has shown these skills are usually developed only through on-the-log and classroom instruction, practise, and ongoing coaching. As such, students should ensure prospective courses have at least 50% of the course content devoted to field exercises.

To ensure scaling courses meet scaling licencing requirements, the ministry's Scaling Board of Examiners may set criteria for minimum scaling course content and curricula.

Prospective scaling students may be required to take a pre-screening exam conducted by the college or other institution. This exam is in place to test the students mathematical ability and aptitude. While this examination may not preclude students from enrolling in a scaling course, all students should be aware scaling does require a basic understanding of mathematics and weakness in this area is a significant disadvantage.

11.4.2 Scaling Examination

11.4.2.1 Coast and Interior Examinations

Because grading did not significantly apply to timber cut from the interior until the late 1980s and separate grade schedules are in effect, separate scaling licences are issued for the coast and the interior. Coast, for the purpose of scaling, refers to the area where timber is appraised using log selling prices. Interior refers to the area where timber is appraised using lumber selling prices. Generally, coast is considered the area west of the Cascade Mountains and the interior is considered the area east of the Cascade Mountains.

Because the grading schedules are significantly different, scalers with a coast licence are not authorized to scale timber originating from the interior unless they have successfully passed the interior grading endorsement exam. Similarly, scalers with an interior licence, are not authorized to scale timber originating from the coast until they have successfully passed the Coastal scaling licence exam.

11.4.3 Examination Procedures

11.4.3.1 Conducting the Exam

Scaling examinations are held at the discretion of the regional scaling manager and are generally held in the spring or fall.

All scaling students should be aware that examinations are held only when there is adequate demand. Examinations are open to any member of the public who has paid the examination fee. Examinations are generally advertised in the local press and at Forest Service offices at least two to four weeks prior to the examination date.

The procedures for conducting the practical exam, selection, spreading, and scaling of exam logs, setting and marking the written exam, are established and monitored by the Scaling Board of Examiners. In all cases, the exam must be conducted by appointed scaling examiners.

Province of
British ColumbiaMinistry
of Forests**APPLICATION TO SCALE**

I HEREBY MAKE APPLICATION (PLACE CHECK MARK IN SQUARES APPLICABLE):			
☐ FOR AUTHORIZATION TO SCALE AT _____		(NAME AND ADDRESS OF MILL OR OTHER OPERATION)	
☐ FOR APPOINTMENT AS ACTING SCALER TO SCALE AT _____			
☐ TO TAKE EXAMINATION FOR SCALER'S LICENCE, TO BE HELD AT _____		(PLACE)	
ON _____, 19__			
☐ FOR APPOINTMENT AS OFFICIAL SCALER IN THE _____		(NAME OF REGION OR DISTRICT)	
HAVE YOU EVER HELD A SCALING LICENCE, ACTING SCALER'S APPOINTMENT OR RESIDUE SURVEYOR'S LICENCE? ☐ YES ☐ NO		IF SO, WHERE?	APPOINTMENT OR LICENCE NO.
FULL LEGAL NAME AND ADDRESS (please print)			
LAST NAME		FIRST NAME	MIDDLE NAMES / INITIALS
TELEPHONE NO.		FAX NO.	ADDRESS
PROOF OF IDENTITY (please complete at least one of the following)			
DRIVER'S LICENCE NO.		CITIZENSHIP CERTIFICATE NO.	
BIRTH CERTIFICATE NO.		LANDED IMMIGRANT CARD NO.	
SOCIAL INSURANCE NO.		WORK PERMIT NO.	
PASSPORT		BRITISH COLUMBIA IDENTIFICATION	
PLEASE STATE PLACE OF BIRTH			DATE OF BIRTH Y M D
SIGNATURE OF APPLICANT			DATE SIGNED Y M D
FOR OFFICE USE ONLY			
DATE OF EXAMINATION Y M D		MARK %	LICENCE NO.
LOCATION		DATE ISSUED Y M D	
APPROVED ☐ YES ☐ NO		FEE PAID ☐ YES ☐ NO ☐ N/A	
DATE APPROVED Y M D		FS CLIENT NO.	

FS 87 HVA 93/11

Figure 11.5 FS 87 - The application to scale.

11.4.4 Requirements to Take the Examination

11.4.4.1 Applications

Anyone wishing to take the licenced scalers examination must submit an application form FS 87 (see Figure 11.3).

11.4.4.2 Payment of Examination Fees

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

11.4.5 Examination Marking Standards

Examination marking standards are set as follows:

11.4.5.1 Coast Examination

The coast examination consists of two parts: a written exam and a practical exam. Candidates are given a maximum of five hours for the written exam, while a maximum of eight hours is given for the practical exam, which requires the scaling of 75 logs. To pass the examination, a candidate must obtain at least 50% of the marks in each of four categories and at least 75% of the total marks.

The following categories are included:

	Maximum Marks	Minimum Pass
Written paper	25	12.5
Net scale volume	40	20
Grading	20	10
Accuracy	15	7.5
Total	100	75

a. Written Paper

The written paper has a value of 100 marks. The mark on the paper is multiplied by 0.25 for inclusion in the final mark.

b. Net Scale Volume

The scaled logs are marked as three groups of 25 logs and one group of 75 logs. The net length, net top radius, and net butt radius recorded for each log are used to compute the net volume. The net volume of each group is compiled and the percent difference from the master scale calculated. Marks are allocated as follows:

Difference %	Mark
0.0 to 3.0	100 - (% difference x 3.333)
Over 3.0 to 5.0	90 - ((% difference - 3) x 10)
Over 5.0 to 8.0	70 - ((% difference - 5) x 23.333)

The sum of the marks for the four groups is divided by four to obtain a mark for the category and is multiplied by 0.4 for inclusion in the final mark.

c. Grading

A count of each incorrectly recorded species and grade is made and the total count subtracted from 75 and the result is multiplied by 100 and divided by 75 to obtain a mark for the category. The mark for the category is multiplied by 0.2 for inclusion in the final mark.

For example, if 25 grading errors were recorded, the % mark for the category would be calculated as follows and expressed as a percentage:

$$(75 - 25) \frac{100\%}{75} = 66.67\%$$

As 20% (i.e., 20 marks out of 100) of the total examination mark is assigned to grading. The 66.67% score must be multiplied by 0.2 to report the mark in the examination total (i.e., $(66.67) (.2) = 13.3$ marks out of 20).

d. Accuracy

A count is made of each log with an incorrectly recorded gross length and each gross radius out by more than one radius class. The total number of logs with accuracy errors is subtracted from 75 and the result multiplied by 100 and divided by 75 to obtain a mark for the category. The mark for the category is multiplied by 0.15 for inclusion in the final mark.

11.4.5.2 Interior Examination

The interior examination consists of two parts: a written exam and a practical exam. Candidates are given a maximum of four hours for the written examination and a maximum of four hours for the practical examination, which requires scaling and reporting scale results for 50 logs.

To pass the exam, candidates must achieve at least 50% in each of 3 categories and at least 75% of the overall exam marks.

Marks are allotted by the following categories:

	Maximum mark	Minimum pass
Written paper	30	15
Net scale volume	30	15
Accuracy	40	20
Total	100	75

a. Written Paper

The written paper has a value of 100 marks. The mark obtained on the written paper is multiplied by 0.3 for inclusion in the total mark for the examination.

b. Net Scale Volume

The species, gross length, gross top radius, gross butt radius, net length, net top radius and net butt radius are recorded for each log. The candidate looks up the net half volume for each length and radius in the Table of the Half Volume of Cylinders in cubic decimetres (dm³), FS 546, and enters this volume alongside the corresponding radius. The individual half volumes are summed to obtain the total net volume.

The percentage difference of the candidate's net scale volume from the master scale net volume is calculated and a mark allotted based on the percentage difference from the following table.

Difference %	Mark	Difference %	Mark
0.5	98 ^{29.4}	4.5 ^{22.5}	75
1.0	97 ^{29.1}	5.0 ²¹	70
1.5	95 ^{28.5}	5.5	58
2.0	93 ^{27.9}	6.0	47
2.5	92 ^{27.6}	6.5	35
3.0	90 ²⁷	7.0	23
3.5	85 ^{26.5}	7.5	12
4.0	80 ^{24.0}	8.0	00

The mark is multiplied by 0.3 before being included in the total mark for the examination.

c. Accuracy

A count is made of the following errors: incorrect species name, incorrect gross length, gross radius out by more than one radius class, incorrectly entered half volume, and incorrect addition of half volumes. The total count of errors is multiplied by three and then subtracted from 100 to establish a mark out of 100 for accuracy. The mark for accuracy is multiplied by 0.4 and added to the total mark for the examination.

11.4.6 The Administration of Scaling Licences

11.4.6.1 Invigilating Scaling Examinations

Both the written and practical parts of the examination are supervised by examiners who ensure each candidate receives no assistance from another person or from written notes. Candidates found to be receiving assistance will be disqualified and receive an automatic fail.

11.4.6.2 Marking Requirements

Examinations are to be marked by an examiner who must allocate marks in accordance with the mark distribution as described. All examinations are to be marked twice by different people to minimize errors. The examination papers of successful candidates are forwarded to Victoria for review and confirmation of results. At the same time, the examiner must ensure the names of successful candidates are entered on the corporate client record.

11.4.6.3 Issuance of Scaling Licences

Upon confirmation, the names of successful candidates are entered on the Scaling and Administrative Control System (SCS). This system assigns a licence number in accordance to licence type and issues the scaling licence. The examination papers of successful applicants are sent back to the regional scaling manager for retention.

11.4.6.4 Review by Unsuccessful Students

The pass rate on scaling examinations is frequently less than 50%. Scaling by its nature requires not only an understanding of theory, but also requires manual dexterity coupled with sound judgement. The most frequent cause of failure is insufficient time spent observing and scaling logs.

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

11.4.7 Other Examination and Endorsements

11.4.7.1 Scaling Endorsements

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

Failure to pass an endorsement exam within a specified time period will not result in termination of the scaling licence. It may, however, terminate the scalers authorization to scale or make the scaler ineligible for future authorizations until the endorsement has been achieved. Endorsement exams will be scheduled to minimize the disruption to active scalers. Where scalers are inactive and/or miss the scheduled endorsement exams, they may be required to take the licencing exam again to achieve the endorsement.

11.4.7.2 Re-examinations

In addition, Section 79 of the *Forest Act* empowers the Chief Forester to require a scaler to be re-examined. This provision is usually exercised where check scales or other inspections have concluded a re-examination is needed to confirm the scalers ability to meet licencing standards. Failure to pass the examination within a specified time will render the scaling licence cancelled.

11.4.7.3 Other Examinations

As the *Forest Act* (Section 78) authorizes the appointment of acting scalers other examinations are also administered by the ministry to ensure applicants are capable of meeting ministry requirements. These examinations are generally set and administered on a local basis under the overall guidance of the Scaling Board of Examiners.

11.4.8 Scalers Oath

Because scale data serves the needs of both buyers and sellers, as well as others, it is of utmost importance that scalers be absolutely objective in their conduct.

All scalers are required to swear and sign the following oath as part of receiving their scaling licence or being authorized or appointed to scale:

"I, _____, do solemnly swear that I will, in my capacity as a scaler, without fear, favour, or affection, and to the best of my ability and judgement, scale, record and report scale results in accordance with the *Forest Act*, applicable regulations, the Scaling Manual and other requirements set by the Ministry of Forests."

To students just obtaining a scaling licence:

Students obtaining a scaling licence should be commended for their achievement. All students, however, should understand passing the scaling examination is the first step toward becoming a scaler.

To become proficient and maintain your skills as a scaler, you need experience on the job, periodic study, and you should always be receptive to new knowledge.

Having a scaling licence does not authorize you to scale timber for purposes of the *Forest Act*. If you want to scale, you must also be appointed and/or authorized to scale. Section 11.5 documents these requirements.

11.5 Authorization and Appointments of Scalers

11.5.1 Legal Requirement for Authorization and Appointments

Anyone wishing to scale for purposes of the *Forest Act* must first be appointed and/or authorized to scale by the ministry.

Figure 1.4 in Chapter 1 details the legal and administrative requirements of Sections 73 and 78 of the *Forest Act*.

Section 73 requires that all scalers except Forest Service scalers must be authorized by the Ministry of Forests to conduct the official scale. Section 78 provides for the appointment of acting scalers, official scalers and Forest Service scalers. Section 159 (c) of the *Forest Act* states that it is an offence for any person to represent that they are authorized to perform a scale if that person is not so authorized.

11.5.2 Administrative Reasons for Authorization and Appointments

Authorization and appointment of scalers is carried out for the following reasons:

- to ensure the public's valuable resource is scaled by the most competent scalers available,
- to ensure scalers are clearly aware of their legal obligations and responsibilities with respect to scaling, and the documentation, retention, and submission of scale data, and
- to enable the ministry to monitor scaling activity and conduct check scales by knowing who is scaling, as well as, where and when.

11.5.3 Terms of Requirements of Authorization and Appointments

Authorizations and appointments are restricted to the geographic jurisdiction of the signing official. They are also limited in duration.

To meet the objectives of ensuring a reliable and controlled scale, the *Forest Act* provides considerable administrative flexibility in scaling appointments and authorizations. In all cases, unless otherwise specified, appointments and authorizations are restricted to the geographic jurisdiction of the signing official and are limited in duration.

11.5.3.1 Official Scalers

Official Scalers are usually appointed by the regional manager for a term not exceeding five years. Appointments may be re-issued upon expiry.

Requirements to be appointed as an official scaler include:

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

11.5.3.2 Licenced Scalers

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

Requirements to be authorized as a licenced scaler include:

- valid licence with all endorsements current.

11.5.3.3 Acting Scalers

An acting scaler appointment is considered only where:

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

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

Requirements to be appointed as an acting scaler are:

- order must be issued by the regional manager, the district manager, or a forest officer stating that the timber may be scaled by an acting scaler,
- applicant must complete an acting scalers examination,

- applicants who scale more than 300 m³/year must pay a fee of \$100, and
- appointment may be conditional upon the applicant attending the next scaling examination held in the region. Each acting scaler appointment may not exceed one year. While these appointments are normally for minor volumes and for a short term they may be renewed upon expiry.

11.5.3.4 Forest Service Scalers

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

- hold a valid scaling licence, and
- have been appointed as a forest officer.

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

All scalers are required to take the Scalers Oath upon their first authorization to scale (see Section 11.4.9).

11.5.4 How to Obtain an Authorization and/or Appointment

Any person requiring an authorization or appointment should complete an Application to Scale (FS 87) and return it to the local Forest Service office for processing.

11.5.5 Authorization Conditions

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

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

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

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

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

Figure 11.6 is an example of an authorization to scale issued using SCS.



Province of
British Columbia

Ministry of
Forests



AUTHORIZATION TO SCALE

Authorization Num.....119223
License Num.....XXXX
Authorization Date.....April 01, 1994

Pursuant to the Forest Act, Part Six, Section 73, I hereby authorize

JOE SCALER, of
P.O. BOX 555
SMITHERS, BC
V0J 2N0

to Weigh and Stratify Timber

at site 237 (SMITHERS)

for a period commencing April 01, 1994 and ending December 31, 1995 subject to the following condition

1. COMPLIANCE WITH FOREST ACT

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

2. FAILURE TO COMPLY WITH CONDITIONS

This authorization may be suspended or cancelled by the District Manager or Scaling Supervisor for failure to comply with these conditions.

3. ORDERLY SCALING

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

4. SCALE PROCEDURES - UNIQUE RETURN NUMBER

The scale details of each parcel or load are to be recorded against the licence number and unique return number assigned by the scaler.

5. SCALE PROCEDURES - SCALED PARCELS

After scaling, each piece and parcel or load are to be clearly marked to clearly indicate they have been scaled.

6. ACCURATE RECORDS RETAINED BY SCALER

Accurate records (including date and place of scaling) are to be retained by the scaler for all scales performed.

Page 1 of 3

Figure 11.6 An example of an authorization to scale - page 1.



Province of
British Columbia

Ministry of
Forests



AUTHORIZATION TO SCALE

Authorization Num.....119223

License Num.....XXXX

Authorization Date.....April 01, 1994

7. **PRIOR TO SCALING - CONDITIONS**
Before scaling at each site, the scaler must familiarize themselves with the conditions of scale for the site and ensure each timber mark has been approved for scaling at that site.
8. **SCALERS OBLIGATION - CONDITION OF SCALE**
The scaler must ensure that conditions of scale for the scale site are met and report to the Forest Service where they are not met.
9. **WEIGHING OF TRUCKS**
All loaded trucks must be weighed entering the site and reweighed after unloading and prior to leaving the scaling station.
10. **UNMARKED TIMBER**
Loads of unmarked timber must not be scaled without first contacting the local Forest Service Office for instructions.
11. **RESPONSIBILITY OF WEIGHMASTER**
The person weighing shall ensure that the scale functions accurately and within tolerances. Regular tests are to be done and the scale and associated attachments and devices are to be maintained in good working condition.
12. **MIXING SCALED AND UNSCALED TIMBER**
No unscaled logs are to be mixed with scaled material at any stage of the operation.
13. **SCALE MALFUNCTIONS**
The Forest Service must be notified immediately in the event of malfunctioning equipment or any other irregularity affecting the weighing and selection of loads.
14. **ILLEGIBLE MARK**
All logs which do not bear a legible timber mark must be recorded as NMV. This does not apply to weight scale samples unless they must be 100% marked.
15. **LOADS NOT MEETING STRATA SPECIFICATIONS**
Loads not meeting stratification specifications must be excluded from the population and piece scaled.

Page 2 of 3

Figure 11.6 An example of an authorization to scale - page 2.

	Province of British Columbia	Ministry of Forests	
<h2 style="margin: 0;">AUTHORIZATION TO SCALE</h2>			
Authorization Num.....119223 License Num.....XXXX Authorization Date.....April 01, 1994			
16.	FOREST SERVICE RIGHT OF ACCESS A Forest Officer has the right of access to the scaling office and yard and, if necessary, to temporarily shut down the operation to check compliance with the conditions of scale to obtain a check scale or to test the weighing equipment.		
17.	DEVIATIONS FROM SAMPLE PLAN - REPORTING Deviations from the approved stratification plan, and unrepresentative samples must be reported to the Forest Service.		
18.	CANCELLATION/SUBSTITUTIONS OF SAMPLES Weight scale samples are not to be cancelled or substituted without express written permission by the District Scaling Supervisor.		
19.	NOTIFICATION PRIOR TO SCALING Prior to scaling, the District Scaling Supervisor must be notified of the dates and duration of scaling, changes in operating hours, and must be notified on completion before logs are moved so as to ensure check scale requirements are met.		
Issued At	Bulkley Forest District 3333 Tatlow Road, Bay 6000 SMITHERS, BC V0J 2N0		
On this	6th day of March, 1995		
By	District Manager		

Page 3 of 3

Figure 11.6 An example of an authorization to scale - page 3.

11.5.6 Suspensions and Cancellations

Where scalers fail to fulfill their requirements under an authorization or appointment, or fail to perform in a capable and competent manner, the authorization and/or appointment may be subject to suspension for a set term or it may be cancelled where contravention is blatant. Any person subject to a cancellation will be given an opportunity to be heard before the regional manager or a district manager.

The *Forest Act* also provides for the Chief Forester to cancel a scaling licence where scalers fail to properly perform their duties. Where this is contemplated, the scaler will be given an opportunity for a hearing before the Chief Forester.

11.6 Assessing Compliance with Scaling Requirements

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

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

Several basic questions are answered through these activities:

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

11.6.1 Data monitoring is covered in detail in the Scale Data Control Manual

11.6.2 Check Scaling

11.6.2.1 Purpose of Check Scaling

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

11.6.2.2 Conducting a Check Scale

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

Usually the check scale should comprise one truckload of logs. Where this is not feasible, the check scale should comprise enough logs so that meaningful conclusions can be made about the original scale.

11.6.2.3 Check Scale Frequency

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

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

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

Similarly, a reduced checking frequency might be warranted where:

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

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

11.6.2.4 Coaching

While check scaling plays an important role in assessing compliance with ministry requirements and scaling procedures, it also plays an important role in scaler development and training. Whenever feasible, the check scale should include an on-site review by the check scaler and the original scaler to share the check scale details and go over significant variances between the check scale and the original scale. This may include use of a saw or axe to confirm assumptions concerning the extent of decay or other defects. It is only through this process that inconsistencies or other sources of variance can be identified and resolved.

11.6.2.5 Division of Responsibilities

11.6.2.5.1 The Scaler

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

At the request of the check scaler, scalers must make themselves available to discuss check scale results and where required, review check scale logs on-site.

11.6.2.5.2 Scale Site Operator

The scale site operator is responsible for ensuring the last scaled load for each scaler is retained for check scaling. To this end the last scaled load must be clearly marked or tagged as scaled as per the scale site authorization and wherever feasible the load should remain in exactly the same position as originally scaled. This is an integral part of ensuring reliable check scale results, and as such, several provisions in the *Forest Act* and *Scaling Regulation* address this topic.

Under Section 73. (2.2) of the *Forest Act* the owner and operator of the scale site and the owner of the timber are responsible for ensuring the most recently scale parcel or load of logs is set aside or retained at the scale site and be accessible for check scaling. In the event of non-compliance with this requirement, Section 13 of the *Scaling Regulation* enables the ministry to assess its costs in attempting to conduct a check scale. In addition, contravention of Section 73. (2.2) of the *Forest Act* is an offence and subject to ticketing and/or summary conviction. Similarly, contravention may jeopardize the scale site authorization.

11.6.2.6 Checks to be Made

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

11.6.2.6.1 Piece Scale

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

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

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

11.6.2.6.2 Weight Scale

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

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

Check that the monthly return summary is balanced correctly by days and timber marks and that the total net weight per day on the summary agrees with the total on the daily load inventory. Check a completed daily load inventory to see that the total gross weight equals the sum of the net and tare weights. Cross check a few weight scale slip details with the details on the daily load inventory and ensure these agree.

11.6.2.6.3 Special Forest Products - Stacked

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

11.6.2.6.4 Special Forest Products - Piece Sampling

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

11.6.3 Actions Upon Completion of the Check Scale

11.6.3.1 Check Scale Advisory

In all instances, only the original scaler is privy to the results of the check scale. To this end an advisory letter showing the scale details for the original and check scales is issued to the original scaler as soon as possible following the check scale. This report is usually printed at the scale site and presented by hand to the original scaler.

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

Figure 11.7 shows an example of a check scale comparison report produced by a handheld computer and printed at the scale site.

Release of Check Scale Data

1. Upon completion of a check scale, the check scale detailed log listing will always be provided to the scaler who performed the scale.
2. Check scale detailed log listings are available to other parties upon request, subject to:
 - Where the ministry has reasonable grounds to believe that the release of check scale data to parties other than the scaler may cause harm, may place undue pressure on the scaler, or impair the scaler's impartiality, release should be denied.
 - If access to check scale data is denied, the person requesting the data may make a formal written request for the information through the *Freedom of Information and Protection of Privacy Act* procedures.

11.6.3.2 Replacement of the Original Scale by a Check Scale

Where the volume or value of the check scales varies by more than the prescribed 3% set by regulation, Section 75. (4) of the *Forest Act* requires that the original scale be replaced by the check scale. Section 75.(5) authorizes an exemption to this replacement where it is considered the original scale was conducted in accordance with good scaling practices and the differences in the original and check scale are attributable to the condition of the timber. The term 'good scaling practices' is subjective and requires an assessment of the nature, magnitude and frequency of scaling errors (both interpretative and quantitative).

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

Where the scale is to be replaced by the check scale, a copy of the new scale return should be provided to the scaler, the owner of the timber and the mark holder.

The responsibility for ensuring that the scale is replaced by the check scale rests with the owner of the scale site, the operator of the scale site, the owner of the timber, and the scaler.

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

Printed

CHECKS

95.03.08

Page 1

COMPARISON OF SCALE AGAINST CHECK - SUMMARY REPORT

Parcel ID :

Company :

Scale Site Sclr Ret ScaleDate Time G/N Scaled By

Orig. 5G5 852A 023 94.07.13 13:19 G TOM ZELEZNIK

Check 5G5 861A 040 94.07.13 13:11 G E. KUSY

Category				Original Scale				Check Scale					
TbrMark	Pt	S	Sp	G	Srt	Pcs	GrsVol	NetVol	NetVal	Pcs	GrsVol	NetVol	NetVal
NACRS			CE	2		18	8.22	8.19	75.10	18	8.22	8.18	75.01
NACRS			CE	4		2	1.51	1.32	0.33	2	1.43	1.12	0.28
NACRS			R	Z		1	0.00	0.00	0.00	1	0.00	0.00	0.00

		----- Gross -----				----- Net -----				
Totals	Pieces	Lengths	Tops	Butts	Volume	Lengths	Tops	Butts	Volume	Value
Orig.	21	218.8	183	277	9.73	216.1	183	277	9.51	75.43
Check	21	218.6	181	276	9.65	214.6	181	276	9.30	75.29
Diff.	0	0.2	2	1	0.08	1.5	2	1	0.21	0.14

% Diff/

Check	0.0	0.1	1.1	0.4	0.8	0.7	1.1	0.4	2.3	0.2
-------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Remarks: _____

C.C: _____

Forest Officer

Figure 11.7 Example of a check scale comparison report prepared at the scale site - part 1.

Printed

CHECKS

95.03.08

Page 1

COMPARISON OF SCALE AGAINST CHECK - SPECIES/GRADE REPORT

Parcel ID :

Company :

Scale	Site	Sclr	Ret	ScaleDate	Time	G/N	Scaled By
-------	------	------	-----	-----------	------	-----	-----------

Orig. 5G5 852A 023 94.07.13 13:19 G TOM ZELEZNIK

Check 5G5 861A 040 94.07.13 13:11 G E. KUSY

-- Original Scale --					---- Check Scale ----		
---- Volume ----					---- Volume ----		
Sp	G	Pcs	Gross	Net	Pcs	Gross	Net
CE	2	18	8.22	8.19	18	8.22	8.18
CE	4	2	1.51	1.32	2	1.43	1.12
R	Z	1	0.00	0.00	1	0.00	0.00
Totals		21	9.73	9.51	21	9.65	9.30

Figure 11.7 Example of a check scale comparison report prepared at the scale site - part 2.

Printed

CHECKS

95.03.08

Page 1

COMPARISON OF SCALE AGAINST CHECK - LOG REPORT

Parcel ID :

Company :

Scale Site Sclr Ret ScaleDate Time G/N Scaled By

Orig. 5G5 852A 023 94.07.13 13:19 G TOM ZELEZNIK

Check 5G5 861A 040 94.07.13 13:11 G E. KUSY

ORIGINAL													CHECK												
Defects													Defects												
			-Top-		-But-			Defect								-Top-		-But-			Defect				
Log#	Sp	G	Len	Top	Butt	DTM	Ou	In	Ou	In	Len	Per	Volume	Log#	Sp	G	Len	Top	Butt	DTM	Ou	In	Ou	In	Len
0001	CE	2	100	011	012	BF3	0	4	20			0.003	0001	CE	2	100	010	012	BF3	0	5	20			0.005
0002	CE	2	150	010	019									0002	CE	2	150	010	019						
0003	CE	2	140	007	012	BF3	0	7	26			0.013	0003	CE	2	140	007	012	BF3	0	7	25			0.013
0004	CE	2	110	006	012									0004	CE	2	110	006	012						
0005	CE	2	100	012	014									0005	CE	2	100	012	014						
0006	CE	2	138	008	014	BF3	0	4	12			0.002	0006	CE	2	138	008	014							
0007	CE	2	142	006	011									0007	CE	2	140	006	011						
0008	CE	4	100	015	021	HF1	14	14	30			0.185	0008	CE	4	100	015	021	HF1	1	14	100			0.309
0009	CE	2	100	018	021									0009	CE	2	100	018	021						
0010	CE	2	150	006	013									0010	CE	2	150	006	013						
0011	CE	2	100	010	011									0011	CE	2	100	010	011						
0012	CE	2	100	005	010									0012	CE	2	100	005	010						
0013	R	Z	004	005	005									0013	R	Z	004	004	005						
0014	CE	2	100	008	014									0014	CE	2	100	008	014						
0015	CE	2	076	007	011									0015	CE	2	076	007	011						
0016	CE	4	100	010	014									0016	CE	4	100	010	012						
0017	CE	2	100	008	015									0017	CE	2	100	008	015						
0018	CE	2	058	008	012									0018	CE	2	058	008	012						
0019	CE	2	110	008	014									0019	CE	2	110	008	014						
0020	CE	2	110	005	010									0020	CE	2	110	005	010						
0021	CE	2	100	010	012	BF3	0	7	30			0.015	0021	CE	2	100	010	013	BF3	0	8	30			0.020

Summary of Differences : Number = %

--Species-- --Grade--- --Length--- ----Top---- ---Butt---- -Defects Volume
 0 = 0.0% 0 = 0.0% 1 = 4.8% 0 = 0.0% 1 = 4.8% 0.133 = 37.8%

DEFECT CODES

A Ring Count	G Goiter	O Conk	U Sweep
B Butt Rot	H Heart Rot	P Pocket Rot	V Crook
C Star Check	I Pitch Pockets	Q Ring Shake	W Water Shake
D Straight Check	K Knots	R Ring Rot	
E Sun Check	L Hole	S Sap Rot	
F Fire Damage	M Missing Wood	T Twist	

Figure 11.7 Example of a check scale comparison report prepared at the scale site-part 3.

11.6.3.3 Update Scaler File and Records

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

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

11.6.3.4 Second Check Scale

Under the *Scaling Regulation* (Section 15) a scaler whose scale is replaced by a check scale may request a second check scale if they disagree with the check scale. As such, this section provides a recourse for scalers to have a second binding opinion about a scale.

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

Where a second check scale is conducted, it becomes the basis of comparison with the original scale. Unlike a check scale where value is included in the replacement criteria, replacement of an original scale by a second check scale is dependent only upon the volume difference. If the second check scale varies from the original scale by more than the prescribed 3%, the second check scale must replace the original scale and the scaler who requested the second check scale must pay the costs and expenses incurred by the ministry in conducting the second check scale. Where the second check scale is between 0 and 3% of the original scale, the original scale is confirmed and the scaler who requested the second check scale is free of any expenses incurred by the ministry in conducting the second check scale.

11.6.3.5 Second Scales

Unlike a second check scale, which is available to a scaler who disagrees with a check scale that replaces the original scale, a second scale (under Section 77 of the *Forest Act*) is available to anyone with an interest in the scale. If a second scale is undertaken, the basis for comparing the second scale with the original scale is restricted to the volume difference between the scales and value is not considered. If the second scale varies from the original scale by more than the prescribed 3% (high or low) the original scale is replaced by the second scale and the person requesting the second scale is free of any expenses incurred by the ministry in conducting the second scale. If the second scale confirms the original scale (i.e., the original and second scale vary between 0 and 3% by volume) the person requesting the second scale must pay for the costs and expenses incurred by the ministry in conducting the second scale.

Note: When the Ministry of Forests was responsible for conducting scaling, it invoiced the person who requested the scale the costs and expenses of conducting it. When a second scale was requested the person requesting the second scale paid for the second scale. If the second scale resulted in cancellation of the original scale, a credit was issued for the costs and expenses billed for the original scale.

11.6.3.6 Suspension of a Scaling Licence

Under Section 80 (1)(a) of the *Forest Act*, the regional manager or the district manager is authorized to suspend a scaling licence where its holder fails to properly perform their duties or comply with the requirements of the *Forest Act* or applicable regulation(s).

Where this flagrant contravention of scaling requirements the inspecting forest officer should promptly recommend suspension of the scaling licence to the district manager and suspension should proceed without any warning.

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

Where suspensions are made because the scaler lacks expertise, the scaler may be required to pass the licenced scalers examination again before being authorized or appointed to scale again (Section 79 of the *Forest Act*).

11.6.4 Scale Site Inspections

11.6.4.1 Purpose of Scale Site Inspections

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

11.6.4.2 Conducting a Scale Site Inspection

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

Because scaling is conducted under diverse conditions, the format of the inspection varies considerably. Appendix 11.A, for example is a procedure used for inspecting a piece scale site. Figure 11.8 provides an example of a Site Inspection Report.

Another series of checks is required for weight scaling operations:

- check that the monthly return summary is balanced correctly by days and timber marks, and that the total net weight per day on the summary agrees with the total on the daily load inventory,
- check a completed daily load inventory to see that the total gross weight equals the sum of the net and tare weights,
- cross check a few weight scale slip details with the details on the daily load inventory and ensure these agree,
- review the gross, tare and net weights recorded on the daily summary for any abnormalities,
- if feasible, reweigh the most recently weighted truck to ensure weighings are the same,
- check that daily scale section tests are performed and corrective action is taken if applicable,
- check stratification calls using sample scale details where feasible,
- check the frequency and documentation of red tag loads,
- check compliance with weight scale emergency procedures if applicable, and
- check compliance with other conditions defined under the scale site authorization.

Ministry of Forests

SCALING SITE INSPECTION FORM

Page 1 of 2

Site Number: 3FS
Site Name: CHAPUT
Site Type: Weight Piece
File Number:

Inspection Date: 94.02.01
Inspection by: GEORGE MORGAN
Region: KA KAMLOOPS
District: VE VERNON

- 1: Site operating? Y
- 2: Scaler on site? Y
Authorized? Y
- 3: Unauthorized person performing scaling duties? N
- 4: Last scaled parcel retained for check scaling? Y
- 5: All scaled timber marked to signify scaling status as required? Y
- 6: Required scale data on site? Y
Completed correctly? Y
Scale data submitted as required? Y
- 7: Production ledger/site diary current? Y
- 8: Logs spread properly for scaling? Y
- 9: Previously scaled timber being delivered to this site? N
- 10: Scaled timber being removed from this site? Y
To where? 353
- 11: Timber marking requirements being met? Y
- 12: Scaling area free of scaled chunks and pieces? Y
- 13: Check scale done? Y
Reference #: _
- 14: Unscaled timber on site? Y
Estimated volume: 2 LOADS
Scaling of loads being kept current? Y
- 18: Approved scaling procedures being followed? Y
- 19: All loads being numbered upon arrival? Y
- 21: Unauthorized decking of unscaled timber? N
- 22: Mixing of scaled and unscaled timber? N
- 23: Loads flagged/tagged as required? Y
- 26: All timber designated to be scaled at this site? Y
- 29: Area designated for scaling being used for other activities? N

Figure 11.8 Scaling site inspection report - page 1.

Ministry of Forests SCALING SITE INSPECTION FORM Page 2 of 2

Site Number:	3FS	Inspection Date:	94.02.01
Site Name:	CHAPUT	Inspection by:	GEORGE MORGAN
Site Type:	Weight Piece	Region:	KA KAMLOOPS
File Number:		District:	VE VERNON

31: In compliance with all authorization conditions? Y

32: Other documents/ instructions issued? N

34: Final Remarks? N

GEORGE MORGAN

(Forest Officer's Signature)

(Received by)

(Print received by name)

Figure 11.8 Scaling site inspection report - page 2.

11.6.4.3 Actions Upon Completion of a Scale Site Inspection

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

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

Where a site inspection reveals non-compliance with the scale site authorization conditions, always be sure the contraventions are communicated to the site operator and try to resolve them on site before considering any other action.

Appendix 11A Guidelines for Scale Site Inspections at Piece Scale Sites

To ensure thoroughness and to optimize the effectiveness of the actual time spent at the scale site, the inspecting forest officer should have an inspection plan or follow an established routine. Some guidelines should be observed.

11A.1 Before Leaving the Office

An important and often overlooked part of the inspection takes place prior to visiting the site. Before leaving the office, you should check the relevant files and note the following:

- violations - note any recent violation tickets or warnings issued for follow up,
- site authorization - familiarize yourself with site specific conditions (you may wish to print a copy to take for reference),
- previous scale site inspection reports - check for trends, problems, issues (e.g., trim end removal and recording, adherence to timber marking policy, proper completion and maintenance of forms on site),
- clerical problems (e.g., proper completion, submission on time - consult with your scaling clerk),
- scaler authorizations - determine who is authorized to scale and familiarize yourself with any specific special conditions,
- designated marks - run the report off SCS so you know what marks are authorized for the site, and
- timber marking exemptions - check for any in effect and familiarize yourself with the terms, and do the same for any bucking orders, permissions, or restrictions.

11A.2 Upon Arrival at the Scale Site

These checks should be conducted upon arrival:

- check if the most recent load scaled for each scaler is intact and available for check scaling purposes, and
- trucks waiting to be unloaded should be checked for timber marks and load documentation. Any irregularities should be traced back to the origin of the timber.

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

11A.3 Routine Yard Inspection

While on the scale site ensures the following procedures are met:

- check timber marks on incoming timber against the report produced prior to leaving the office,
- check loads for adherence to marking requirements,
- ensure that only authorized persons are scaling and/or assisting with the scaling,
- confirm that any bucking orders, permissions, or restrictions are being complied with,
- check that the scale yard is being cleared of bucking residue, trim ends, and other debris before arriving loads are spread for scaling,
- ensure that the loads are being spread properly, and
- talk to the scalers and determine if they have any problems with the site - try to resolve any problems on site.

11A.4 Previously Scaled Timber Checks

When checking previously scaled timber, ensure the following:

- if there are defined parcels, piles or decks of previously scaled (SB4) timber, check against the corresponding documentation required to be maintained at the scale site and against the controlling conditions written in the site authorization,
- seek an immediate explanation where any apparently unscaled timber is mixed with scaled material. If any doubt exists, a seizure may be in order, and
- check to ensure that scaled timber brands and marine log brands (if applicable) are being used correctly.

11A.5 Scale Data and Forms

When checking scale data and forms, ensure the following:

- ensure that copies of all scale returns, scaler diaries, load slips, site ledgers, and other required documentation are current and accurate, complete, and securely and orderly stored,
- check that scalers are maintaining their tally or raft numbers, and
- if handhelds are in use, check to ensure that the handheld and software are approved. Ensure that the scalers are downloading and/or making hard copies regularly and are complying with the requirements in the site authorization and/or computer approval. Periodically, a set of test data with a known volume and grade profile should be entered into the handheld and the resultant output compared to the accepted results.

11A.6 Before Leaving Site

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

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Glossary of Terms

The following definitions apply in this manual:

Accuracy	how close measurements or estimates are to their actual value or quantity.
Adventitious	used to describe a plant part, means that it develops outside the usual order of time or position, or both (e.g., adventitious branching on trees).
Airdry	the condition at which the moisture content of wood is closely in equilibrium with conditions outdoors, but undercover (usually at about 12% moisture content).
Annual ring	the annual increment of wood (including early-wood and late-wood) which appears on a transverse section (or cross section) of a piece of wood and denoting one year's growth.
Bark	the tissues of a tree outside cambium and is composed of inner living bark and outer dead bark.
Bark Seams	seams of bark extending into or embedded in the log.
Bias	a consistent or systematic distortion of sampling results or measurements arising from an incorrect method of sampling or measurement.
Bole	the trunk of a tree (seeding and saplings have stems, not boles).
Bolt	any short log specially cut to length, usually for the manufacture of a specific product (e.g., shake bolt).
Branch whorl	a more or less circular arrangement of branches around a point on the stem of a tree.

Burl	a hard woody bump on a tree, more or less rounded in form, usually resulting from the entwined growth of a cluster of adventitious buds.
Butt end	the fat end of a log.
Butt log	a log which was originally connected to the stump.
Butt swell	that part of a log outside its normal taper and extending from where the normal taper ends and the flare begins to the large end of the log. It is usually manifest only in butt logs due to the self buttressing growth of the tree near its base.
By the piece	by a count or tally of pieces.
Calipering	to take a diameter measurement at a point on a log other than at an end.
Catface	a defect on the surface of a tree or log resulting from a wound where healing has not re-established the normal cross section.
Check	a lengthwise separation of the wood in a log or piece of timber, which usually extends across the rings of annual growth, commonly resulting from stresses set up in the wood during seasoning.
Chipper	a machine for cutting wood into wood chips, and includes chipper canters, chipper edgers, chipping headrigs, and portable debarker chippers.
Church door fire scar	a defect on the surface of a butt log caused by a ground fire, resulting in a tapered piece of sound wood missing from the butt end of the log.
Coast	for the purpose of scaling, coast is defined as that area of the province where a log based stumpage appraisal is used (generally west of the Cascades).
Coefficient of variation	a measure of variability among units expressed as the ratio of the standard deviation (s) to the mean (x) and is usually expressed by the formula $CV = s/x$.
Collars	the portion of the log between the inside of the bark and a hole or rot in the heart of the log (the same as shells).

Confidence interval	the interval within which the true value of an estimate is said to be with a given probability of the statement being correct (e.g., at 2 confidence intervals there is a 95% [or 19 lines out of 20] probability the estimate will be within ± 2 sampling errors of the true value).
Contraindicators	log characteristics where presence deem the log to be cut from a living tree.
Crook	an abrupt bend or curvature in the length of a log.
Dead side	a misshapen side of a log caused by the lack of growth of wood because of the death or removal of the inner bark, or phloem, along the side of the living tree.
Decay	the decomposition of wood substance cause by the action of wood-destroying fungi, resulting in softening, loss of strength and mass, and often change of texture and colour.
Advanced decay	the late stage of decay in which the decomposition is readily recognized as the wood becomes punky, soft, stringy, pitted, or crumbly.
Butt rot	any decay or rot developing in, and sometimes characteristically confined to, the butt log.
Firm redheart	a form of incipient decay characterized by a reddish colour produced in the heartwood that does not render the wood unfit for the majority of uses. Firm redheart contains none of the white pockets that characterize the more advanced stage of decay (not to be confused with natural red heartwood).
Heart rot	any rot characteristically confined to the heartwood. It generally originates in the living tree.
Honeycomb decay	see Pocket rot.
Incipient decay	the early stage of decay in which the decomposition has not proceeded far enough to soften or otherwise change the hardness of the wood noticeably. It is usually accompanied by a slight discolouration of the wood (see also Firm redheart).

Intermediate decay	a more advanced stage of decay than incipient decay characterized by a change in the colour of the wood and some slight decomposition and loss of strength that do not, however, render the wood unfit for general purposes (see also White specks).
Pocket rot	in wood, any rot localized in small areas, generally forming rounded or lens shaped cavities.
Punky	a soft, weak, often spongy wood condition caused by decay.
Ring rot	any rot localized mainly in the earlywood of the annual rings, giving a concentric pattern of decayed wood in cross section.
Sap rot	any rot characteristically confined to the sapwood.
White specks	the intermediate stage of <i>Fomes pini</i> decay, characterized by small white pits or streaks in the wood.
Defect	any abnormality or irregularity which lowers the commercial value of wood. Typically defects may reduce a log's firmwood volume and/or log grade.
Diameter breast height (DBH)	<p>the stem diameter of a tree measured outside bark at breast height (1.30 m above ground level).</p> <p>DBH is used for standing trees, usually in the context of cruise data. The minimum butt diameter is usually used in the context of utilization standards.</p>
Diameter, small end	the average diameter, inside bark, at the upper end of the log.
Diameter tape	a tape measure specially graduated so that the diameter may be read directly when the tape is placed round a tree stem, bole, or piece of roundwood.
Diameter deduction	a method of compensating for through-running firmwood defects by reducing the recorded radius or radii of a log or slab.

Dryland sorts	flat areas, usually paved where loads of logs are lifted out of the water or off loaded from logging trucks and spread onto the ground for scaling, grading and subsequent sorting.
Earlywood	that part of the growth ring which is produced at the beginning of the growing season (usually it is less dense and lighter in colour than late wood). It is also called springwood.
Estimate (of a sample)	a value for a characteristic or parameter derived through using a sampling method.
Face (of a pile)	one of the surfaces of a pile of logs showing only the cut ends of the logs.
Figure	any design or distinctive markings on the long surfaces of wood.
Fire scar	a healing or healed-over injury, caused or aggravated by fire, on a woody plant.
Firmwood deductions	deductions made from the gross volume of a log to account for rot, hole, char and missing wood.
Flare	a rapid increase in the taper of a log at the butt end of the log due to swell.
Foreign material	any material extraneous to roundwood such as earth, ice, snow, and branches, any of which add mass to the load.
Forest	a plant community consisting predominantly of trees and other wood vegetation, growing together.
Fork	a division of a log or a stem of a tree into two or more branches.
Fuelwood	roundwood, whole or split, produced for burning.
Grade deduction	in log grading, the process of determining the portion of the log not suitable for the manufacture of various products.
Grain	the general direction of the longitudinal wood elements in the tree.

Grain density	used in some log grading, refers to the spacing between the annual rings and measured as a ring count over a set distance.
Gross weight	the weight of a load before any deduction for moisture content and, when present, bark, defect, and foreign material.
Gross oven dry weight	the gross weight (or mass) of wood, bark, and defect less their moisture content.
Gross volume	total inside bark volume and includes any defects.
Hardwoods	trees of the botanical group Angiospermae that generally have broad leaves in contrast to the conifers. The term has no reference to the actual hardness of the wood.
Heart	see Heartwood.
Heart shake	a shake that originates at the pith of a log and extends across the annual rings (also called heart check and reft crack).
Heartwood	the inner core of a woody stem wholly composed of non-living cells and usually differentiated from the outer enveloping layer (sapwood) by its darker colour. It is usually more decay resistant than sapwood.
Hole	any opening in a log, other than check, shake, or split. It may extend partially or entirely through a log and be from any cause.
Bird holes	holes and damage caused by woodpeckers and other species of birds.
Borer holes	voids made by wood-boring insects or worms.
Insect holes	voids made by insects or insect larvae.
Worm holes	see Borer holes.
Interior	for the purpose of scaling, interior is defined as the area where a lumber based stumpage appraisal is used (generally east of the Cascades).
Knot	a branch base that is embedded in the wood of a log.

Latewood	the denser, smaller-celled, usually darker, later formed part of an annual ring, also called summerwood.
Length deduction	a method of compensation for firmwood defects by reducing the recorded length of a log or slab.
Linear measure	a measure of length.
Local volume table	a table showing, for one or more species, the average cubic contents for tree lengths by diameter classes, within a smaller geographic region.
Log	any section of the bole, or of the thicker branches, of a felled tree, after trimming and cross cutting.
Log rule	a table showing the estimated or calculated volume of wood that is contained in logs of given length, form, and end diameter inside bark.
Mass	the same as the weight.
Mean	the average of a set of measurements derived by summing all values and dividing by the total number of measurements.
Minimum butt diameter	the smallest diameter, inside bark, that can be measured through the geometric centre of the large end of a log with visible butt swell.
Minimum collar thickness	same as minimum shell thickness. The collar of firmwood surrounding heart defects considered in grading to be the minimum thickness for the manufacture of lumber.
Missing wood	wood that is absent from a log or part of a log that otherwise would usually be regarded as naturally complete. It may be caused by advanced decay, fire, or the operation of a machine to tool.
Moisture content	the mass of water in wood expressed as a percentage of its total weight.
Mould or mildew	a superficial fungal growth usually appearing in the form of a woolly or furry coating of varying colour.

Net firmwood volume	the volume remaining after all allowable firmwood deductions for defects from gross volume have been made; in stacked measure, deductions include voids.
Normal taper	the regular decrease in diameter of a log from its large to small end, exclusive of butt swell.
Out of round	used to describe a shape and means that it departs from what is usually regarded as approximately circular.
Outside checks	checks or fractures on the outside part of the log which extend through the bark into the adjacent sapwood. Severe checking will extend into the heartwood.
Oven dry weight	the weight of wood obtained by drying it in an oven at 105° C until there is no further weight loss.
Parameters	certain constants, characterizing a population or a whole, to be studied in a survey.
Parcel	any quantity of grouped logs.
Peeled	all or most of the bark has been removed.
Piece	a part of a whole (as of a tree); it also means an object regarded as a unit of a kind (as one of a number of products of the group).
Piece product	a product scaled by the number of separate pieces of one kind.
Piece scale	the scaling method whereby each piece is scale by recording the timber mark, species and by taking its length, top and butt diameter, deducting for firmwood defects, and assigning a grade.
Pile	for scaling purposes, an orderly arrangement of logs that are longer than the 2.6 m class.
Pile divider	in tree-length scaling, the surface formed by butt ends that have been piled with the butts all aligned in a nearly vertical plane.
Pipe	a hole, the product of decay, running through the centre of a log.

Pistol grip	a pronounced bend at the butt end of a log and resembling the handle of a pistol.
Pith	the small cylinder of primary tissue of a tree stem around which the annual rings form.
Pocket rot	see Decay.
Population	the aggregate of all units from which samples are selected to make estimates about the aggregate.
Precision	the closeness, to each other of repeated measures of the same quantity. When precision is achieved, values will be clustered around their mean.
Probability statement	a statement that gives a range of a characteristic within which the true value lies, with a stated probability that the statement is correct (e.g., there is a 95% probability that value X will be within 2 sampling errors of the actual value).
Punky	see Decay.
Pulpwood	wood cut and prepared primarily for manufacture into wood pulp.
Quality considerations	in log grading, the factors which reduce the log's quality in terms of its potential product recovery and is usually confined to the size and placement of knots and the degree of any twist observed on the log.
Ring shake	a shake that partially or completely encircles the pith.
Rot	see Decay.
Round (adjective)	approximately correct; of an approximate circular cross section.
Round (transitive verb)	to express as a round number.

Rounding	the process of approximating to a number by omitting certain of the end digits, replacing by zeros if necessary, and adjusting the last digit retained so that the resulting approximation is as near as possible to the original number. If the last digit is increased by unity, the number is said to be rounded up; if decreased by unity, it is rounded down. When both are under consideration, the process is said to be one of rounding off.
Roundwood	any section of the stem, or of the thicker branches, of a tree of commercial value that has been felled or cut but has not been processed beyond removing the limbs or bark, or both, or splitting the section (for fuelwood).
Sample	a unit or part selected from a population that is representative of that population.
Sample scaling	the method of scaling where only a portion of the total production is piece scaled. Weight scaling is the most prominent example of sample scaling. Sample scaling is also used to scale some special forest products.
Sample size	the number of samples to be taken to sample the population to meet the sampling objectives.
Sampling error	a statistic which defines how reliable (or precise) sampling results are (the same as the standard error of the estimate, or the standard error of the mean and the standard error).
Sapwood	the living wood of pale colour near the outside of the log. Under most conditions the sapwood is more susceptible to decay than heartwood.
Scale (noun)	the measured or estimated quantity, expressed as the volume, or area, or length, or mass, or number of products obtained from trees and measured or estimated after they are felled.
Scale (verb)	to measure or estimate the quantity, expressed as the volume, or area, or length, or mass, or number of products obtained from trees after they are felled.
Scaler	a person who is licenced or appointed to scale timber under the <i>Forest Act</i> .
Scales	an instrument or machine for determining weight.

Scale stick	a graduated stick for measuring the end diameters of logs or felled trees inside bark. Of many types, it usually has a shaped handle on one of its ends, a tine at the other, and a log rule reproduced on its length; it also means a graduated stick for measuring the external dimensions of stacked wood.
Schedule of Coast Timber Grades	the set of coast grade rules appended to the <i>Scaling Regulation</i> .
Schedule of Interior Timber Grades	the set of interior grade rules appended to the <i>Scaling Regulation</i> .
Segregated tally	a tally sheet that is segregated into sections for timber with the same species and grade. It can be used as an input document into the Harvest Data Base system (HDBS) to generate an invoice.
Shake	a separation along the grain of a log or tree and occurring between or across the annual rings but not extending from one surface to another.
Shells	see Collars.
SI units	only the base, supplementary, and derived units of measure included within the International System of Units (SI) (see CSA Standard CAN3-Z234.2).
Significant digit	any digit that is necessary to define the specific quantity or value.
Slab	a piece of timber that has fractured along a plane roughly parallel to the longitudinal axis of the original log.
Softwood	generally, one of the botanical groups of trees that in most cases have needle- or scale-like leaves; the conifers; also the wood produced by such trees. The term has no reference to the actual hardness of the wood.
Solidwood Equivalent	the firmwood volume of logs required to produce a given quantity of a specified product.
Sound wood	wood free from defect.

Special Forest Products and Special Forest Products Regulation	as defined under the Forest Act to include: poles, post, pilings, shakes, shingle, bolts, Christmas trees, building logs, mining timbers, props and caps, cribbing, firewood and fuel logs, hop poles, orchard props, car stakes, round stakes, sticks and pickets, split stakes, pickets, palings and logging, shake bolts, blocks, and blanks and shingle blocks.
Spiral grain	see Twist.
Split	cleft completely and lengthwise along the grain of a log.
Springwood	see Earlywood.
Stack	for scaling purposes, an orderly arrangement of bolts less than or equal to the 2.6 m class in length.
Stacked cubic metre (symbol m^3 [stacked])	the total amount of wood, bark, and airspace contained in a stack of roundwood, as determined by its external dimensions, equal to 1 m^3 .
Stacked cubic metre peeled (symbol m^3 [stacked] peeled)	the total amount of wood and airspace contained in a stack of peeled roundwood, as determined by its external dimensions, equal to 1 m^3 .
Stacked scaling	the act or process of measuring or estimating the total amount of wood, bark, and airspace contained in a stack of roundwood, where the bolt length is less than or equal to the 2.6 m class as determined by its external dimensions.
Standard deviation	the square root of the variance. It is symbolized by s .
Stem	the principle axis of a plant, from which buds and shoots develop.
Stratum	a subdivision of the entire population.
Sweep	a gradual curve in the length of a log, as distinct from an abrupt bend or curvature.
Tally	a form completed by a scaler used to capture timber details such as timber marks, species, grade, volume, products, and dimensions. It also identifies the time and place of scale, as well as who the ownership timber is scaled for. It is used as a basis for stumpage collection.

Tally number	also called a raft or return number. It is a unique number (in conjunction with the scaler's licence number and date), and is assigned to a parcel of timber by a scaler. The scaler assigns #001 to the first parcel scaled each year and continues consecutively through to 999. If the scaler scales more than 999 parcels of timber in a year they then restart with 001. The dates will then determine the uniqueness of the number.
Taper	the progressive decrease or increase in the diameter of a log from one end or point on its length to another.
Tare	the weight of the unloaded vehicle or container.
Tier	one of a set of layers or rows arranged one above another.
Tolerance	the total range of variation permitted for a required size.
Tracheid	an imperforate wood cell with bordered pits to congeneric elements.
Tree	a woody perennial plant, typically large and with a single well-defined stem carrying a more or less definite crown.
Tree length	the trimmed bole of a tree that has been felled and had the top removed.
Trim allowance	the sound wood surrounding rot and other defects made in grade deductions to account for loss in lumber recovery because defects must be squared out by a sawyer.
Trunk	see Bole.
Twist	a quality consideration in log grading where the logs grain is aligned in a helical orientation around the axis of the log. It is the same as spiral grain and its measurement is often referred to as the slope of grain.
Unsegregated tally	a tally that is used to scale timber in the order it is spread out for scaling. There are no species and grade segregations, therefore, it cannot be used as an input document for the HBS. It must be summarized and segregated through a pre-processing system prior to input into the HBS to generate an invoice.

Variable	a characteristic of a population that may vary from one unit to another.
Continuous variable	a variable that is characterized by being related to some numerical scale of measurement, any interval of which may, if desired, be subdivided into an infinite number of values, such as length, height, volume, and mass.
Discrete variable	a qualitative variable represented by an integral value or ratio of integral values, such as number of logs in a stacked cubic metre, that cannot be expressed as a proportion. By increasing the number of values that a discrete variable can assume, it is often possible to handle such data by continuous variable methods.
Variance (of a population)	a measure of the dispersion of individual unit values about their mean.
Vessel	an axial series of cells that have coalesced to form an articulated tube-like structure of indeterminate length; the pits of congeneric elements are bordered.
Void	an unnecessary airspace in a stack of roundwood, large enough to accommodate the average size of log or bolt in the stack.
Weigh	to measure the weight of an object.
Weighing machine	any device for measuring weight (or mass).
Weight	a measure of the force of gravity (or heaviness).
Wood	the hard fibrous substance, basically xylem, that makes up the greater part of the stems and branches of trees or shrubs, beneath the bark.
Wood fibres	any long, narrow cells of xylem, other than vessel elements or parenchyma; it also means (as a loose term) wood elements in general.
Wood chip	a small, thin, flat piece of wood cut from a larger piece of wood by knife action, mechanically operated. A wood chip must show two knife cuts and its width must be greater than its thickness.

Wood Chips	as a collective term, the total material that is produced from passing wood fibre through a chipper. Unless specified otherwise, the wood fibres being subjected to the chipping process must have passed through a debarking procedure.
Wood pulp	wood fibres separated by mechanical means for use in manufacturing paper, textiles, and many other products derived from cellulose.
Worm holes	voids (or holes) made by insects or insect larvae.
Xylem	the woody part of the tree which functions chiefly in conduction but also in support and storage.

