NOVA SCOTIA SCALING MANUAL

2nd Edition

October 2007

Nova Scotia Scaling Manual

2nd Edition

October 2007

Department of Natural Resources
Renewable Resources Branch
Forestry Division

TABLE OF CONTENTS

APPENDICES

FIGURES

TABLES

FOREWORD

This Scaling Manual provides instruction for the measurement of primary wood products in Nova Scotia. These manuals will be revised, improved and updated periodically to reflect changes brought on by industry and technology. Revisions will be made through consultation with representatives from the pulpwood sector, sawmill sector, small private land tenure sector, Department of Natural Resources and technical committees.

1. AUTHORITY

1.1 Authority Recognized Under Act

Authority to produce this Scaling Manual describing the methods of measuring primary wood products in Nova Scotia is contained in Chapter 11 of the Acts of 2001, the Scalers Act.

The Scalers Act can be found in Appendix I.

1.2 Supervisor to Prepare Manual

Subject to the approval of the Board, the Supervisor of Scaling shall prepare, and amend as required from time to time, in accordance with subsection (2), a scaling manual.

1.3 Contents of Manual

The Scaling Manual may set out:

(i) the qualifications necessary for each type of scaling license;

(ii) how examinations will be conducted, listing the pass requirements in written and practical scaling examinations and species identification;

(iii) the terms and conditions of scaling licenses;

(iv) the acceptable units of measure;

(v) the duties of licensed scalers;

(vi) scaling standards and procedures for the scaling of primary wood products in the Province;

(vii) the mathematical factors to be used to convert the volume or mass of primary wood products from one common unit of measure to another common unit of measure;

(viii) methods of settling scaling disputes;

(ix) such other information as the Board deems pertinent to scaling.

1.4 Compliancy to Manual

Every scaler shall comply with the provisions of the scaling manual.

1.5 Regulations

The Governor in Council may make regulations:

(i) authorizing the Board to exempt applicants from licensing requirements;

(ii) authorizing the Minister to set the conditions for licensing;

(iii) authorizing the Minister to prescribe the fees for each type of license or examination;

(iv) authorizing the Supervisor of Scaling and the Board to investigate and hear complaints regarding scalers or scales;

(v) authorizing the Minister to suspend or revoke a license and set conditions for re-application for a license;

(vi) authorizing the Minister to require licensed scalers to keep books and records and to prepare returns as directed by the Minister;

(vii) defining any word or expression used but not defined in this Act;

(viii) respecting any matter the Governor in Council deems necessary or advisable to carry out effectively the intent and purpose of this Act.

The exercise by the Governor in Council of the authority contained in subsection (1) is regulations within the meaning of the Regulations Act.

The Scaling Regulations can be found in Appendix II.

Portions of this Scaling Manual have been extracted from a publication “Scaling Roundwood” and “Measurement of Woodchips, Tree Residues, and Byproducts” prepared by the Canadian Standards Association (O302.1-00/O302.2-00). The Department of Natural Resources acknowledges with gratitude the C.S.A. for the use of its materials in production of this publication.

2. DEFINITIONS

2.1 The following definitions apply in this Scaling Manual:

(i) "Act" means the Scalers Act, Chapter 11 of the Acts of 2001;

(ii) "active scaling license" means the status of a license issued to a scaler who has attended the requisite scaling and refresher courses and passed the required examinations;

(iii) "Board" means Board of Examiners appointed under the Act;

(iv) "Department" means Department of Natural Resources;

(v) "enforcement officer" means a person designated as a conservation officer under the Crown Lands Act, the Forests Act or the Wildlife Act, a regional, municipal or town police officer, a member of the Royal Canadian Mounted Police or a person designated under this Act;

(vi) "cord" means 128 cubic feet of stacked roundwood (whole or split, with or without bark) containing wood and airspace with all bolts of similar length piled in a regular manner with their longitudinal axis approximately parallel;

(vii) "license" means a license issued under the Act;

(viii) "Minister" means the Minister of Natural Resources;

(ix) "primary wood products" means any commercially valuable raw material, consisting essentially of xylem, obtained from the stems or limbs of a felled or cut tree, including, but not limited to, roundwood and woodchips;

(x) "stacked wood" means primary wood products measured collectively;

(xi) "pulpwood" means wood cut and prepared primarily for processing into wood pulp;

(xii) "roundwood" means 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 a section for fuelwood;

(xiii) "scale" means to measure or estimate the quantity, expressed as the volume, area, length, mass, or number of products obtained from trees after they are felled;

(xiv) “scaler” means a person qualified to scale primary wood products who is licensed under this Act;

(xv) “Scaling Manual” means the manual prepared by the Supervisor of Scaling pursuant to this Act;

(xvi) “stacked cubic metre” symbolized: m^3 (stacked) means one cubic metre of stacked roundwood (whole or split with or without bark) containing wood and airspace with all bolts of similar length piled in a regular manner with their longitudinal axis approximately parallel;

(xvii) “Supervisor of Scaling” means the person appointed by the Minister to supervise scaling practices in the Province;

(xviii) “Weights and Measures Act” means Chapter 36 of the Statutes of Canada, 1970-71-72, as amended and administered by the Weights and Measures Division of the Department of Consumer and Corporate Affairs.

2.2 Definitions of other Forestry Terms

Unless defined otherwise in this Scaling Manual, definitions of other forestry terms shall be as shown in C.S.A. Standard “O302.1/O302.2 Scaling Roundwood / Measurement of Woodchips, Tree Residues and Byproducts (hereafter referred to as the C.S.A. Standard “Scaling Roundwood”).

3. BOARD OF EXAMINERS (SCALING)

3.1 Nature of Board and Responsibilities

(i) The Governor in Council may appoint a Board of Examiners consisting of four persons.

(ii) One member of the Board shall be appointed from the sawmill sector of the forest industry, one member from the pulpwood sector of the forest industry, one member from the small private land tenure sector who does not operate a sawmill or pulpmill and one member from the Department.

(iii) The members of the Board from the sawmill sector and the pulpwood sector must be or represent registered buyers, as defined in the Forests Act and regulations.

(iv) The member of the Board appointed from the Department is the Chair of the Board.

(v) The Board shall determine the qualifications of candidates for licenses as scalers and shall perform such other duties as the Minister prescribes.

(vi) The Chair and two other members of the Board constitute a quorum.

(vii) The members of the Board shall be paid such remuneration and be reimbursed for such reasonable expenses as determined by the Governor in Council.

(viii) The Supervisor of Scaling and one other employee of the Department, in addition to the Department member appointed as a member of the Board, shall act as advisers to the Board.

4. LICENSES

4.1 Need for a License

Section 8(1) of the Act states that subject to subsections (3) and (5), no person shall be employed as a scaler or act as a scaler unless that person holds an active scaling license.

Section 8(2) of the Act states that an individual or organization involved in the scaling of primary wood products, other than the weighing only of those products, in quantities exceeding one thousand cubic metres per year shall use the services of a licensed scaler to scale those products.

4.2 Exceptions

A scaling license is not required

(i) if a person or organization is involved in the measurement of primary wood products in quantities less than one thousand cubic metres per year;

(ii) to count or grade Christmas trees; or

(iii) to fulfill the practical requirements of a novice scaler under the supervision of a licensed scaler.

(iv) to weigh primary wood products if no conversions, deductions or quality assessments are made on the weighed primary wood products.

4.3 Grandfather Clause

A person who holds a license pursuant to Chapter 411 of the Revised Statutes, 1989, the Scalers Act, on the coming into force of this Act shall be granted a license pursuant to section 7(1) to carry out the activities referred to in clauses (a), (b), and (c), whichever license is equivalent to the license held by that person on the coming into force of this Section.

4.4 Types of Licenses

Pursuant to Section 7 (1) of the Act, the Minister shall issue to any person so recommended by the Board:

(i) A **Stacked Wood License**, which authorizes a scaler to scale primary wood products measured collectively, including making deductions;

(ii) A **Log Scaling License** which authorizes a scaler to scale primary wood products measured individually;

(iii) A **Primary Wood Products Scaling License** which authorizes a scaler to scale all primary wood products.

4.5 Pass Requirements for Stacked Wood Scaling License

The pass requirement for each type of scalers license shall be as follows:

(i) A mark of 60 or more on the written pulpwood exam.

(ii) Come within ± 7.0% of a check scale on a field test of pulpwood scaling.

(iii) Correctly identify the species of 75 or more of the logs on a field test of 100 logs.

(iv) Scale 500 cords or more of stacked wood under the apprenticeship of an Active Licensed Scaler. Scaling experience may be obtained either before or two years after writing the exams. An equivalent volume measured in metric (SI) units, 1812 m^3 (stacked) is acceptable for scaling experience.

(v) A person having passed the written exam and field tests, but not having obtained the required scaling experience within the allotted two years, may complete a refresher course to reinstate the candidate for another two years in which to complete their compulsory experience.

(vi) Have a recommendation for a Pulpwood Scaling License from an Active Licensed Scaler. A recommendation from the employer of a scaling candidate may be accepted at the discretion of the Board.

NOTE: The figures underlined above (60, ±7.0%, 75, 500, 1812) are subject to revision at the discretion of the Board.

4.6 Pass Requirements for Log Scaling License

(i) A mark of 60 or more on the written log scaling exam.

(ii) Come within ± 10.0% of a check scale on a field test of log scaling.

(iii) Correctly identify the species of 75 or more of the logs on a field test of 100 logs.

(iv) Scale the volumes and mass of sawlogs as outlined in Table 1 under the apprenticeship of an Active Licensed Scaler. Scaling experience may be obtained either before or within two years after writing the exam.

Table 1. Acceptable experience for obtaining a sawlog license.

Volume		Plus	*Mass
fbm	or m^3		tonnes
200 000	1133	+	----
175 000	991	+	500
150 000	850	+	1000
125 000	708	+	1500
100 000	566	+	2000

*Deductions for non-conforming materials must be made (ie. weigh only can not be used).

(v) Have a recommendation for a Log Scaling License from an Active Licensed Scaler. A recommendation from the employer of a scaling candidate may be accepted at the discretion of the Board.

NOTE: The figures underlined above (60, ±10%, 75, 200,000, 1 133) as well as those included in Table 1 are subject to revision at the discretion of the Board.

4.7 Primary Wood Products Scaling License

A scaler must fulfill all the requirements for both Stacked Wood and Sawlogs as outlined above to qualify for a Primary Wood Products Scaling License.

4.8 Special Authorization

The Supervisor of Scaling may issue a special authorization to a person competent in scaling, authorizing the person to act as a scaler, but the special authorization is valid only until the first day of the next scheduled scaler licensing course.

4.9 Persons Holding Scaling Licenses from Other Provinces or Territories

The Board may recommend that above provisions be waived if a candidate holds a valid scalers license from another province, has sufficient work experience and is reasonably familiar with the provisions of the Act, regulations and scaling manual, and successfully completes a refresher course.

4.10 Examination Procedure

The Supervisor of Scaling shall:

(i) ensure that scaling courses for new scalers and refresher courses for licensed scalers are held as required.

(ii) set the standards for scaling course curricula and examinations;

(iii) oversee and monitor all scaling examination processes to ensure standards are consistently adhered to;

(iv) present examination results to the Board;

4.11 Fees

Section 12(1)(c) of the Act states that the Governor in Council may make regulations authorizing the Minister to prescribe the fees for each type of license or examination.

Fees for Scaling School and Scaling Refresher shall be paid in advance of the date of the opening of the scaling school. Total fee may be forfeited if the candidate does not attend the scaling school without a reason found to be acceptable by the Supervisor of Scaling.

4.12 Duration of License

A scaler will be considered to be an Active Licensed Scaler for a period of five (5) years from the last day of attendance by that person at the scaling school organized by the Supervisor of Scaling.

To be considered an Active Licensed Scaler beyond that date, a scaler must attend and successfully complete a refresher course on scaling conducted by the Department.

Successful completion of one of these refresher courses will reinstate the scaler as an Active Licensed Scaler for a further five (5) year period from the last day of attendance at a refresher course.

A person having passed the written exam and field tests, but not having obtained the required scaling experience within the allotted two years, may complete a refresher course to reinstate the candidate for another two years in which to complete their compulsory experience.

4.13 Lists of Licensed Scalers

The Supervisor of Scaling will maintain two separate lists of licensed scalers:

(i) A master list of all scalers who have been issued scalers licenses. This list will show name, last known address, year of graduation from scaling school and type of license.

(ii) A current list of Active Licensed Scalers who have attended scaling school for the initial course or a refresher course and completed the same to the satisfaction of the Board. This list will show name, address, year of last course attended and type of license.

5. DUTIES OF SCALERS

5.1 Description of Duties

The scaler shall perform the duties listed below:

(i) scale fairly and correctly all primary wood products that the scaler is employed and licensed to scale making such deductions as are necessary to allow for defect.

(ii) become familiar with any new techniques or measurement units that may have been developed since the scaler was licensed.

(iii) know the conditions and specifications of sale or purchase for any primary wood products the scaler is required to scale.

(iv) be able to identify the commercially valuable tree species in log or bolt form common to the area in which the scaler is employed.

(v) know the tree symbols of species common to the area in which the scaler is employed as outlined in the CSA Standard “Scaling Roundwood” and included in Appendix III.

(vi) ensure that all scaling instruments and tapes the scaler is using are properly calibrated as prescribed in the Weights and Measures Act and as set out in this manual.

(vii) supervise and instruct an assistant working under the scaler’s supervision.

(viii) be responsible for work done by an assistant under the scaler’s supervision.

(ix) successfully complete any necessary refresher course to keep a scaling license updated.

5.2 Scaling Records and Books

Every licensed scaler shall keep such books (tally cards, scale slips, computer printouts, etc.) showing date, location, species, gross scale, deductions, net scale, scaler’s name and scaler’s license number. These shall be open for inspection by the Minister or any officer or agent of the Minister and copies of the same and other relevant information shall be made available when requested by the Minister or any officer or agent of the Minister.

The Minister may suspend or revoke the license of any scaler who fails to comply with subsection (1).

6. DISCIPLINE

6.1 Handling of Complaints

All complaints regarding scaling shall be directed to the Supervisor of Scaling.

When a written complaint is submitted to the Supervisor of Scaling, the supervisor shall conduct an investigation and document all findings, which shall be open to inspection by the parties affected and advise the parties in writing what options are recommended for consideration by the complainant(s) and what action will be taken by the Supervisor.

The Supervisor may request that the Board be convened to:

(i) review the results of a complaint investigation carried out by the Supervisor of Scaling; and

(ii) make a recommendation to the Minister to suspend or revoke a license.

A recommendation by the Board made pursuant to subsection 7 (3) of the Scaling Regulations shall be in writing and a copy shall be served upon the scaler involved.

6.2 Revocation or Suspension of License

The Minister may suspend or revoke a license upon the recommendation of the Board by serving a notice on the scaler involved.

A notice of license revocation or suspension may be published in such a manner as the Minister considers necessary.

A person whose license has been revoked shall not be eligible for reinstatement as a licensed scaler until a period as dictated by the Minister has elapsed since the date of revocation of the license and the person has successfully completed a scaling refresher course.

A person whose license has been suspended shall not be eligible for reinstatement as a licensed scaler until a period as dictated by the Minister has elapsed since the date of suspension of the license and the person has demonstrated to the satisfaction of the Supervisor of Scaling that the person possesses the necessary scaling skills in accordance with the scaling manual.

A person whose license has been revoked or suspended may appeal to the Appeal Division of the Supreme Court of Nova Scotia within 30 days from the date the notice of license revocation or suspension was served on the person.

7. UNITS OF MEASURE

7.1 Units of Measure for Logs

(a) Logs shall be volume scaled in:

(i) board feet as determined from the New Brunswick Log Rule or “Rule of Thumb” as outlined in this manual.

(ii) cubic metres

(iii) a unit of measure agreeable to both the supplier and buyer pending written approval from the Supervisor of Scaling.

(b) Weighed on a weighing machine that conforms to the Weights & Measures Act and regulations and recorded in kilograms or metric tonnes.

7.2 Units of Measure for Stacked Wood

(a) Stacked Wood shall be volume scaled in:

(i) cords or

(ii) stacked cubic metres, or

(b) Weighed on a weighing machine that conforms to the Weights & Measures Act and regulations and recorded in kilograms or metric tonnes.

7.3 Units of Measure for Tree Length Softwood or Hardwood

Weighed on a weighing machine that conforms to the Weights & Measures Act and regulations and recorded in kilograms or metric tonnes.

7.4 Poles and Pilings

Poles and pilings shall be scaled according to the specifications of the purchaser or if no specifications are provided, according to the specifications as determined by the Canadian Standards Association.

7.5 Other Primary Wood Products

Other primary wood products not covered by the above methods shall be scaled in the unit shown in the purchaser's specification.

7.6 Conversion Factors

General conversion factors from Canadian Yard/Pound Units to Metric are located in Appendix IV.

7.7 Rounding Rules

Rules for Rounding Numbers are located in Appendix V.

7.8 Scaling Equipment Requirements

Instruments shall conform to the requirements outlined in the Weights and Measures Act and Regulations which may be amended from time to time.

Maximum permissible deviation from true measurement indicated for the boundaries of 2 cm diameter classes shall be 1 mm.

Maximum permissible deviation from true measurement indicated for 0.2 m graduations shall be 2 mm.

No scaler shall use a metal or woven tape that exceeds the limits of error shown in Appendix VI.

8. PILING OF PRIMARY WOOD PRODUCTS

8.1 General Requirements

The following general piling and marking requirements for primary wood products that are to be scaled may, at the discretion of the scaler and with the approval of his immediate supervisor, be adopted to suit local requirements.

Logs or stacked wood shall not be piled on ice and shall be piled beyond the reach of rising waters of lakes or streams.

Logs and stacked wood shall be piled on firm ground.

There shall be a clearance of not less than 1m (one metre) on all sides of piles of logs or stacked wood.

When logs are to be scaled in piles, the correct length shall be clearly marked on the small end.

The small end of each log to be scaled in a pile shall be so positioned as to be visible and measurable.

Primary wood products with different stumpage rates shall be piled separately according to the terms of the agreement of cutting contract.

If sound primary wood products are used as skids or bedlogs, their volumes shall be determined by measurement or estimation and included in the scale.

If primary wood products are to be scaled in stacked measure, hardwood and softwood species shall be piled separately.

Different hardwood species to be scaled in stacked measure shall be piled together or separated according to the terms of the agreement or cutting contract.

Different softwood species to be scaled in stacked measure shall be piled together or separated according to the terms of the agreement or cutting contract.

9. RESCALE (PRIVATE LANDS)

9.1 Request for Rescale

When a party having a vested interest in a quantity of primary wood products is not in agreement with or disputes the first scale results, either party may request a rescale. This situation could occur when a transaction takes place between private individuals.

All requests for a rescale and the results shall be reported to the Supervisor of Scaling.

9.2 Conditions of Rescale

A rescale shall be conducted by a mutually acceptable independent Active Licensed Scaler who will arbitrate the dispute.

If a rescale is to be conducted, the primary wood products whose volume is in dispute shall be available for rescale at the place and in the form in which it was originally scaled. The wood shall not be re-piled or rearranged in any manner before the rescale is conducted. This condition may be waived with the consent of both parties. However, if the wood is re-piled or rearranged the original scaler will not be held responsible for any discrepancy in scale.

The rescale shall be made using the same specifications and instructions issued for the original scale.

If in the opinion of the arbitrating scaler the first scale is within acceptable limits, the original scale shall be accepted as final and binding.

If in the opinion of the arbitrating scaler the first scale is within acceptable limits, the party requesting the rescale shall be responsible for all costs of rescale.

If in the opinion of the arbitrating scaler the first scale is not within acceptable limits, the party responsible for conducting the original (first) scale shall be responsible for all costs of the rescale and the rescale shall be accepted as final and binding.

A rescale and the resulting responsibility may be waived if the disputing parties reach an agreement prior to rescale.

9.3 Acceptable Limits for Rescale

The quality and preparation of harvested wood along with the manner in which it is piled can contribute to the accuracy in which it can be scaled. For the purpose of arbitrating rescales the limits outlined in Table 2 will be considered acceptable. These limits take into consideration the average quality and conditions encountered when scaling these products. When poor piling or preparation exists the arbitrating scaler may waive these limits.

Table 2. Limits of error for rescale.

Product	Limit
Studwood, Palletwood	+ or - 3%
Softwood Pulpwood	+ or - 4%
Sawlogs, Hardwood Pulpwood, Fuelwood or Other	+ or - 5%

10. SCALING LOGS - BOARD FOOT

10.1 Lineal Feet

Lineal feet refers to length. The term length is generally used when speaking of the length of one log or piece of lumber. The term lineal feet (see Figure 1) is generally used when referring to the total length of several pieces and may refer to either logs or lumber.

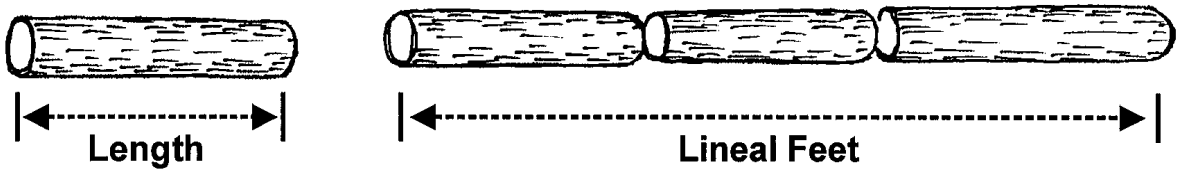


Figure 1. *Length and lineal feet.*

10.2 Superficial Feet

Superficial feet refers to square foot coverage (also known as surface measure). In computing superficial feet, thickness is not considered. There are the same number of superficial feet in a piece of lumber 1" x 6" x 10' long as there are a piece of lumber 3" x 6" x 10' long.

(i) Superficial Feet = L' x W' or L' x W"/12

(ii) The formula for superficial feet (L' x W') would normally be used in such cases as computing the superficial feet in the floor of a building.

(iii) The formula for superficial feet (L' x W"/12) would be used in computing superficial feet in one or several pieces of lumber where the width is normally expressed in inches and the length in feet. Superficial feet is computed on the wider face unless otherwise specified.

10.3 Board Feet

The term Board Feet is used in two different contexts:

(i) Lumber and (ii) Log Scaling.

(i) Board Feet - Lumber - A board foot is a piece of lumber 1' long, 12" wide and 1" thick or an equivalent volume of lumber (see Figure 2). The formula is expressed in this form because length of lumber is usually measured in feet and the width and thickness is measured in inches.

The formula for computing board feet of lumber is as follows:

$$\frac{L' \times W'' \times T''}{12}$$

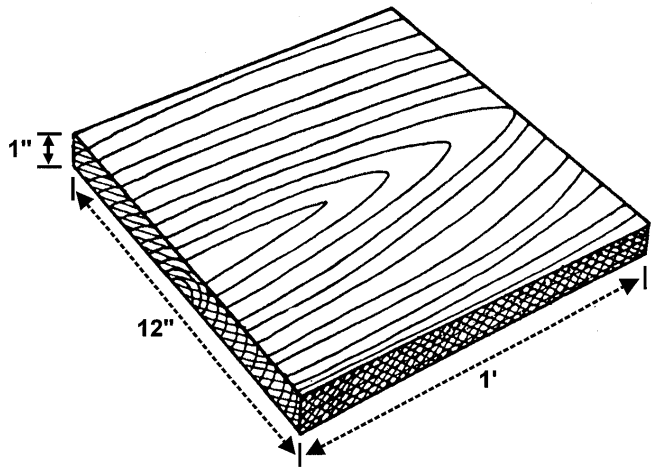


Figure 2. *A board foot of lumber.*

(ii) Board Feet - Log Scaling - Board Feet is also used in log scaling. In this context it refers to the number of board feet of lumber that can be recovered from a log(s) of given dimensions under a fixed set of conditions. There are 12 board feet in a cubic foot of lumber (see Figure 3). However, a cubic foot in the form of round log will only yield about five or six board feet of lumber because you are manufacturing a rectangular object from a circular one. The balance of the log will be contained in slabs, edgings (or woodchips) and sawdust.

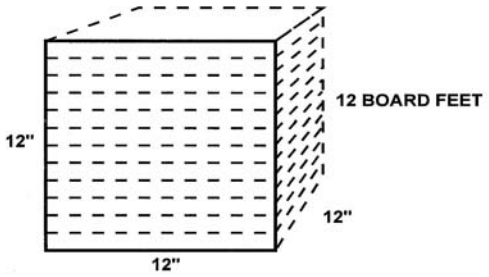


Figure 3. *A cubic foot of lumber.*

10.4 Cubic Feet

A cubic foot refers to a piece of lumber that is one foot long, one foot wide and one foot thick, or any equivalent volume.

(i) Cubic Feet = L' x W' x T' or $L' \times \frac{W''}{12} \times \frac{T''}{12}$

(ii) The first formula would be used for computing the cubic foot volume of a large rectangular piece of lumber.

(iii) The second formula would be used for computing the number of cubic feet in a piece of lumber or several pieces of lumber of the same width and thickness.

NOTE: Volumes of trees and logs may also be expressed in cubic feet.

10.5 General Procedures for Scaling Logs in FBM

In Nova Scotia, the New Brunswick Log Rule (see Appendix VII) shall be used, unless otherwise specified, for scaling logs in Canadian Yard/Pound Units making the appropriate deductions for defects as outlined in this scaling manual.

Weighing logs is also an acceptable method of measuring logs and is covered elsewhere in this scaling manual.

The scaler shall record gross scale, deductions and net scale. Stumpage dues are normally computed on the basis of net scale.

Unless logs are piled so that the corresponding opposite end of each log can be determined, a scaler shall count the number of pieces in each pile and make an adjustment for any difference between the number of pieces scaled and number of pieces counted.

If the piece count exceeds the pieces scaled, it indicates that some pieces did not have lengths marked on them or some pieces were not scaled (missed) by that scaler. If the pieces scaled exceeds the pieces counted, it indicates that some pieces had lengths marked on both ends.

10.6 Measuring Log Diameters

Log diameters shall be measured at the top end inside the bark to the last full inch (see Figure 4). This diameter is considered to run the entire length of the log and is referred to as the “scaling cylinder”. Log taper is not considered for volumes determined by the New Brunswick Log Rule.

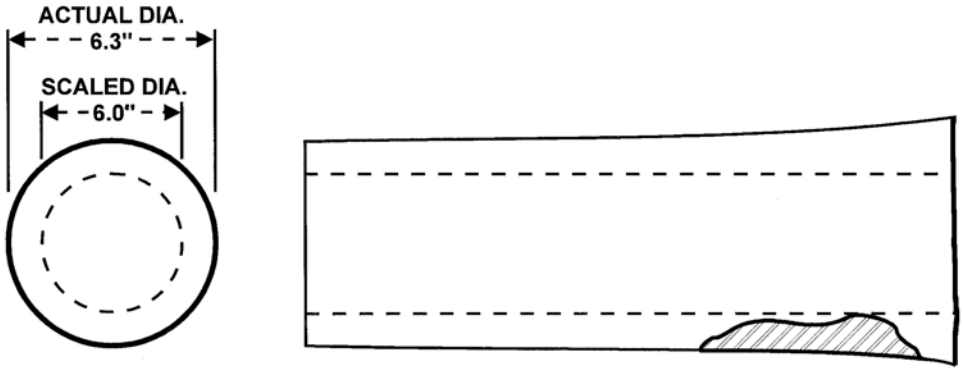


Figure 4. *Diameters measured to last full inch.*

If a log is not round, the diameter recorded shall be a fair representation of a circle with an area equal to the end surface of the small end of the log (see Figure 5).

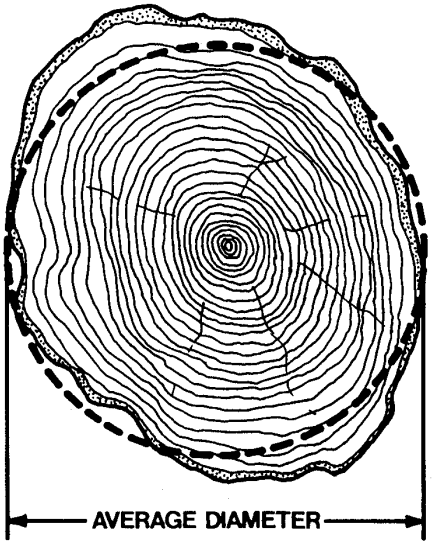


Figure 5. *Average diameter.*

In the case of an abnormality at the point of the diameter measure, such as caused by a burl, branch whorl, fork or disease swelling, the diameter shall be reduced to what it would be if the abnormality did not exist (see Figure 6).

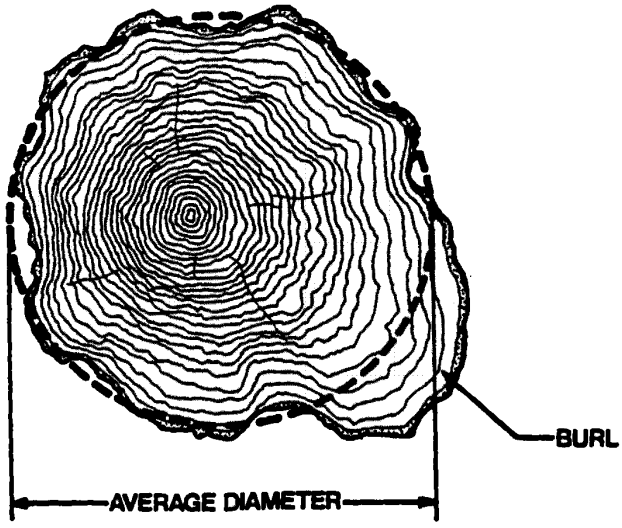


Figure 6. *Abnormality at point of diameter measurement.*

Log diameters shall be measured at right angles to the longitudinal axis of the log (see Figure 7) . Normally logs should be cut at approximately right angles to the longitudinal axis and the diameter can be measured accurately by applying the scale stick directly to the sawn surface.

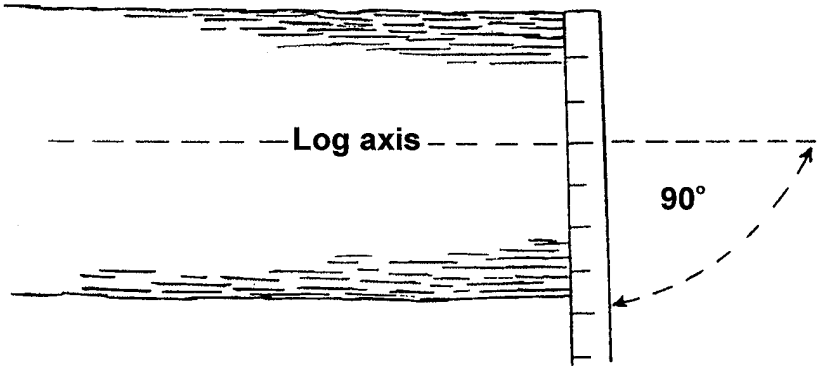


Figure 7. *Diameters measured at right angles.*

If the log is not cut at right angles to the longitudinal axis the diameter shall still be so measured or estimated (see Figure 8).

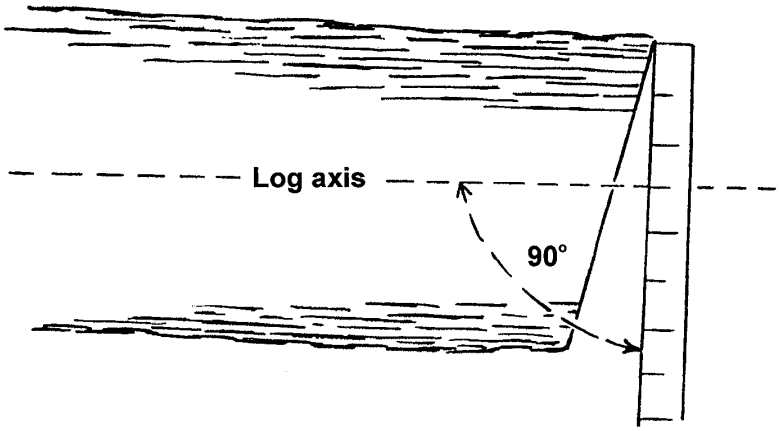


***Figure* 8.** *Diameters if logs not cut at 90°.*

When scaling to determine Crown stumpage fees, lengths shall be measured to the nearest foot, unless specified otherwise in the contract or cutting agreement.

If logs are to be bought or sold on the basis of scaled volume, lengths shall be measured to the last whole foot (plus trim allowance of 0.3 ft.) unless otherwise specified in the contract or cutting agreement.

Logs longer than 18 feet shall be scaled in two or more lengths. These long logs should be scaled in approximately equal lengths. If the log is an unequal number of feet in length, the "extra foot" should be included on the butt long, unless defects on the log would make it practical to do otherwise.

As a general rule roundwood products intended for use in the manufacture of lumber shall be cut to a minimum length of eight feet (plus trim allowance of 0.3 ft.)

Logs or portions that will not produce lumber eight feet or longer shall be considered to be culls with the exception noted below.

Exception: If logs are shorter than eight feet (plus trim allowance of 0.3 ft) for a specific order or purpose they shall not be culled for reason of insufficient length.

10.7 Deduction Procedures

If defects occur outside the scaling cylinder, no deductions shall be made (see Figure 9).

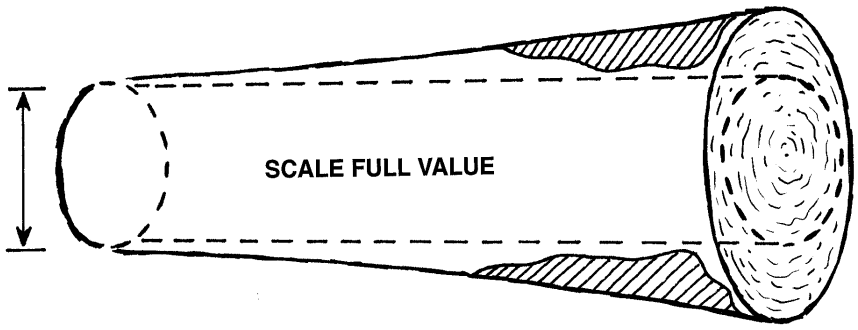


***Figure* 9.** *Defects outside the scaling cylinder.*

If a defect is partially outside the scaling cylinder, only deduct for that portion of the defect within the scaling cylinder. The scaling cylinder is a projection of the measured small end diameter through the length of the log (see Figure 10).

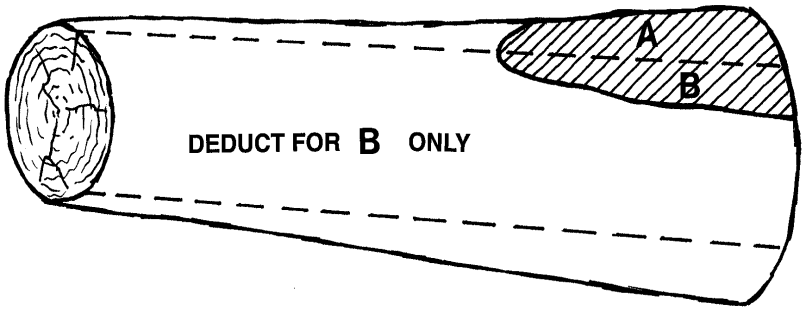


Figure 10. *Scaling cylinder.*

If two defects occur in a log, make the one requiring the larger deduction first (see Figure 11).

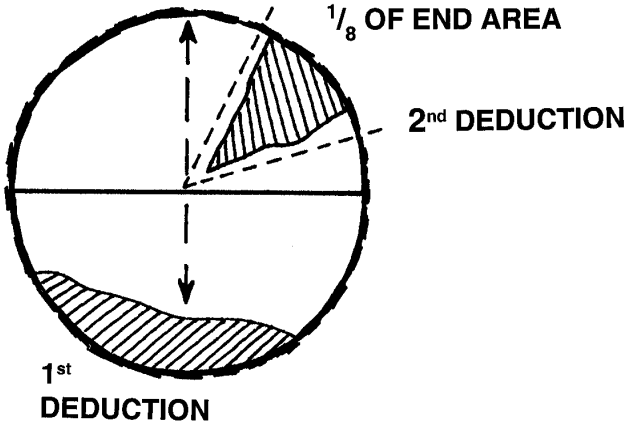


Figure 11. *Two or more defects.*

If a log has strong diameter and/or taper, it may compensate for minor defects and in such cases no deduction may be necessary (see Figure 12).

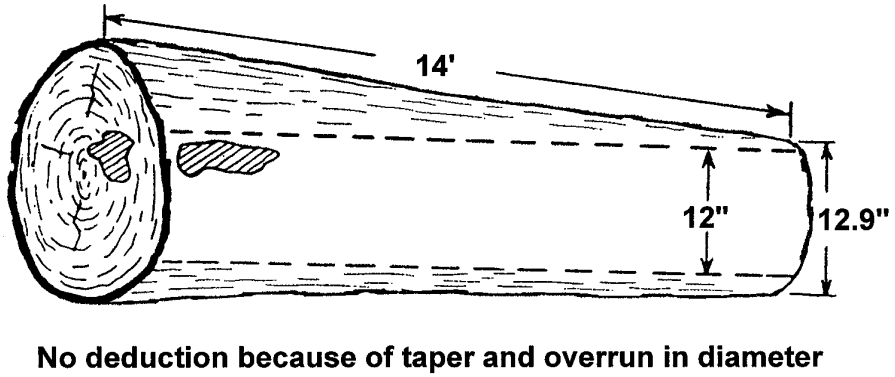


Figure 12. *Strong diameters and taper.*

10.8 Common Defects

Defect may or may not include rot, stain, crook, sweep, seams, splits, excessive knots, insect damage, animal damage and mechanical damage.

Each milling facility has their own specifications and/or contracts that describe the attributes of the wood products they purchase. The scaler may make deductions for that material that does not conform to those specifications.

10.9 Methods of Making Deductions

Reducing Length - Reducing length is a proportionate deduction. If the length of a 16 foot log is reduced by four feet, the scaled volume is reduced 25 percent.

If a defect covers the major portion of an end area, then reduce the log length by the length of the affected section (see Figure 13).

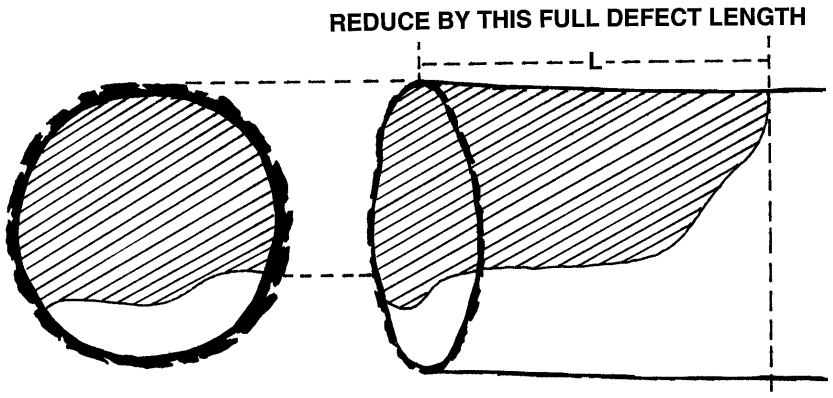


Figure 13. *Reducing length.*

If a defect only covers a portion of the section on which it occurs, reduce the log length by a portion of the length of the affected section (see Figure 14).

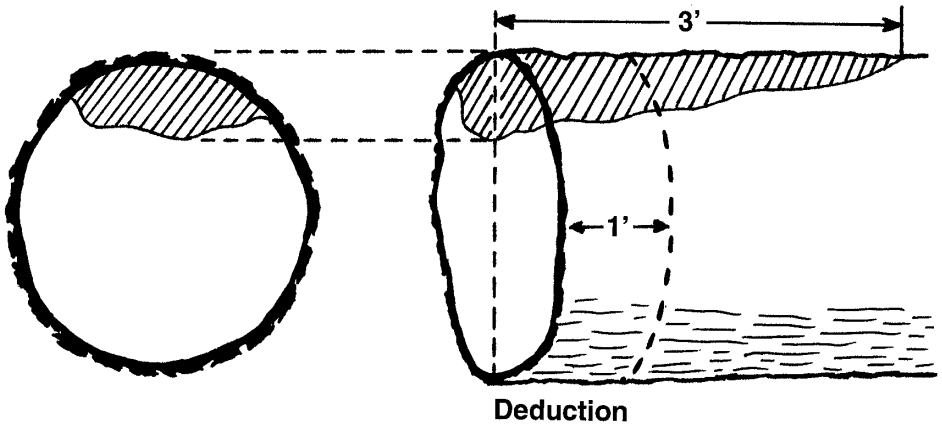


Figure 14. *Reducing length by portion of length affected.*

Reducing diameter - Reducing diameter is not a proportionate deduction. This method shall be used for making deductions for defects on the circumference of the log such as sap-rot. When making deductions for external defects around the circumference of the log, the scaler shall deduct twice the thickness of the defect from the diameter.

When deducting for sap rot or similar defects affecting the entire circumference of a log, the gross scale will be the volume computed by measuring the diameter inside the affected portion. If such a log contains other defect(s) only deduct for the affected portion inside the scaled diameter (see Figure 15).

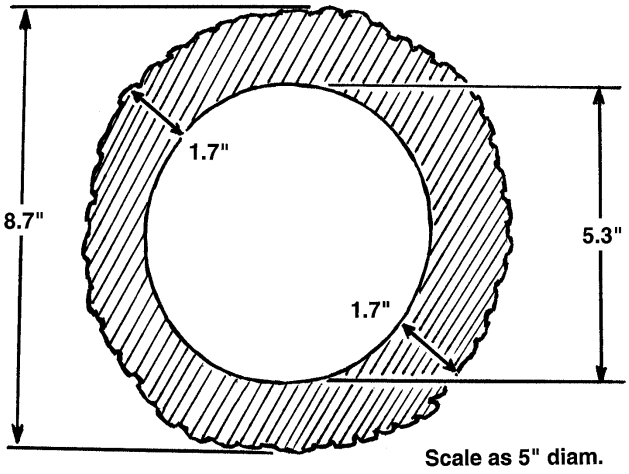


Figure 15. *Reducing diameter for defects on circumference of log.*

If a defect only covers a portion of the circumference and/or length, a scaler shall reduce the deduction proportionately (see Figure 16).

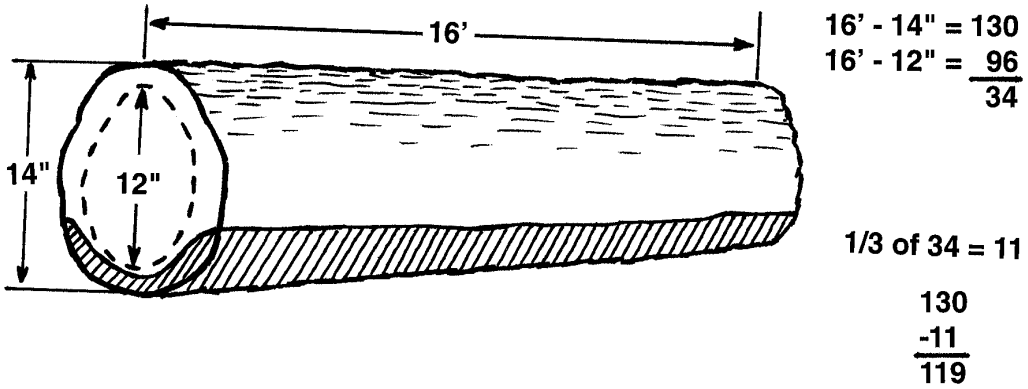


Figure 16. *Defect on portion of circumference.*

Sector Method - This method is used for making deductions for defects such as seams (see Figures 17 and 18). This method may also be appropriate for other defects such as logging scars, porcupine chews or pocket rot that can be confined within a wedge shape (see Figure 19) This is usually a percentage deduction and a section (similar to a wedge of pie) is deducted. The amount that the defect twists around the circumference of the log determines the percentage of deduction.

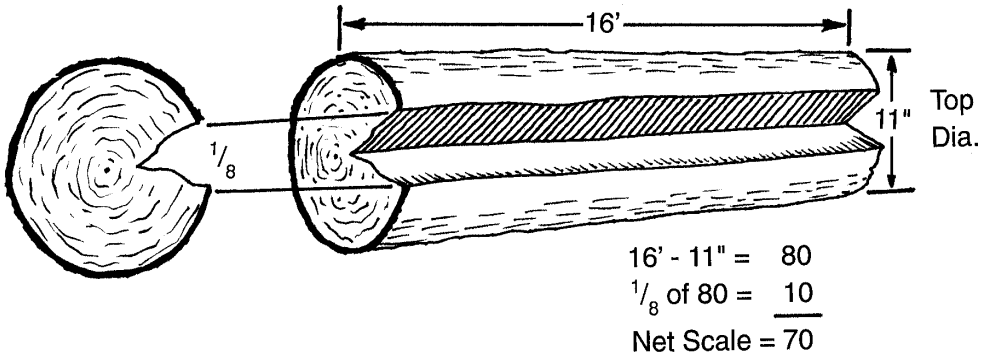


Figure 17. *Straight seam.*

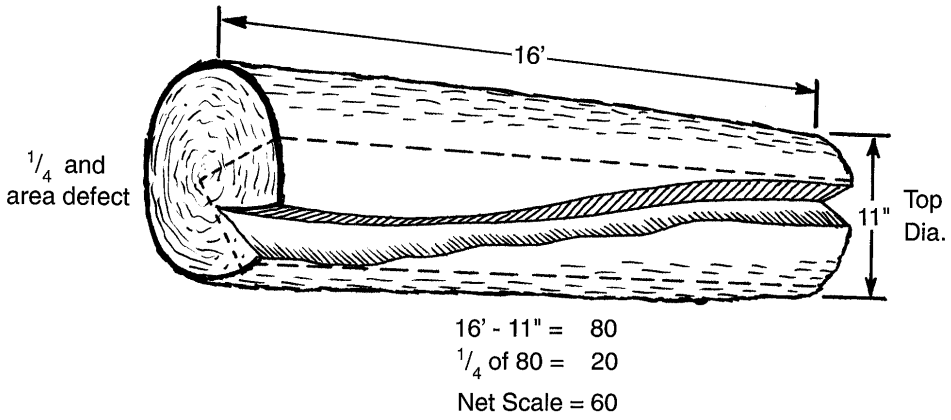
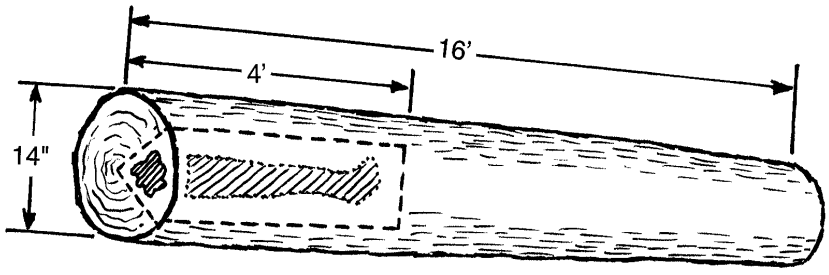


Figure 18. *Spiral seam.*



16' - 14" = 130 board feet
25% of 130 = 32 board feet
$^{4}/_{16}$ x 32 = 8 board feet
Net Scale 130 - 8 = 122 board feet

Figure 19. Deduction for defects along portion of sector.

Diagram Method - In this method the defective portion is enclosed within a rectangular area in the face of the log where the defect shows (see Figure 20). The distance that the defect extends into the log is estimated and the board foot volume is computed, similar to computing the volume of a piece of lumber. A divisor of 15 (instead of the usual 12) is used in computing board foot volume to be deducted by the diagram method, to compensate for the fact that an allowance of saw kerf has already been made in the New Brunswick Log Rule. In computing volume of the rectangular section to be deducted, dimensions are raised to the first whole inch above actual measurements so that the defective portion will be completely contained within the block.

Gross Scale 15' - 14" = 122

Deduct $\frac{8 \times 8 \times 5}{15} = \frac{21}{101}$ Net Scale

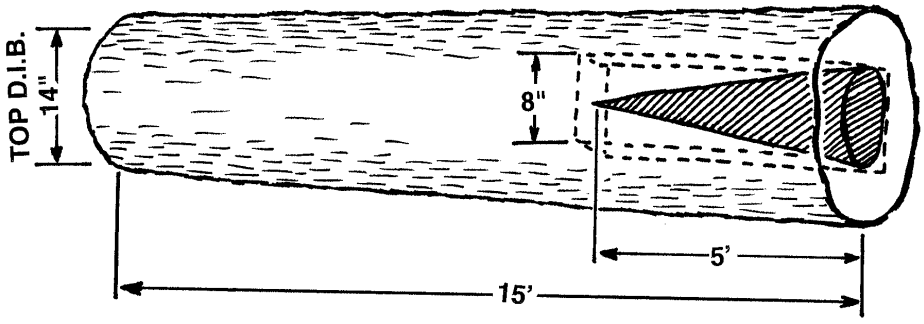


Figure 20. *Diagram method.*

A minimum of 2" is required from the rot extremity to the outside of the scaling cylinder on each side. If a defect covers a large portion of the end surface it is usually better to reduce log length than use the diagram method for making deductions (see Figure 21).

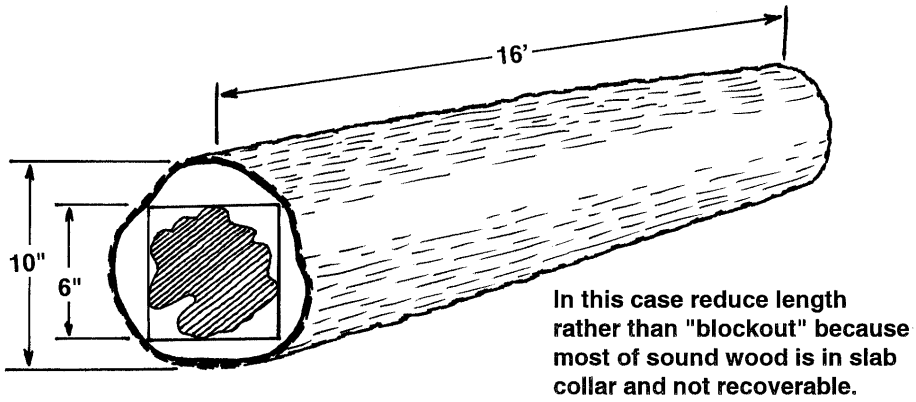


Figure 21. *Extensive butt rot.*

When using the diagram method, if the defect extends so far into the log that there is less than eight feet remaining beyond the defective section, then the full length of the log will be used in computing the amount to be deducted (see Figure 22).

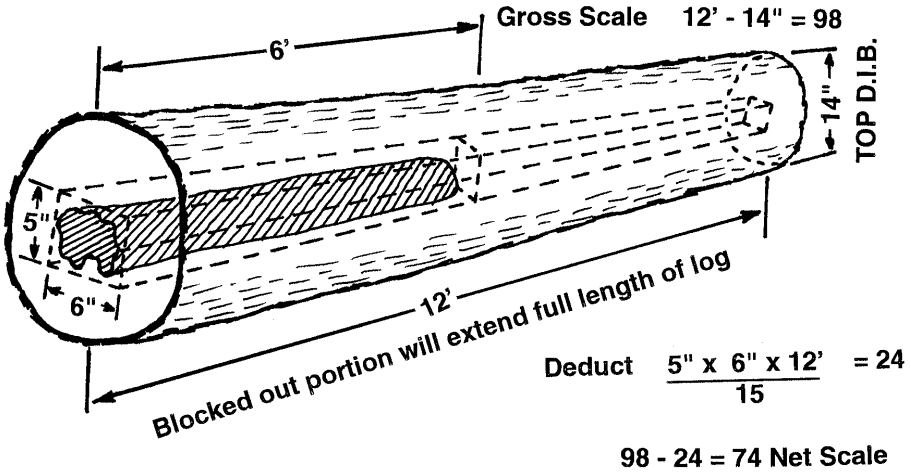


Figure 22. *Rot restricting recovery of 8 foot lumber.*

Percentage Method - Crook or sweep up to 2 inches in 16 foot logs and 1 inch in 8 foot logs and proportionate amounts between these lengths is acceptable without deduction. The following illustrations are meant as guidelines only in making percentage deductions for crook or sweep. To use the method, extend an imaginary line along the longest, straightest section of a log on the inside bend of the crook or sweep.

If the imaginary line dissects the opposite end of the log at a point down to and including the centre, deduct 10% (see Figure 23).

Figure 23. *Sweep of 10%.*

If the imaginary line dissects the opposite end of the log at a point below the centre but not completely off the end of the log deduct 25% (see Figure 24).

Figure 24. *Sweep of 25%.*

If the imaginary line dissects the opposite end of the log one foot or less from the end, deduct 33 ⅓% (see Figure 25).

Figure 25. *Sweep of* 33 ⅓*%.*

If the imaginary line dissects the opposite end of the log more than one foot from the end, deduct 50% or more (see Figure 26).

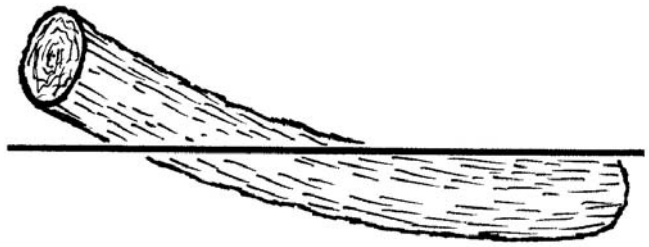


Figure 26. *Sweep of 50%.*

If applying the above method on short logs, remember that any portion of a log that will not produce lumber 8 feet or more in length is considered to be cull.

10.10 Information to be recorded

The following information shall be recorded on the Tally Card:

(i) Date

(ii) Buyer and/or seller depending for whom the scale is being made.

(iii) Location - Logs are normally scaled either near the area where they have been cut or in the storage yard of the purchaser.

(iv) Species or groups of species - Species shall be tallied separately or combined according to the terms of the contract or cutting agreement. When scaling to determine stumpage dues it is generally permissible to combine species with the same stumpage rate.

(v) Pile(s) or load(s). Large piles will normally be tallied separately. Several small piles may be tallied on one tally card and the numbers of all the piles shown on the tally form.

(vi) Gross scale

(vii) Deductions

(viii) Net scale

(ix) Scaler's name

(x) Scaler(s) license number

(xi) Number of pieces scaled

(xii) The number of pieces counted. The number of pieces are counted to ensure all pieces have been scaled and to facilitate making appropriate adjustment if the pieces counted and the pieces scaled are not the same.

11. SCALING LOGS - CUBIC METRES

11.1 General Procedures

The purpose in measuring individual sawlogs in the metric system is to determine total log volume as compared to board foot log scaling which measures in terms of the end product.

Log volumes will be measured in cubic metres (m^3) to three places of decimal (0.001).

11.2 Gross Volume

The gross volume of each individual log shall be calculated using one of the three following methods:

Volume table or formula - The volume, in m^3 to three places of decimal, may be determined from the table contained in Appendix VIII for even length class logs or Appendix IX for odd length class logs. These tables are constructed with the following formula which assumes a taper of 1 cm for each 0.75 m of length.

$$V = L \times \left(\frac{\pi}{40000}\right) \times \left(d + \frac{L \times 0.5}{0.75}\right)^2$$

Where V = volume of log in cubic metres
L = length in metres
d = top diameter in centimetres (measured in 2 cm classes)
ð = 3.141 59

Smalian's Formula - Log volume may be determined by Smalian's Formula. This method where applied to logs, is as follows: the volume of a log equals the area of the small end plus the area of the large end, then divided by two and multiplied by the length, where the area at each end is expressed in square metres.

$$V = \frac{a + A}{2} \times L$$

Where V = volume of log in cubic metres
a = area of small end of log in square metres
A = area of large end of log in square metres
L = length of log in metres

Huber's Formula - Log volume may be determined by Huber's Formula. This method where applied to logs, is as follows: The volume of a log equals the area at mid length multiplied by the length, where the area at mid length is expressed in square metres.

$$V = A_{½} L$$

Where V = volume of log in cubic metres
$A_{½}$ = area, inside bark, at mid length of log in square metres
L = length of log in metres

11.3 Procedures for Measurement

General - Although the volume of a log may be calculated from measurements taken on one or both ends or the mid length of a log, the procedures and techniques of measurement are the same in all cases.

Diameter Measurement - Diameter shall be measured across the log along a plane perpendicular to the longitudinal axis of the log using calipers, a tape measure or a scale stick. Log diameters shall be measured inside bark in 2 cm size classes with the boundary between size classes on the odd centimetre. A scaled piece which falls within a class interval shall be said to belong to that size class; a scaled piece which coincides with the boundary of two class intervals shall be said to belong to the lower size class. For example, to qualify for the 12 cm class, diameters must be greater than 11 cm or equal to or less than 13 cm. Exactly 11 cm would be recorded in the 10 cm class and exactly 13 would be recorded in the 12 cm class.

When using 2 cm classes and the average of two diameter measurements is an odd number, the diameter recorded is the class surrounding that mean that is divisible by 4.

Example: A diameter measuring 28 x 34 centimetres is recorded as 32 centimetres (see Figure 27).

$$\frac{28 \times 34}{2} = \frac{62}{2} = 31$$

Since 31 is an odd number, it cannot be recorded. The scaler must tally 30 or 32. 32 is divisible by 4, 30 is not, therefore record 32.

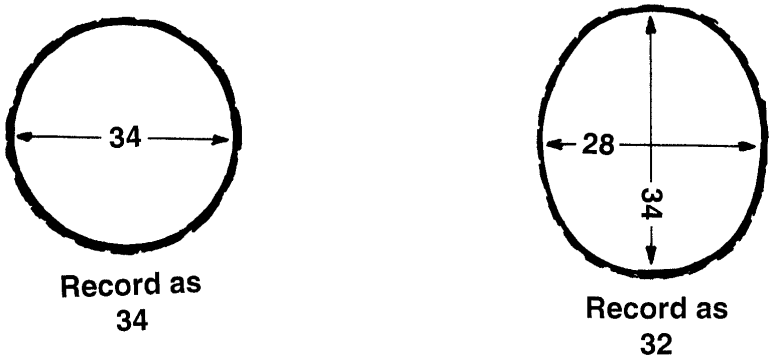


Figure 27. *Recording diameters of logs with regular and irregular cross sections.*

NOTE: When using Smalian's or Huber's formula, diameter measurements may be increased in precision to as high as 1.0 cm.

Bark - The diameter shall be taken inside the bark. However, where a measurement is not possible, the outside bark diameter may be used with a corresponding reduction for an appropriate bark thickness (see Figure 28).

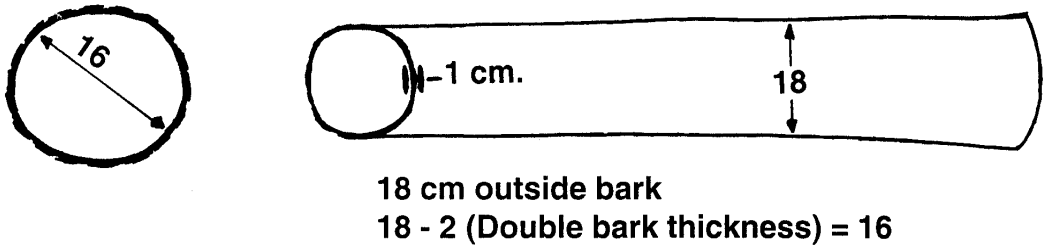


Figure 28. *Reducing diameter for outside bark measurements.*

Butt Swell - Where butt swell visibly influences a diameter reading, the diameter shall be reduced to the normal projected taper on the log end measured (see Figure 29).

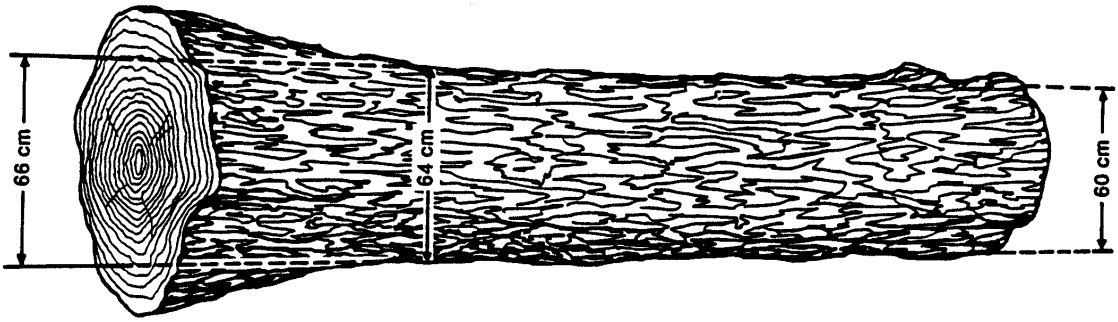


Figure 29. *Reducing diameter to normal projected taper.*

Logs out of Round - Where any log is irregular in cross section, the diameter of a circle of similar area to the cross sectional area of that log shall be estimated from the measurement of one or more axis of the cross section (see Figure 30).

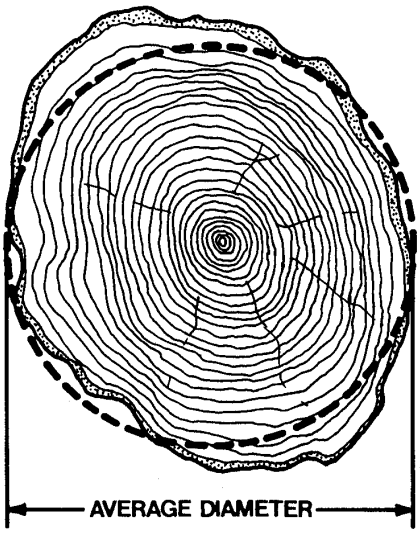


Figure 30. *Measurement of irregular diameter.*

Abnormalities - In the case of an abnormality at the point of diameter measurement, such as is caused by a burl, branch whorl, fork or disease swelling, the diameter shall be reduced to what it would be if the abnormality did not exist (see Figure 31).

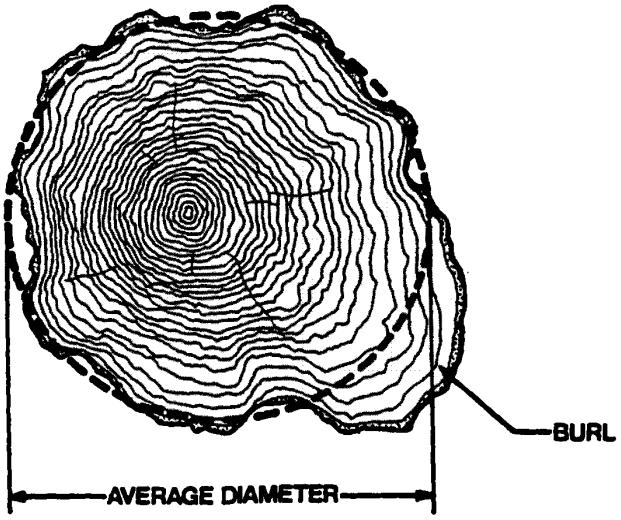


Figure 31. *Abnormality at point of diameter measurement.*

Length Measurement - Measurement of length shall be made with a tape measure or a scale stick parallel to the longitudinal axis. Log lengths shall be measured in 0.2 m size classes with the boundary between size classes on the even 0.1 m.

Logs longer than 5.6 m in length will be scaled in two or more sections.

Length measurements shall be equal to the distance between two planes perpendicular to the longitudinal axis of the log and the geometric centre of the end faces (see Figure 32).

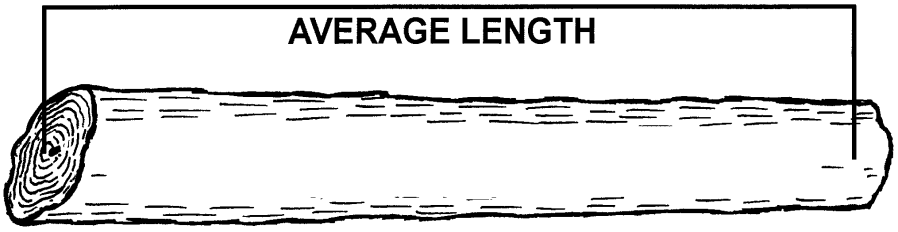


Figure 32. *Measure average length.*

11.4 Deduction Procedures

The formula used to calculate defect volume shall be that for the geometric solid that nearest approaches the shape of the defect.

Logs longer than 5.6 m shall be scaled in two or more lengths. These long logs should be scaled in approximately equal lengths. If the log is an unequal length class, the "extra class" should be included on the butt length, unless defects on the log would make it practical to do otherwise.

As a general rule roundwood products intended for use in the manufacture of lumber shall be cut to a minimum length of 2.44 m (plus trim allowance of 0.10 m). Logs or portions of logs that will not produce lumber 2.44 m (plus trim allowance of 0.10 m) in length shall be considered culls with the exception noted below.

Exception: If logs are shorter than 2.44 m (plus trim allowance of 0.10 m) for a specific order or purpose they shall not be culled for reason of insufficient length.

Sap Rot - Compensation for sap rot shall be made by measuring the average diameter inside the rot. This is the only defect deduction where the log is scaled directly into the net scale (see Figure 33).

***Figure* 33.** *Measurement of sap rot.*

Rot - The diameter of the rot shall be measured and the length of the rot estimated in 0.5 m units. The volume of the rot shall be deducted from the gross volume.

Example 1:

Rot extends only a portion of the length of a log (see Figure 34).

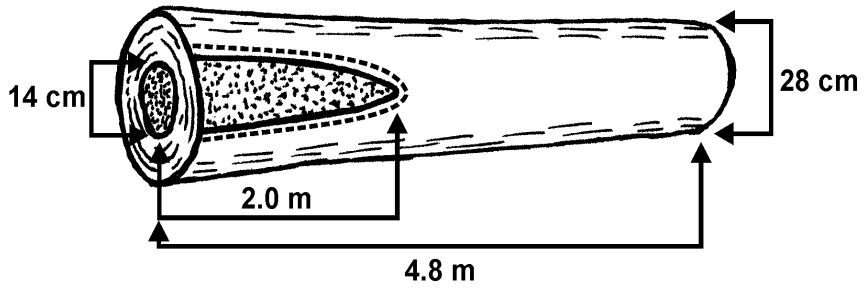


Figure 34. *Rot showing on one end of log.*

Gross Log Volume = 28 cm top, 4.8 m length
= reference Appendix VIII = 0.367 m^3

Volume of Rot = 14 cm rot, 2.0 m length
= reference Appendix X = 0.015 m^3

Net Log Volume = Gross Volume - Rot Volume
= 0.367 - 0.015
= 0.352 m^3

For logs with rot extending full length, diameters are measured at both ends and the deduction determined using the total length for both ends. These two values are added together to obtain the total deduction for the defect.

Example 2:

Rot extends the full length of a log (see Figure 35).

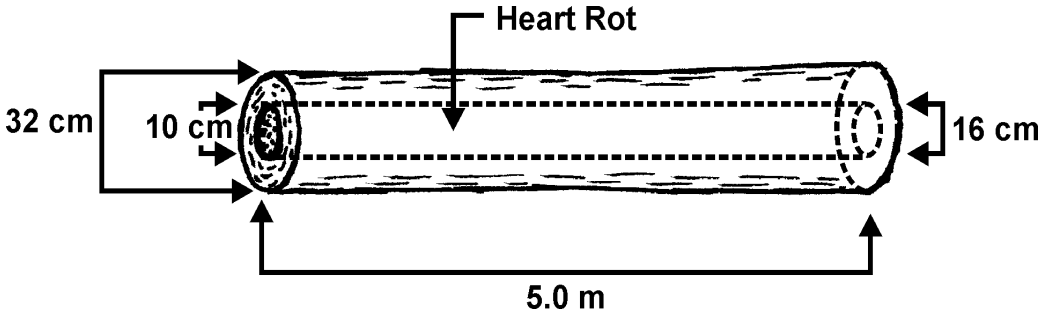


Figure 35. *Rot extending the full length of a log.*

Gross Log Volume = 32 cm top, 5.0 m length
= reference Appendix VIII = 0.490 m^3

Volume of Butt Rot = 16 cm rot, 5.0 m length = see Appendix X = 0.050 m^3
Volume of Top Rot = 10 cm rot, 5.0 m length = see Appendix X = 0.020 m^3
Total Rot Volume = = 0.070 m^3

Net Log Volume = Gross Volume - Rot Volume
= 0.490 - 0.070
= 0.420 m^3

NOTE: When rot lengths do not correspond exactly with the length of the rot given in Appendix X use the length which is closest.

Pocket rot and shake - The defect in these instances are diagramed out. The defective portion is enclosed within a square or rectangle area in the face of the log, and recorded in 2 cm classes. The distance that the defect extends into the log is estimated and recorded in 0.5 m units. The volume of the defect is calculated in cubic metres and deducted from the gross scale of the log.

Example 1:

Pocket rot showing on the end of a log (see Figure 36).

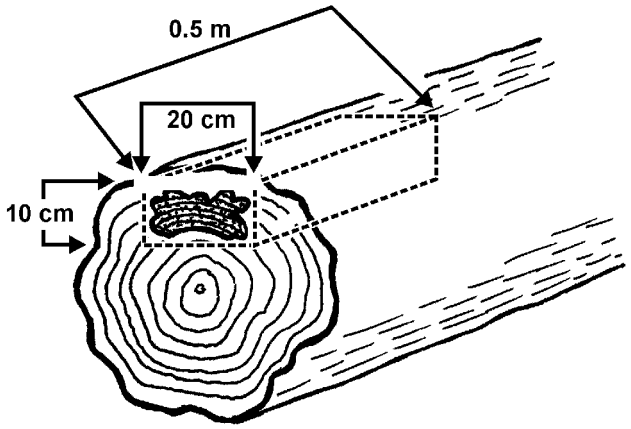


Figure 36. *Pocket rot showing on end of log.*

Volume of Rot = 10 cm x 20 cm x 0.5 m
= 0.10 m x 0.20 m x 0.5 m = 0.010 m^3

Example 2:

Shake showing on the end of a log (see Figure 37).

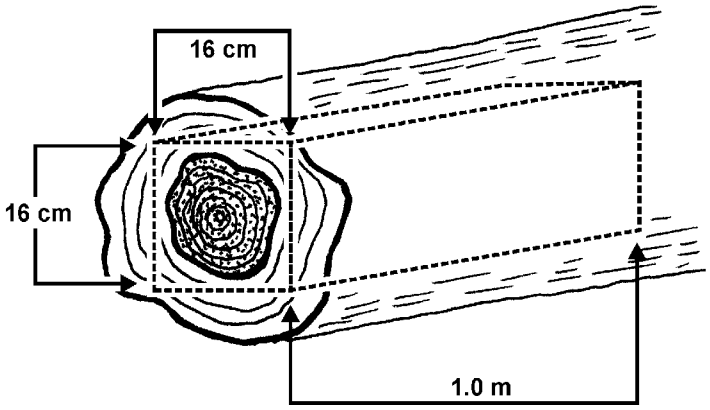


Figure 37. *Shake on end of log.*

Volume of Defect = 16 cm x 16 cm x 1.0 m
= 0.16 m x 0.16 m x 1.0 m = 0.026 m^3

Seams or Dead Side - The average defect sector shall be deducted from the gross log volume as a percentage.

Example:

Dead side affecting a 20% sector of a log (see Figure 38).

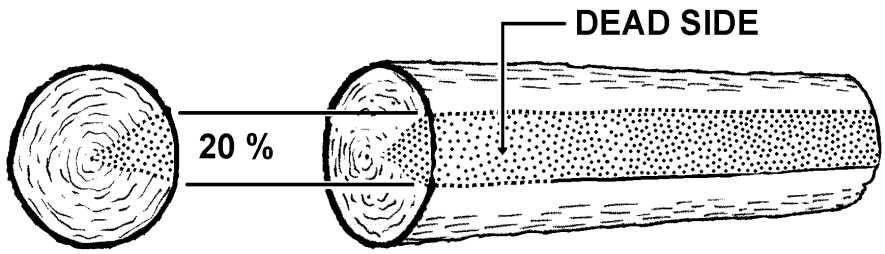


Figure 38. *Dead side.*

Gross Log Volume = 30 cm top, 4.8 m length
= reference Appendix VIII = 0.415 m^3

Volume of Defect = Gross scale x 20%
= 0.415 x 20% = 0.083 m^3

Net Log Volume = Gross Volume - Defect volume
= 0.415 - 0.083
= 0.332 m^3

Scars and Porcupine Chews - The average defect sector shall be deducted from the gross log volume as a percentage. These types of defects may affect the total log length or a portion of the log length.

Example 1:

Porcupine chew affecting 25% of the length of a 20% sector of a log (see Figure 39).

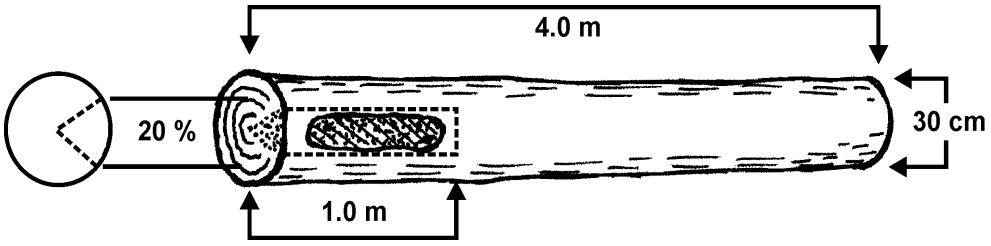


Figure 39. *Porcupine chew.*

Gross Log Volume = 30 cm top, 4.0 m length
= reference Appendix VIII = 0.335 m^3

Volume of Defect = Gross scale x 25% x 20%
= 0.335 x 25% x 20% = 0.017 m^3

Net Log Volume = Gross Volume - Defect volume
= 0.335 - 0.017
= 0.318 m^3

Example 2:

Porcupine chew located so that no merchantable length lumber may be recovered from either end of defect, therefore the whole sector volume is deducted (see Figure 40).

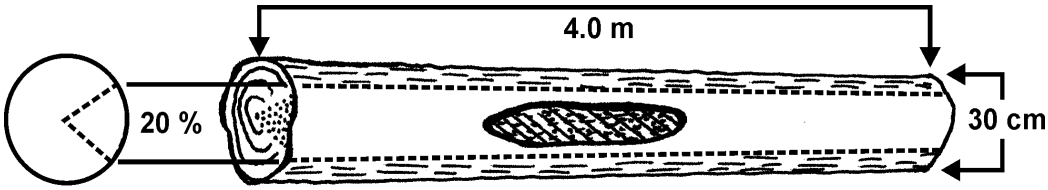


Figure 40. *Porcupine chew affecting full length of log.*

Gross Log Volume = 30 cm top, 4.0 m length
= reference Appendix VIII = 0.335 m^3

Volume of 20% Sector = Gross scale x 20%
= 0.335 x 20% = 0.067 m^3

Net Log Volume = Gross Volume - Defect volume
= 0.335 - 0.067
= 0.268 m^3

Crook and Sweep - Deductions for crook and sweep are made by either reducing log length or the percentage method to account for the volume affected by these types of defects. A scaler will often choose one method over the other as a personal preference for reducing for sweep, however, it must be remembered that both methods should end up with a similar net scale. A crook will normally be deducted by reducing log length as the percentage method is designed for sweep.

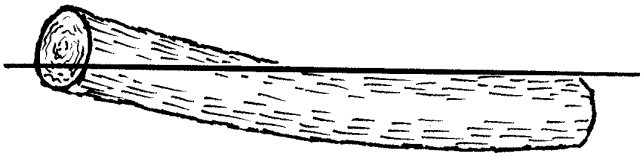
The following illustrations are meant as guidelines only in making percentage deductions for crook or sweep. To use the method, extend an imaginary line along the longest, straightest section of a log on the inside bend of the crook or sweep.

If the imaginary line dissects the opposite end of the log at a point down to and including the centre, deduct 10% (see Figure 41).

10 %

Figure 41. *Log with 10% sweep.*

If the imaginary line dissects the opposite end of the log at a point below the centre but not completely off the end of the log deduct 25% (see Figure 42).



25 %

Figure 42. *Log with 25% sweep.*

If the imaginary line dissects the opposite end of the log 30 cm or less from the end, deduct 33% (see Figure 43).

33 $^{1}/_{3}$ %

Figure 43. *Log with 33 1/3 % sweep.*

If the imaginary line dissects the opposite end of the log more than 30 cm from the end, deduct 50% (see Figure 44).

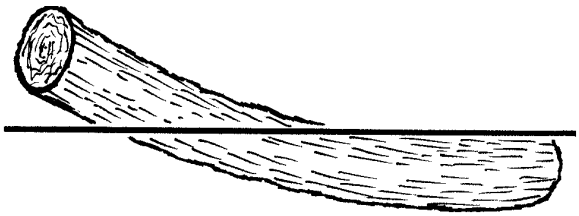


Figure 44. *Log with 50% sweep.*

If applying the above method on short logs, remember that any portion of a log that will not produce lumber 2.44 m or more in length is considered to be cull.

12. SCALING STACKED WOOD

12.1 General Procedures

As previously explained in “Units of Measure”, stacked wood shall be measured in either stacked cubic metres or cords. The procedure for measuring stacked wood in either unit is very similar. The procedure for scaling in metric (SI) units is given first and the differences when scaling in cords is then presented.

When scaling 2.44 m wood, length and height measurements shall be taken on both sides of the stack. The average length and height are then computed from these measurements. Using this procedure, defects are assumed to extend halfway through the bolt length and deductions for defects are made on both sides of the pile.

When scaling 1.22 m wood, length and height measurements shall be taken on one side, alternating the side on which measurements are taken from one pile to the next. The average length and height are then computed from these measurements. Using this procedure, defects are assumed to affect the entire bolt length and deductions are made on only one side of the pile.

When scaling stacked wood it shall be understood to be rough (not peeled) unless it specifically states otherwise.

12.2 Scaling Stacked Wood in Metric

The unit of measure for scaling stacked wood in the metric (SI) system is the stacked cubic metre symbolized as m^3 (stacked). This unit is defined as follows: **One cubic metre of stacked roundwood (whole or split with or without bark) containing wood and airspace with all bolts of similar length piled in a regular manner with their longitudinal axis approximately parallel.**

Pile dimensions shall be measured and recorded in 0.02 m units (2 cm classes).

12.3 Measuring Pile Dimensions (Metric)

Lengths - Lengths of stacks shall be measured to a minimum precision of the nearest 2 cm class. Tapes are recommended for length measurements as they are more accurate on long measurements and will reduce errors and permit the marking of even intervals.

Stacks longer than 30 m will be scaled as two or more separate sections with no section exceeding 30 m in length. In such cases, each section shall be measured, recorded and marked as a separate stack.

If a stack is not staked and sloping on the ends, the length shall be measured along and parallel to the bottom of the stack (see Figure 45).

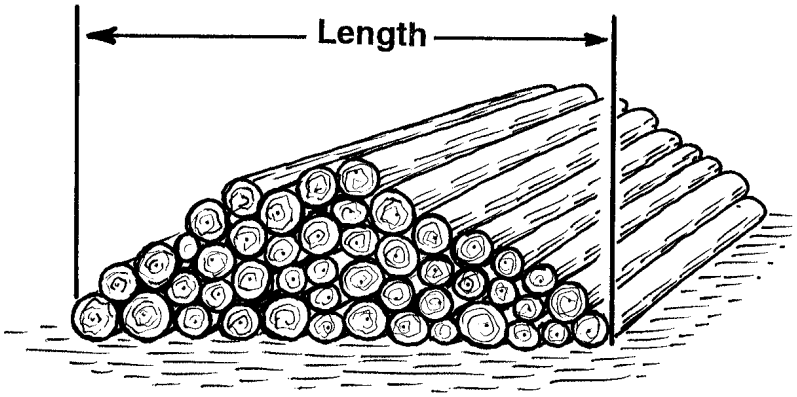


Figure 45. *Length of stack.*

NOTE: Visually estimating the length to which a pile will "square-up" on the ends and making a corresponding adjustment in the height measurements near the ends of the pile will also give reliable estimates if carefully applied. In practice it has been found that more consistency will be obtained by using the recommended procedure.

When a stack is contained with stakes, e.g. truck loads, the length shall be measured at half the height of the stack (see Figure 46).

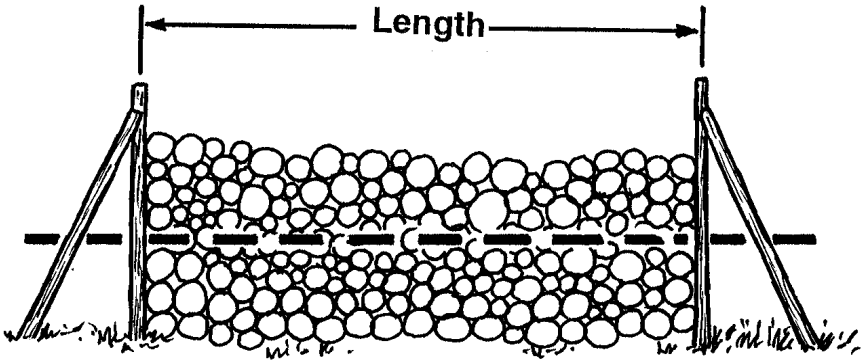


Figure 46. *Length of stack contained with stakes.*

Heights - Height measurements are to be taken at the mid point of equal intervals on both staked piles or loads and piles with sloping ends (see Figure 47). The maximum recommended interval distance is 1.5 m (5 ft.). More height measurements shall be taken if the top of a pile is highly irregular than if the top of the pile is relatively level.

The points where height measurements are to be taken can conveniently be marked on the face of the stack as the tape is being unwound to measure the length. The scaler may find it convenient to mark the points at which to take height measurements on the measuring tape. For example, if the scaler decides to use the maximum recommended interval distance of 1.5 m, he or she would mark the following points on the tape: 0.75, 2.25, 3.75, 5.25, 6.75, 8.25. These measurements could easily be transferred to the stack face to indicate where to make height measurements. This will eliminate mental calculations and the chance of error.

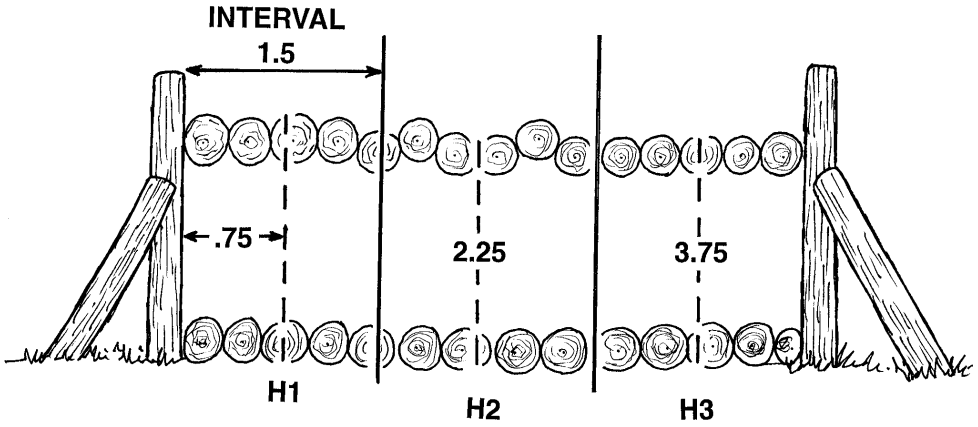


Figure 47. *Heights at midpoint of intervals.*

When measuring heights on hillside or slopes they shall be measured at right angles to the pile bottom (see Figure 48).

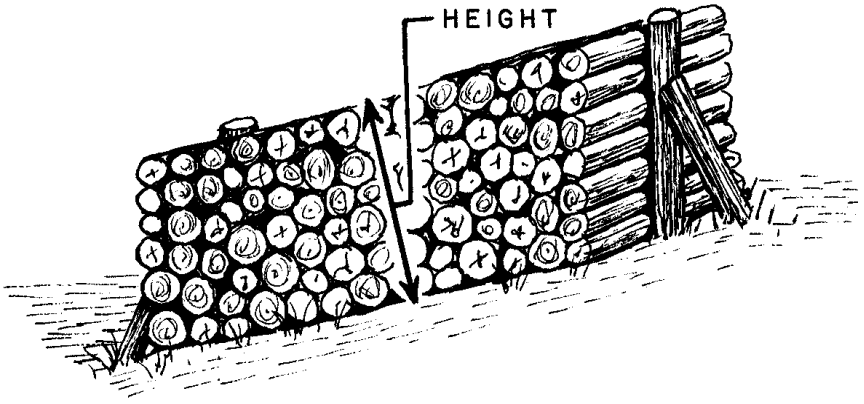


Figure 48. *Height of sloped stack.*

A stack of wood may be piled on a slope and so supported that the bottom of the pile is level. In this case the rule still applies - measure the height at right angles to the pile bottom, not at right angles to the slope (see Figure 49).

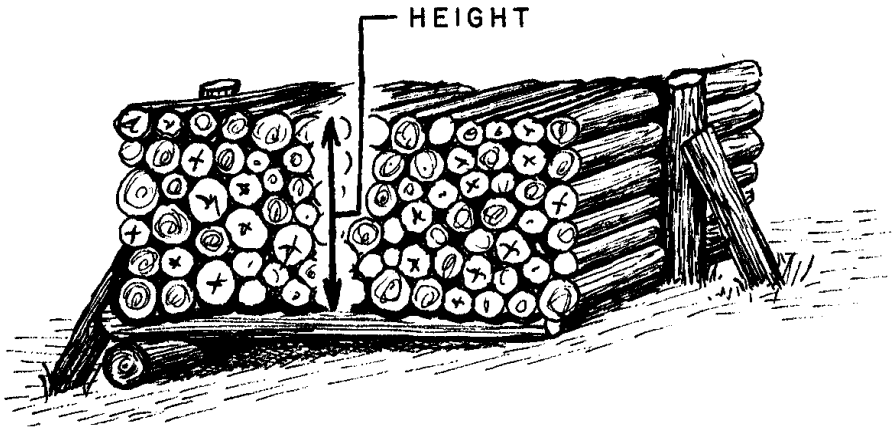


Figure 49. *Height of supported stack.*

If scaling a stack with sloping ends, mark the mid points of equal intervals along the base of the stack and measure the height of each interval at these points (see Figure 50).

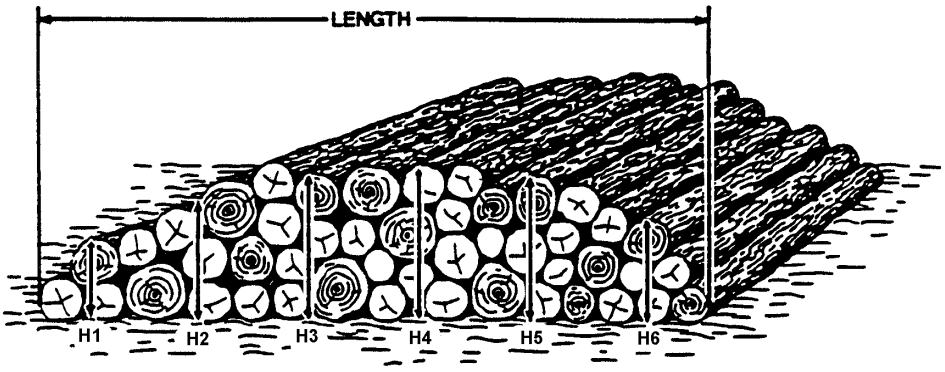


Figure 50. *Heights of stacks with sloping ends.*

If the top of an interval is noticeably irregular measure the average height of the interval (see Figure 51).

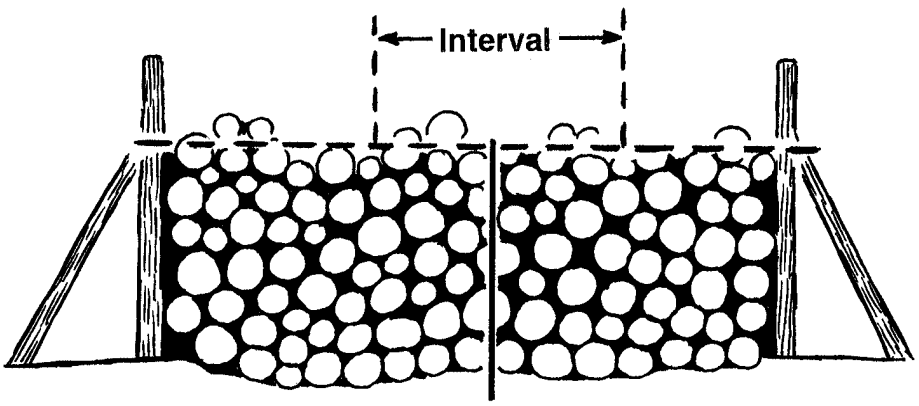


Figure 51. *Height of irregular in*terval.

It should be noted that this procedure is not consistent with statistical methods. If statistical practice was followed, the scaler would read whatever height occurred directly under the scale stick. Such a procedure would give comparable precision if equally well applied for measuring a large volume of wood. The recommended procedure of averaging the height of the interval will give more precise volumes for individual loads. In Nova Scotia each individual load may belong to a different supplier.

If the mid point of an interval falls on or near the centre of a bolt in the top tier and the top of the pile is regular, measure the height to the top of the bolt (see Figure 52).

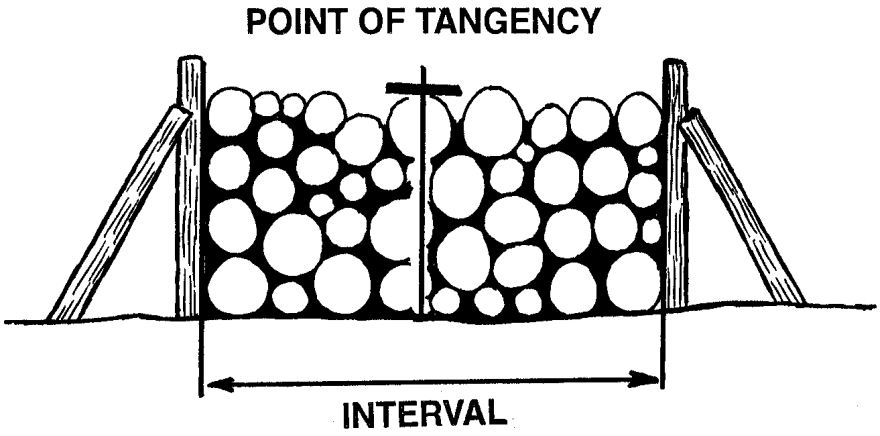


Figure 52. *Height when mid point of interval falls on a bolt in the top tier.*

If the mid point of an interval falls between two bolts in the top tier, measure the height to the point of tangency between two bolts (see Figure 53).

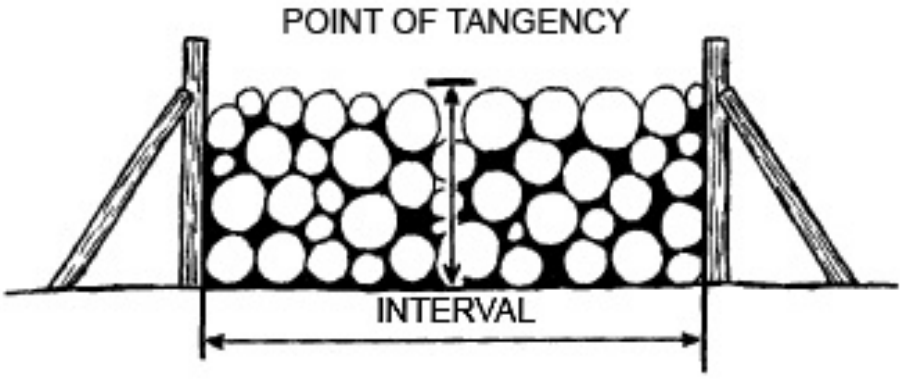


Figure 53. *Height when mid point of interval falls between two bolts in the top tier.*

If there is more than half an interval at the end of a stack, a height measurement shall be taken at the mid point of the remaining distance (see Figure 54).

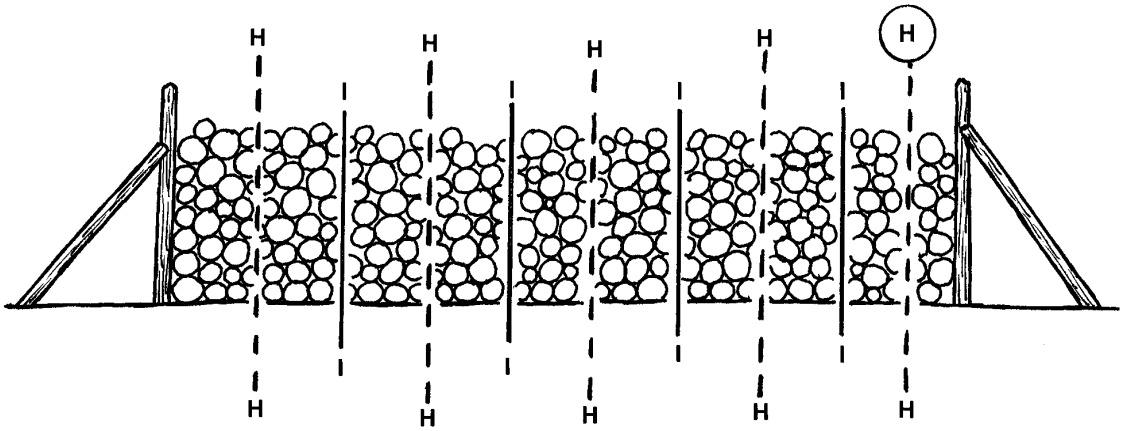


Figure 54. *Height if more than half an interval remains*.

If there is less than half an interval remaining at the end of a stack, it shall be included in the last interval (see Figure 55).

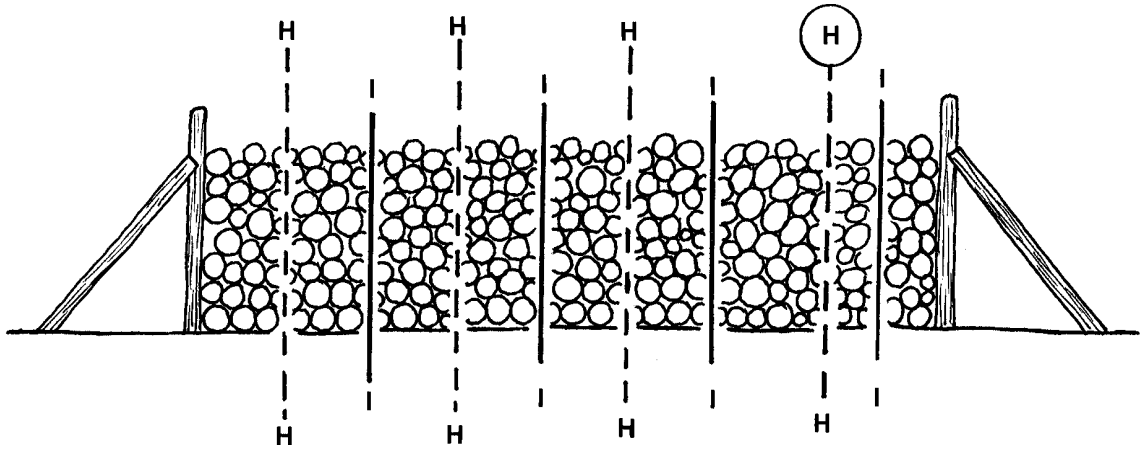


Figure 55. *Height if less than half an interval remains*.

Widths - Width of stack is the average length of the bolts. At least one bolt length per interval on one side shall be checked to determine if the bolt length falls within the tolerance limit which requires no deduction (see Figure 56). If the bolt length does not fall within this tolerance limit, measure sufficient additional bolts to determine the average length so as to determine the amount of deduction to be made.

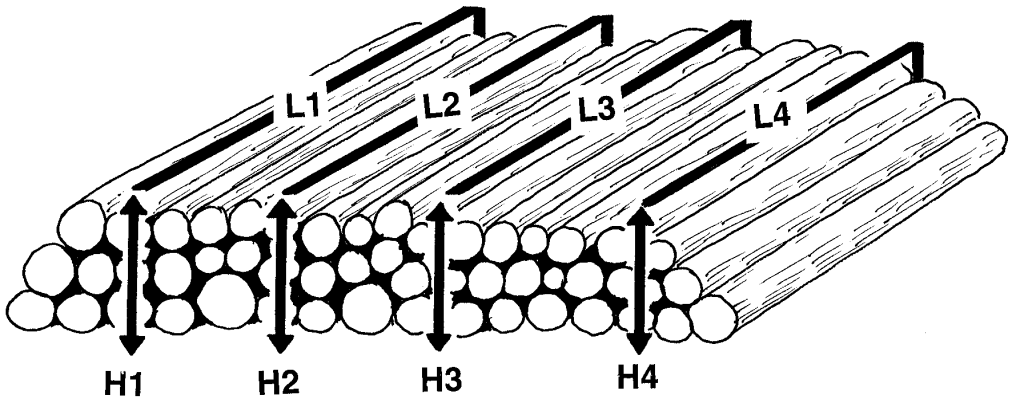


Figure 56. Average bolt length.

Maximum Length - Maximum allowable average bolt length in stacked measure shall be 3.14 m class. Stacked scaling of roundwood greater than 3.14 metres in bolt length is not recommended due to the affect that longer bolt lengths have on stacked volume and solid wood content. Scaling of stacked wood beyond this length should be achieved by weight scaling methods outlined in Chapter 16 of this manual, Mass Scaling - Weighing. Notwithstanding this limit, roundwood greater than 3.14 metre bolt length may be scaled by stacked wood methods if a written agreement exist, between all parties involved in the transaction, affirming the acceptance of this procedure.

12.4 Calculation of Average Dimensions (Metric)

A scaler shall calculate and record the average height, length and width to the nearest 0.01 m unit.

Example: The following height measurements have been taken on a pile of pulpwood:

Side 1	Side 2
1.74	1.78
1.94	1.98
2.32	2.24
2.12	2.14

$$\text{Average height} = \frac{\text{sum of heights}}{\text{number of height measurements}}$$

$$= \frac{16.26}{8}$$

$$= 2.0325$$

$$= 2.03 \text{ m}$$

Note: The average height, length and widths are to be rounded to the nearest 0.01 m and shall be used to determine gross volume.

12.5 Gross Volume Calulation (Metric)

Gross volume in stacked cubic metres shall be calculated with the use of the following formula:

$$GVS = L \times H \times W$$

Where GVS = gross volume stacked expressed with a precision 0.01 m^3 (st)
L = length of stack in metres (0.01)
H = height of stack in metres (0.01)
W = width of stack in metres (0.01)

12.6 Deduction for Long and Short Wood (Metric)

If wood is over the specified length no upward adjustment is made for over length bolts. In fact long bolts can cause manufacturing problems. Deductions may be made for individual over-length bolts and loads may not be accepted if a lot of the bolts do not fall within the tolerance limits.

There are two common methods of making allowance for short wood:

(i) Compute average bolt length and use this figure to compute volume, or

(ii) Assume that bolt length is correct (2.44 m commonly) and compute the volume on this basis and then make a deduction for shortwood. When using this method, allowance for short wood is a deduction.

In 2.44 m wood a difference of 2 cm in bolt length, affects volume by 0.82%. For ease of application, it is recommended that the following rule be applied:

For each 2 cm that the wood is short of required length reduce the volume one percent (1%). For example, if the wood is 14 cm short, reduce the volume 7%.

Individual bolts in a load or pile between 2.42 and 2.60 m shall be scaled with no adjustment for length, so long as the average length is not less than the 2.44 m class. Deductions for short wood shall be made if the average length is less than the 2.44 m class.

Buyers shall retain the right to either refuse or accept loads in which more than 10% of the volume is contained in bolts more than 2.60 m in length depending on the capability of the mill to utilize this long wood without creating manufacturing problems.

These recommended procedures for allowing for short or long wood are for use if no other guidelines are provided. If they conflict with any other conditions of agreement of sale or purchase, then the conditions of the agreement shall take precedence.

12.7 Deductions for Defects and Voids (Metric)

The common defect classifications are rot, void, size and other. As explained previously, deductions in 2.44 m wood are made on both faces of the stack and are assumed to extend halfway through the bolt. Deductions on 1.22 m wood are made on one face of the stack and assumed to extend through the full length of the bolt so the same deduction table can be used for both lengths of wood.

The factor for converting solid contents of 2.44 m wood to stacked measure is slightly larger than the conversion factor for converting solid contents of 1.22 m wood to stacked measure. However, the difference is considered insignificant and for simplicity the same deduction table is used for both 2.44 m and 1.22 m wood. The amount of 1.22 m wood cut annually is small and expected to further decline. Note that because there is a larger variation in the conversion factors for softwood and hardwood separate deduction tables have been made for them in metric units.

Volumes of defects and voids shall be calculated using the following formula:

$$V = A \times L \times \text{Factor}$$

Where V = volume of defect or void expressed to a precision of 0.01 m^3(st)
*A = area of defect or void in square metres
L = length of bolt in metres where one side of stack is measured, but where two sides of stack are measured L equals one half of the bolt length;
Factor = expansion factor from solid wood to space occupied

* area m^2 = (0.0000785) (diameter of defect cm)^2

The conversion factor is the relationship between stacked measure and solid contents and is the same when computing either stacked cubic metres or cords. In Nova Scotia the factor to be used is 1.60 for rough (unpeeled) softwood. The conversion factor for 2.44 hardwood is 1.75. In 2.44 m wood, the solid volume of each half bolt length is computed as a cylinder based on the area of the end under consideration.

Voids - A void is an unnecessary air space large enough to accommodate the average size of a bolt in the stack (or load) and can usually be eliminated by careful piling. When a void occurs in the form of a definite hole in the face of a pile, the scaler shall estimate the diameter of a bolt required to fill the void and make a corresponding deduction.

The size of void is expressed by the diameter of the largest circle that could be contained in the void, expressed in 2 cm classes. If a void is a lot larger than the average diameter of the bolts in the pile, estimate the diameter and volume of two or more smaller bolts that would fill the void.

Unnecessary air space may occur in the form of overall loose piling rather than distinct "holes". This is usually caused by poor limbing or improper piling. If loose piling frequently occurs, the scaler should notify the appropriate people and try to have the situation corrected.

Other Defects - Deductions shall be made for oversize, undersize, crook, fork and individual poorly cut bolts in accordance with the specifications of the purchaser.

Charred Wood - Charred wood is an unacceptable defect in pulpwood. Delivered wood may be rejected if it contains any charred wood at the discretion of the purchaser.

Deduction Tables - Deduction values of defects or voids, by diameter class, in stacked cubic metres for 1.22 m and 2.44 m softwood are shown in Table 3. Deduction values of defects or voids, by diameter class, in stacked cubic metres for 1.22 m and 2.44 m hardwood are shown in Table 4. These tables show volumes in stacked cubic metres and mass in both metric tonnes and kilograms. These tables can be used for making deductions in either or both mass (weight) or volume for defective bolts. Mass may be expressed in either metric tonnes or kilograms. Several 2 cm classes have been grouped for ease of application.

Table 3. Deductions for 1.22 m and 2.44 m softwood.

SOFTWOOD PULPWOOD (metric units)			
Diam Class (cm)	**m^3 (stacked)**	**t**	**kg**
8 - 14	0.02	0.01	10
16 - 26	0.07	0.04	40
28 - 38	0.17	0.09	90
40 - 50	0.31	0.16	160
52 - 62	0.50	0.26	260
64 - 76	0.75	0.40	400
78 - 90	1.08	0.57	570

Table 4. Deductions for 1.22 m and 2.44 m hardwood.

HARDWOOD PULPWOOD (metric units)			
Diam Class (cm)	**m^3 (stacked)**	**t**	**kg**
8 -14	0.02	0.01	10
16 -26	0.08	0.04	40
28 -38	0.18	0.11	110
40 -50	0.34	0.20	200
52 - 62	0.55	0.31	310
64 -76	0.82	0.48	480
78 - 90	1.19	0.68	680

NOTE: On 2.44 m wood - make deductions on both faces. On 1.22 m wood - make deductions on one face. These simplified tables for grouped diameter classes were developed from Appendices XI and XII which show defect volumes computed for 2 cm classes for Softwood and Hardwood respectively.

Deductions for Undersized Bolts - If minimum acceptable diameter is 8 cm: Determine the number of undersize ends on the load, divide by two and multiply by 0.01 m^3 (stacked). i.e. 24 undersize ends = 24/2 x 0.01 = 0.12 m^3 (stacked).

If the minimum acceptable diameter is 10 cm: Determine the number of undersize ends on the load and multiply by 0.01 m^3 (stacked) i.e. 16 undersize ends = 16 x 0.01 = 0.16 m^3 (stacked).

Stacked Wood Tally - The following information shall be recorded on the tally form:

(i) Date

(ii) Buyer and/or seller depending on for whom the scale is being made.

(iii) Location - The location of where the wood is actually scaled.

(iv) Gross Scale

(v) Deductions

(vi) Net Scale

(vii) Scaler's Name

(viii) Scaler(s) license number(s)

(ix) Recording Units - The tally shall be recorded in stacked cubic metres to the minimum precision as outlined in the preceding chapter.

12.8 Scaling Stacked Wood in Canadian Yard/Pound Units

The unit of measure for scaling stacked wood in the Canadian Yard/Pound system is the cord. This unit is defined as follows: **One cord means 128 cubic feet of stacked roundwood (whole or split, with or without bark) containing wood and airspace with all bolts of similar length piled in a regular manner with their longitudinal axis approximately parallel.**

12.9 Measuring Pile Dimensions

When scaling in cords, measurements shall be made to the nearest tenth of a foot and scale rules and tapes shall be graduated accordingly. The measurement of pile dimensions (length, width, height) when scaling in cords is exactly the same as scaling in stacked cubic metres, excluding measurement units (see Section 12.3).

The maximum recommended interval distance is five feet. For ease of application, heights are often measured at the centre of four foot intervals. Average measurements are computed to the nearest tenth of a foot.

12.10 Gross Volume Calculation

Gross volumes in cords shall be calculated with the use of the following formula:

$$GVS = \frac{L' x W' x H'}{128}$$

Where GVS = gross volume stacked expressed to a precision of 0.01 cords
L = length of stack to nearest tenth of a foot (0.1)
H = height of stack to nearest tenth of a foot (0.1)
W = width of stack to nearest tenth of a foot (0.1)

12.11 Deductions for Long and Short Wood

If wood is over the specified length, no upward adjustment is made for over-length bolts. In fact, long bolts can cause manufacturing problems. Deductions may be made for individual over-length bolts, or loads may not be accepted if a lot of the bolts do not fall within the tolerance limits.

If four-foot wood is one tenth of a foot short it reduces volume 2.5%

If eight-foot wood is one tenth of a foot short it reduces volume 1.25%.

The common defect classifications are rot, void, size and other. Deductions in 8 foot wood are made on both faces of the stack and are assumed to extend halfway through the bolt. Deductions on 4 foot wood are made on one face of the stack and assumed to extend through the full length of the bolt so the same deduction table can be used for both lengths of wood.

Volumes of defects and voids shall be calculated with the use of the following formula:

$$V = \frac{A \times L \times Factor}{128}$$

Where V = volume of defect or void expressed to a precision of 0.01 cords
*A = area of defect or void in square feet
L = length of bolt in feet where one side of stack is measured, but where two sides of stack are measured L equals one half of the bolt length;
Factor = expansion factor from solid wood to space occupied

Deduction Tables - Canadian Yard/Pound Units - Deduction values of defects or voids, by diameter class, in cords for 4 foot and 8 softwood are shown in Table 5. This table is recommended for use in making deductions when scaling stacked wood in cords. The table is designed to estimate the volume of softwood bolts. The volume of hardwood bolts does not vary significantly through the normal range of sizes, so the table is also recommended for use in scaling hardwood.

The cord is a much larger unit than the stacked cubic metre. The volume of both units is expressed to 0.01 units. The expressed volume of softwood and hardwood bolts in the common range of sizes will often be the same when expressed to 0.01 cords. This is why the same table is used for making deductions in both softwood and hardwood when volume is expressed in cords, but different tables are used for deductions when measuring in stacked cubic metres.

* area $ft^2 = (0.005454)$ (diameter of defect inches) ^{2}

Table 5. Deductions for 4 foot and 8 foot softwood or hardwood.

SOFTWOOD OR HARDWOOD (cords)	
Diameter Class (inches)	**Volume (cords)**
3 and less	4 bolts = 0.01
4	2 bolts = 0.01
5, 6, 7	= 0.01
8, 9	= 0.02
10, 11	= 0.03
12	= 0.04
13, 14	= 0.05
15	= 0.06
16	= 0.07
17	= 0.08
18	= 0.09
19	= 0.10
20	= 0.11

NOTE: On 8 foot wood - make deductions on both faces. On 4 foot wood - make deductions on one face.

Table 5 based on formula $(0.005454 \times D^2 \times 1.60 \times 4) \div 128 = \text{Cords}$

Where D = diameter of the bolt in inches

13. DOT GRID METHOD OF SCALING

13.1 General Procedures

This method is based on the principle of the dot grid used in calculating area of land or forest types from maps or aerial photographs. The method is particularly adapted to measuring the volume of small irregularly shaped piles of wood normally encountered in "trail cut" wood.

The measuring instrument is a rectangular piece of clear plastic with dots spaced on a grid to represent a given number of units of volume.

To use the grid, place it vertically against the face of the pile starting at one end and ensuring that all wood on the extremity of the pile is covered by the grid. Count the dots falling on the end surface of the pile. Dots are also counted that fall on the interstices between bolts. If the grid does not cover all the surface area of the pile, mark the edge of the grid on the pile face with a lumber crayon and move the grid to a new position with the edge of the grid lined up with the mark indicating the edge of the grid in its previous position and repeat the procedure of counting dots. Move the grid as often as necessary to cover the whole face of the pile.

If there is a predominance of butts on one face of the piles, alternate the pile faces on which the grid is applied. To obtain a more precise measurement of an individual pile with widely varying surface area of the two ends, apply the grid to both faces and determine the average number of dots.

The spacing of the dots on the grid determine the volume represented by each dot.

The total number of dots multiplied by the volume represented by each dot equals volume.

The volume obtained will be gross scale and deductions will have to be made for void and defects using the deduction tables shown in the preceding chapters.

The dot grid will under scale individual bolts because the volume of individual bolts is solid contents and the grid is designed for measuring stacked contents. Multiplying the solid volume so obtained of one or more bolts measured individually by the conversion factor between solid and stacked contents should give a reasonable estimate of stacked volume.

The sketch (see Figure 57) shows how the grid would be applied to the pile, if the grid had to be placed in three different positions to cover the face area of a pile.

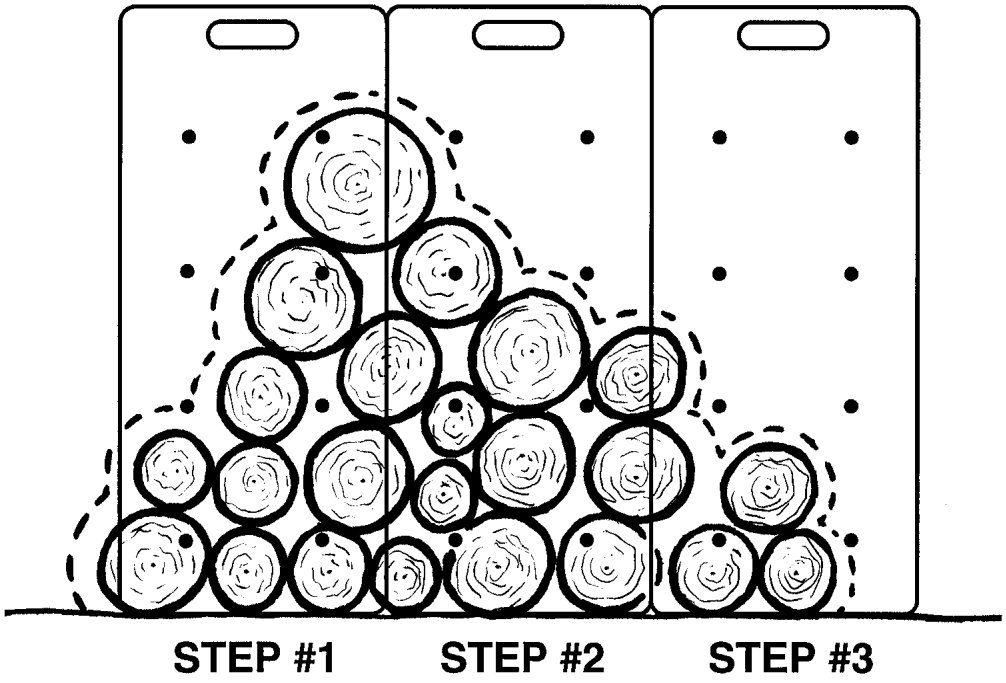


Figure 57. Dot grid applied to a stack.

13.2 Dot Grid for Scaling in Cords

Suppose the scaler wants to establish a grid so that 50 dots represent the face area of a pile of eight-foot pulpwood. A cord of eight-foot wood has a face area of 16 square feet, which is equal to 4' x 4' or 48" x 48" = 2304 square inches. Therefore, the scaler wants 50 dots to represent 2304 square inches.

1 dot represents 2304 ÷ 50 = 46 square inches

6.8" x 6.8" = 46 square inches

Make a grid of 6.8 x 6.8 square inches with a dot in the centre of each square. A count of 50 dots on the face area of eight-foot wood should equal one cord.

Each dot represents 0.02 cords (1.00 ÷ 50 = 0.02).

Count the dots falling on the face area of the pile and multiply by 0.02 to obtain gross cords.

13.3 Dot Grid for Scaling in Stacked Cubic Metres

When making a metric dot grid, the scaler should remember that the stacked cubic metre is a much smaller unit than the cord. Therefore, it would be appropriate to have 20 dots represent 1 stacked cubic metre in 2.44 m wood.

In 2.44 m wood a pile with a surface area of 64 cm x 64 cm = 1 m^3 (stacked).

Example:

0.64 m x 0.64 m x 2.44 m = 1.00 m^3 (stacked)

a surface area of 64 cm x 64 cm = 4096 cm^2

therefore if 20 dots = 4096 cm then 1 dot = 4096 ÷ 20 = 204.8 cm^2

14.3 cm x 14.3 cm = 204.8 cm^2 (approximately)

Make a grid with 14.3 cm x 14.3 cm squares with a dot in the centre of each square. A count of 20 dots on the face area of a pile of 2.44 m wood would represent a stacked cubic metre.

Each dot represents 0.05 m^3 (stacked) (1 ÷ 20 = 0.05). Count the number of dots and multiply by 0.05 to obtain gross volume expressed in stacked cubic metres.

14. STUDWOOD

14.1 Measurement Procedures

The same general measurement procedures are used to scale studwood as other stacked wood products as previously outlined in this manual. Studwood shall be volume scaled in cords or stacked cubic metres or weighed and recorded in kilograms or tonnes (metric).

Studs are pieces of lumber usually eight, nine or ten feet long with thickness and width dimensions of 2" x 3", 2" x 4" and 2" x 6".

Studwood is eight, nine and ten foot roundwood bolts (plus trim allowance) intended for manufacture into studs.

14.2 Studwood Deductions

Common defects include rot, crook, sweep, undersize or oversize and shortwood. Deductions for these defects shall be made as per the procedures outlined in Chapter 12 or Chapter 17.

If studwood is properly cut, the only deductions required should be for voids (if volume scaled). However, if unsuitable bolts are encountered the scaler has to consider the end product to be produced. In practice, if bolts that do not meet mill specifications are encountered, deductions may be made. It is acceptable to deduct an entire bolt when defects occur that prohibit the production of lumber 8 feet long plus trim.

Generally three tenths of a foot (0.3') should be sufficient trim allowances in most cases to ensure that studs are long enough to be “square trimmed”.

15. FUELWOOD

15.1 Measurement Procedures

The same general measurement procedures are used to scale fuelwood as other stacked wood products as previously outlined in this manual. An individual or organization involved in the scaling of fuelwood in quantities exceeding one thousand cubic metres per year shall use the services of a licensed scaler as per Section 8 (2) of the Scalers Act.

In general, the measurement of fuelwood comes under the jurisdiction of the Weights and Measures Division of Consumer and Corporate Affairs. The legal interpretation under this Act is that the volume shall be the volume at time of delivery.

The Weights and Measures Act also requires that a statement of quantity must accompany the delivery of fuelwood unless the fuelwood was measured in the presence of the purchaser.

Fuelwood is still generally scaled in cords in Nova Scotia. When fuelwood is cut in lengths of five feet or shorter (generally in 1 - 2 foot lengths for use in stoves or furnaces) measurements shall be made on one side of the stack. Scalers should be aware that the shorter the bolt length, the more critical accurate bolt length measurement becomes.

Fuelwood is often sold in eight-foot lengths for ease of mechanical handling. If this is the case, length and height measurements shall be taken on both sides of the stack. A load of eight-foot wood will always measure less than its' original scale after it has been processed into shorter lengths and re-piled. This is due to the reduction of air space that is a result of the shorter bolts packing together more tightly.

15.2 Fuelwood Deductions

The only defect classifications in scaling fuelwood are void and missing wood. Deductions for these defects shall be made as per the procedures outlined in the stacked wood section of this manual.

16. MASS SCALING - WEIGHING

16.1 General Procedures

When scaling primary wood products by mass, a scaler shall determine the mass by use of motor vehicle scales or other appropriate weighing machines that conform to the Weights and Measures Act (Canada) and Regulations thereunder.

The weigh scales shall be of sufficient capacity to determine the mass of the loaded vehicle in one operation.

The mass of the primary wood product shall be determined and expressed to the nearest 10 kg or 0.01 tonne and shall include, if present, bark, moisture, rot, and foreign material.

The scaler shall:

i) weigh the primary wood products on the vehicle which is transporting them to determine their gross mass.

ii) After the products are unloaded the empty vehicle shall be re-weighed to determine tare.

iii) The mass of the load shall be determined by subtracting the tare from the gross mass.

16.2 Mass to Volume Conversion

Where mass is converted to volume, a mass to volume conversion factor shall be applied, as approved by the Minister or designate, or by written contract.

16.3 Deductions in Mass

A scaler may make deductions for the mass of defective or non-conforming material. For mass deductions of stacked wood refer to Chapter 12 of this manual. The methodology for sawlog deductions must be approved by the Minister or designate, or specified in a written contract.

16.4 In-Service Limits of Error

The tolerances for truck scales (Class IIIHD devices) are defined in section 8(3) of Measurement Canada's Specifications for Non-Automatic Weighing Devices. In Table 6 that follows, "m" represents the applied load on the scale in terms of the number of verification scale intervals (usually 10 kg for truck scales). For example, if m = 1000, that means that the applied load is 1000 x 10 kg = 10, 000 kg.

The " Limits of Error" column is expressed in terms of the number of "verification scale intervals" (usually 10 kg). For example if the range is 500 < m< = 1300, the tolerance is +-2e = +-20 kg.

Table 6. In-service limits of error.

Class III HD		Class III HD	
Limit of Error	**Load m**	**Limit of Error**	**Load m**
± 1 e	0 ≺ m ≤ 500	± 12 e	8500 ≺ m ≤ 9300
± 2 e	500 ≺ m ≤ 1300	± 13 e	9300 ≺ m ≤ 10100
± 3 e	1300 ≺ m ≤ 2100	± 14 e	10100 ≺ m ≤ 10900
± 4 e	2100 ≺ m ≤ 2900	± 15 e	10900 ≺ m ≤ 11700
± 5 e	2900 ≺ m ≤ 3700	± 16 e	11700 ≺ m ≤ 12500
± 6 e	3700 ≺ m ≤ 4500	± 17 e	12500 ≺ m ≤ 13300
± 7 e	4500 ≺ m ≤ 5300	± 18 e	13300 ≺ m ≤ 14100
± 8 e	5300 ≺ m ≤ 6100	± 19 e	14100 ≺ m ≤ 14900
± 9 e	6100 ≺ m ≤ 6900	± 20 e	14900 ≺ m ≤ 15700
± 10 e	6900 ≺ m ≤ 7700	± 21 e	15700 ≺ m ≤ 16500
± 11 e	7700 ≺ m ≤ 8500	± 22 e	16500 ≺ m

16.5 Weigh Scale Maintenance and Testing

Weigh scale maintenance and testing is crucial to ensuring consistent and accurate measurement of primary wood products. The following visual inspections, usage tests and weight indicator tests are minimum recommended practices that should be included in all scale operators routine scale maintenance programs.

If problems are detected, beyond acceptable tolerances, immediate attention is required to remedy the problem. Scale owners and operators are legally responsible to ensure corrective action is taken. If this is not possible, other means of measurement are to be used.

16.6 Weigh Scale Visual Inspection

The following visual inspections should be carried out on a regular basis.

(i) Scale approach, platform and surrounding area free of foreign material.

(ii) Scale load cell units free and clear of debris (ice, snow, water, mud or dirt).

(iii) Under the scale and ends also free and clear of debris.

(iv) Note the function of the weight displays. Compare indicator, scoreboard and printer to ensure agreement of registration.

16.7 Weigh Scale Usage Tests

For attended scales, verify that the operator is zeroing the scale before a load is supported on the truck scale. The operator must visually confirm that the load being weighed is fully supported on a scale before printing the weight.

For fully unattended scales, an automatic means (ie. green light) must be indicated to the driver that the indicating element of the scale has returned to zero and the operator may drive onto the weigh scales. An automatic means (ie. magnetic strip, light sensor, etc.) must prevent weight indications and the printing of weight tickets unless: i) the scale has returned to zero before weighing the vehicle; and ii) the load is fully supported on the weighbridge.

When loads are removed from scales, also observe the time required for the display to return to zero. The scale must return to zero within 30 seconds (unless affected by extreme wind or weather conditions).

16.8 Section Test

This test will indicate whether the device is weighing consistently at all points on the platform and will provide indication of a malfunctioning load bearing point (load cell, lever).

The test is carried out by using a test vehicle (truck or loader) with a recommended minimum weight of 20000 kg.

To test the sections, first zero the scale and then move the test vehicle onto the scale as close to the inbound end as possible and record the weight. Ensure that the load being weighed is fully supported on the scale. Move the test vehicle three to five positions on the scale (full coverage from end to end) and record the weight each time. The same procedure is then repeated by turning the vehicle around and moving it across the scales in the opposite direction.

The scale must return to zero when the truck is off the scale platform.

The difference between the highest and lowest reading gives the section error found on the scale. The scale is not within tolerance if the error is greater than the limits, as defined under the Weights and Measures Regulations.

A tolerance guideline, for Motor Vehicle scales weighing in 10 kg increments, is as follows:

Test Vehicle Weight	Tolerance
20 000 kg	30 kg
30 000 kg	50 kg
40 000 kg	60 kg
60 000 kg	80 kg

Example: Weights direction 1: 40300 40320 40380 40310
Weights direction 2: 40290 40310 40370 40300

Greatest difference is 40380 - 40290 = 90 kg

Error exceeds section error tolerance therefore maintenance is required.

Note: Measurement Canada administers and enforces the Weights and Measures Act, which regulates approval, usage, inspection, and enforcement of weighing devices. Sections 16.4 -16.8 are included in this manual for information purposes and were developed in consultation with Measurement Canada.

17. Studwood Deductions by Sample (Mass)

17.1 General

Scaling by mass has become the preferred method at many high volume wood processing facilities. For sawable products such as studwood this means the roundwood products are on trucks and piled in a regular manner. This presents a challenge to the scaler in terms of identifying cull material. It is very difficult to identify defect such as sweep, crook, forked tops, etc. that are not accessible to view while loaded on a truck. Unloading and spreading of the entire load is time consuming, cost prohibitive, and impractical. A practical method is to extract a sample from the load which may be closely examined and the deductions from this sample applied to the entire load.

17.2 Procedure **(See Example of a sampling tally card with information).**

i) weigh the entire load of wood products to determine gross mass (Line 1).

ii) the sample will be extracted from the load and the truck re-weighed (Line 2).

iii) the truck will then proceed to the woodyard or other destination where it will be fully unloaded. It will then return to the scale where the mass of the unloaded truck, tare weight, will be determined (Line 3).

iv) the mass of the fully loaded truck minus the mass of the unloaded truck will yield the net mass - weight of wood (Line 4).

v) for studwood a minimum sample size of 75 bolts or 3 tonnes will be unloaded. The sample shall be chosen in an random manner (Line 5).

vi) The mass of the truck fully loaded minus the mass of the truck after the sample has been unloaded will yield the mass of the sample (Line 6).

An alternative method of extracting the sample is for a loader to be used. The loader shall take the sample from the truck and proceed to the scale where it's mass including the sample will be recorded. The sample will then be spread out and the loader re-weighed. It is crucial that the loader be re-weighed instead of a stored tare weight being used. The mass of the loader with sample minus the mass of the empty loader will yield the mass of the sample.

vii) The sample shall then be spread out so that each bolt can be assessed.

viii) The number of cull bolts and the number of undersize bolts shall be recorded separately (Line 7 and 8 respectively) .

ix) Divide the mass of the sample by the number of bolts in the sample to yield the representative weight of each bolt (Line 9).

x) The total mass of the cull bolts for the sample is obtained by multiplying the number of cull bolts by the representative weight of each bolt (line 10).

xi) Since undersize bolts are by default smaller than the average diameter, the weight represented by the average undersize bolt in the sample is acquired from Table 7. The total mass of the undersize bolts for the sample is then obtained by multiplying the number of undersize bolts by appropriate representative weight from Table 7 (Line 11).

xii) The total of all cull and undersize bolts for the sample is then summed (Line 12).

xiii) The ratio of the mass of defective bolts in the sample is applied to the net weight of the load to yield the total deduction of mass for the load.

NOTE: Mass of defective bolts may be classified as a down graded product such as pulpwood and paid for at an agreed rate.

17.3 Example of deductions based on sampling

A truck loaded with 2.44 metre studwood arrives at a mill and drives onto the weigh scale. The gross mass (weight) is recorded as 51.24 tonnes. The truck them proceeds to a designated sampling area where at least 75 bolts are unloaded and spread out. The truck then returns to the scale where it is weighed again. The weight of the truck without the sample is now 46.40 tonnes. Subtracting 46.40 tonnes from 51.24 tonnes will yield a sample weight of 4.84 tonnes.

The truck then proceeds to the wood yard where it will offload the rest of the load and then return to the scale where it will tare out. The tare weight (empty truck weight) is 21.00 tonnes. Subtracting 21.00 tonnes from 51.24 tonnes will yield a net weight of 30.24 tonnes.
The bolts are examined for defect and undersized wood. Four bolts are determined to be culls. On this particular load the average undersized bolt diameter was 9 centimetres. There are 2 undersize bolts found in the sample. The following tally card has been completed using the above information to determine the appropriate deduction in mass for the entire load.

17.4 Example of a sampling tally card with information

Cull bolt count from assessment of sample.

Undersize (diameter)	2	Sweep		Short	
Rot	2	Off species		Seam	
Dead		Crook	1	Fork	1

Table 7. Mass represented by an individual undersized bolt of a given diameter and length.

	* Length (m /feet)		
Diameter(cm)	2.52 m / 8 ft	2.84 m / 9 ft	3.14 m / 10 ft
8	0.011 t	0.012 t	0.014 t
9	0.014 t	0.015 t	0.017 t
10	0.017 t	0.019 t	0.021 t
11	0.021 t	0.023 t	0.026 t
12	0.024 t	0.028 t	0.030 t

* Nominal studwood length plus 8 cm of trim.

Date _____ Time _____ Contract # _____

Contractor ID_____ Trucker ID _____

Line 1	Gross mass.....	51.24 t
Line 2	Mass, after sample is unloaded	46.40 t
Line 3	Tare (weight of unloaded truck)	21.00 t
Line 4	Net mass (weight of wood) (line1 minus line 3)	30.24 t
Line 5	Number of bolts sampled	100
Line 6	Mass of sample (line 1 minus line 2)	4.84 t
Line 7	Number of cull bolts	4
Line 8	Number of undersized bolts	2
Line 9	Average weight per bolt (line 6 divided by line 5, *to 3 decimal places*)	0.048 t
Line 10	Total mass of cull bolts for sample (line 7 multiplied by line 9)	0.192 t
Line 11	Total mass of undersized bolts for sample (line 8 multiplied by value from Table 1)	0.028 t
Line 12	Total mass of cull and undersize bolts for sample (add lines 10 and 11)	0.220 t

Total mass of cull and undersize bolts for this load equals (Line 12 x Line 4) ÷ Line 6

(0.220 t x 30.24 t) ÷ 4.84 t = 1.37 t

18. WOODCHIPS

18.1 General

This section will outline the measurement procedures for a single woodchip as well as a sample of woodchips.

The quality or acceptability of woodchips will be determined by the purchaser's specification.

18.2 Measuring Individual Woodchips

Woodchip dimensions shall be measured in millimetres.

The dimensions of a woodchip shall be measured with a graduated scale or ruler or with a gauge.

Total length - Total length means the longest distance, measured parallel or diagonal to the grain, between the two knife cuts of a wood chip (see Figure 58).

Mean length - Mean length is defined as being the arithmetic mean distance between the beginnings of two consecutive cuts measured parallel to the grain.

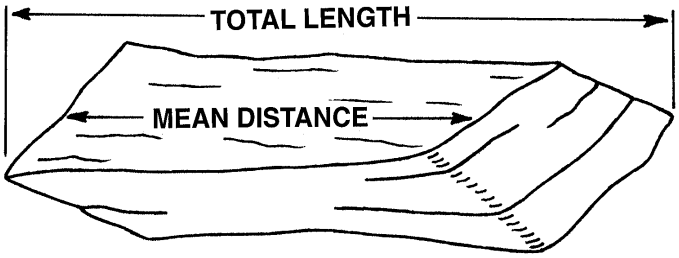


Figure 58. *Length of individual chip.*

Total thickness - Total thickness means the greatest thickness between the two large surfaces of a wood chip measured perpendicular to the grain (see Figure 59).

Effective thickness - Effective thickness shall be determined as the arithmetic mean thickness, measured perpendicular to the grain and to the cut ends of the woodchip between the two closest nonadjacent surfaces or fissures.

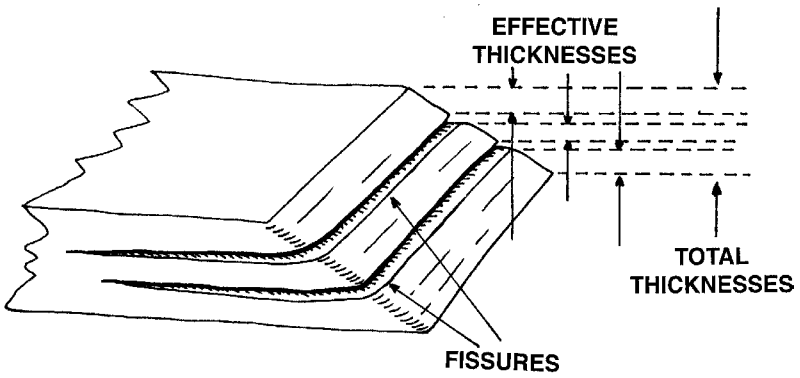


Figure 59. *Thickness of individual chip.*

Width - Width is determined as the arithmetic mean width of the wide surface from side to side.

18.3 Classification of Woodchips

Woodchips may be classified according to their dimensions and forms such as fines, pins, accepts, and oversize. Approximate definitions follow.

(i) Fines - any material very short in length and/or less than 5 mm thick.

(ii) Pins - any material within the normal length range but less than 10 mm in width.

(iii) Accepts - any chip dimension defined as acceptable by the purchaser.

(iv) Oversize - any chip that is too thick, over 8 mm, or too long, 40 mm.

18.4 Determination of Size and Form

An approximate classification of a sample of woodchip material as to size (length or thickness) may be achieved with the use of a mechanical or scanning device. The mechanical device is either a series of round-hole sieves of diminishing diameter holes mounted one on top of the other, square wire mesh sieves of diminishing size mounted one on top of the other, or sieves of parallel steel rods or slots mounted one on top of the other, or adjustable slats mounted in a cylinder that permits various thicknesses to be set.

The measurement of the distribution of size classes shall be made from a representative sample as follows:

(i) the gross mass of woodchips is determined;

(ii) the dimensions of the woodchips are established mechanically;

(iii) the woodchips are distributed in containers corresponding to the size classes;

(iv) the gross mass of each size class is determined;

(v) the ratio of the mass of each class to the total mass of the sample is then calculated;

(vi) more precision can be obtained by using oven-dry woodchip weights.

18.5 Bark Content

Bark is generally considered to be a foreign or unwanted material in chips. The actual percentage that is tolerable will be defined by the purchaser's chip specifications or pulping process.

Generally, in order to determine the bark content in a woodchip sample, the bark must be separated from the woodchips. The most common and practical method is manual separation.

The measurement of the bark content shall be made from a representative sample as follows:

(i) the gross mass of the woodchips with bark is determined;

(ii) the bark is separated manually from the woodchips and placed in a separate container;

(iii) the gross mass of the bark is determined;

(iv) the ratio of the mass of the bark to the total mass of the sample is then calculated.

18.6 Species Identification of Woodchips

Woodchips can be identified according to tree species by a microscopic examination of their anatomical characteristics by a qualified technician.

The percentage of hardwood versus softwood chips in a sample can be determined by chemical analysis as outlined in the CSA Standard O302.2-00.

APPENDIX I

SCALERS ACT

CHAPTER 11
OF THE ACTS 2001

An Act Respecting the Scaling of Primary Wood Products

Be it enacted by the Governor and Assembly as follows:

1 This Act may be cited as the Scalers Act.

2 In this Act,

(a) "active scaling licence" means the status of a licence issued to a scaler who has attended the requisite scaling and refresher courses and passed the required examinations;

(b) "Board" means the Board of Examiners appointed under this Act;

(c) "Department" means the Department of Natural Resources;

(d) "enforcement officer" means a person designated as a conservation officer under the Crown Lands Act, the Forests Act or the Wildlife Act, a regional, municipal or town police officer, a member of the Royal Canadian Mounted Police or a person designated under this Act;

(e) "licence" means a licence issued under this Act;

(f) "Minister" means the Minister of Natural Resources;

(g) "primary wood products" means any commercially valuable raw material, consisting essentially of xylem, obtained from the stems or limbs of a felled or cut tree including, but not limited to, roundwood and woodchips;

(h) "scale" means to measure or estimate the quantity, expressed as the volume, area, length, mass or number, of products obtained from trees after they are felled;

(i) "scaler" means a person qualified to scale primary wood products who is licensed under this Act;

(j) "scaling manual" means the manual prepared by the Supervisor of Scaling pursuant to this Act;

(k) "stacked wood" means primary wood products measured collectively;

(l) "Supervisor of Scaling" means the person appointed by the Minister to supervise scaling practices in the Province.

3 The Minister may, in writing, delegate to any person a power or duty conferred or imposed on the Minister under this Act or the regulations.

4 (1) The Governor in Council may appoint a Board of Examiners consisting of four persons.

(2) One member of the Board shall be appointed from the sawmill sector of the forestry industry, one member from the pulpwood sector of the forest industry, one member from the small private land tenure sector who does not operate a sawmill or pulpmill and one member from the Department.

(3) The members of the Board from the sawmill sector and the pulpwood sector must be or represent registered buyers, as defined in the Forests Act and regulations.

(4) The member of the Board appointed from the Department is the Chair of the Board.

(5) The Board shall determine the qualifications of candidates for licences as scalers and shall perform such other duties as the Minister prescribes.

(6) The Chair and two other members of the Board constitute a quorum.

(7) The members of the Board shall be paid such remuneration and be reimbursed for such reasonable expenses as determined by the Governor in Council.

(8) The Supervisor of Scaling and one other employee of the Department, in addition to the Department member appointed as a member of the Board, shall act as advisers to the Board.

5 (1) The Minister shall appoint a person to be the Supervisor of Scaling.

(2) The Supervisor of Scaling shall

(a) ensure that scaling courses for new scalers and refresher courses for licensed scalers are held as required;

(b) set the standards for scaling course curricula and examinations;

(c) ensure that applications to attend courses and for licences are processed in an efficient manner;

(d) oversee and monitor all scaling examination processes to ensure standards are consistently adhered to;

(e) present examination results to the Board;

(f) develop and periodically publish mathematical factors to be used when converting the volume or mass of primary wood products from one common unit of measure to another;

(g) prepare the scaling manual required by this Act;

(h) monitor the accuracy of licensed scalers by periodically carrying out check scales of primary wood products scaled by licensed scalers in accordance with the general practices and procedures identified in the scaling manual; and

(i) perform such other duties as the Minister may from time to time prescribe.

6 The Board shall sit at such places and on such days as determined by the Board for the purpose of considering examination results and shall make recommendations regarding the licensing of each individual candidate.

7 (1) The Minister shall issue to any person so recommended by the Board

(a) a stacked wood licence, which authorizes a scaler to scale primary wood products measured collectively, including making deductions;

(b) a log scaling licence, which authorizes a scaler to scale primary wood products measured individually; or

(c) a primary wood products scaling licence, which authorizes a scaler to scale all primary wood products.

(2) The Minister shall revoke the licence of any scaler who neglects or fails to comply with this Act or the regulations, upon the recommendation of the Board.

(3) A person is not required to have a licence to weigh primary wood products if no conversions, deductions or quality assessments are made on the weighed primary wood products.

(4) A person who holds a licence pursuant to Chapter 411 of the Revised Statutes, 1989, the Scalers Act, on the coming into force of this Act shall be granted a licence pursuant to subsection (1) to carry out the activities referred to in clauses (a), (b) and (c), whichever licence is equivalent to the licence held by that person on the coming into force of this Section.

8 (1) Subject to subsections (3) and (5), no person shall be employed as a scaler or act as a scaler unless that person holds an active scaling licence.

(2) An individual or organization involved in the scaling of primary wood products, other than the weighing only of those products, in quantities exceeding one thousand cubic metres per year shall use the services of a licensed scaler to scale those products.

(3) A scaling licence is not required

(a) if a person or organization is involved in the measurement of primary wood products in quantities less than one thousand cubic metres per year;

(b) to count or grade Christmas trees; or

(c) to fulfil the practical requirements of a novice scaler under the supervision of a licensed scaler.

(4) A scaler shall complete a refresher course every five years in order to retain a valid and active scaling licence.

(5) The Supervisor of Scaling may issue a special authorization to a person competent in scaling, authorizing that person to act as a scaler, but the special authorization is valid only until the first day of the next scheduled scaler licensing course.

9 (1) Subject to the approval of the Board, the Supervisor of Scaling shall prepare, and amend as required from time to time, in accordance with subsection (2), a scaling manual.

(2) The scaling manual may set out

(a) the qualifications necessary for each type of scaling licence;

(b) how examinations will be conducted, listing the pass requirements in written and practical scaling examinations and species identification;

(c) the terms and conditions of scaling licences;

(d) the acceptable units of measure;

(e) the duties of licensed scalers;

(f) scaling standards and procedures for the scaling of primary wood products in the Province;

(g) the mathematical factors to be used to convert the volume or mass of primary wood products from one common unit of measure to another common unit of measure;

(h) methods of settling scaling disputes;

(i) such other information as the Board deems pertinent to scaling.

(3) The scaling manual shall be published by the Department.

(4) Every scaler shall comply with the provisions of the scaling manual.

10 (1) The Minister may designate any person or class of persons having, in the opinion of the Minister, the qualifications and experience to act as enforcement officers to be enforcement officers for the purpose of this Act and the regulations.

(2) Enforcement officers are responsible for the enforcement of this Act and the regulations.

(3) An enforcement officer, in carrying out duties pursuant to this Act and the regulations, has and may exercise in any part of the Province all the powers, authorities and immunities of a peace officer as defined in the Criminal Code (Canada).

(4) The protection afforded by this Act and any other enactment to an enforcement officer extends to any other person while and to the extent that that person is in the course of assisting an enforcement officer under the direction of an enforcement officer.

11 (1) A person who hinders, obstructs or interferes with a scaler in the discharge of the scaler's duties, is guilty of an offence.

(2) A person who contravenes this Act or the regulations is guilty of an offence.

(3) A person who is guilty of an offence contrary to this Act or the regulations is liable to the penalties provided for in the Summary Proceedings Act.

12 (1) The Governor in Council may make regulations

(a) authorizing the Board to exempt applicants from licensing requirements;

(b) authorizing the Minister to set the conditions for licensing;

(c) authorizing the Minister to prescribe the fees for each type of licence or examination;

(d) authorizing the Supervisor of Scaling and the Board to investigate and hear complaints regarding scalers or scales;

(e) authorizing the Minister to suspend or revoke a licence and set conditions for re-application for a licence;

(f) authorizing the Minister to require licensed scalers to keep books and records and to prepare returns as directed by the Minister;

(g) defining any word or expression used but not defined in this Act;

(h) respecting any matter the Governor in Council deems necessary or advisable to carry out effectively the intent and purpose of this Act.

(2) The exercise by the Governor in Council of the authority contained in subsection (1) is regulations within the meaning of the Regulations Act.

13 Chapter 411 of the Revised Statutes, 1989, the Scalers Act, is repealed.

14 This Act comes into force on such day as the Governor in Council orders and declares by proclamation.

APPENDIX II

Scaling Regulations
made under Section 12 of the Scalers Act
S.N.S. 2001, c. 11
O.I.C. 2007-566 (October 30, 2007), N.S. Reg. 411/2007

Citation

1 These regulations may be cited as the *Scaling Regulations*.

2 In these regulations, “Act” means the *Scalers Act*.

Conditions for Licensing

3 The Minister may set conditions for licensing.

Exemptions for persons holding valid scaling licence from another province

4 The Board may exempt an applicant for a licence from the examination requirements under the Act, if the applicant

(a) holds a valid scaling licence from another province;

(b) has obtained the scaling experience required by the Board;

(c) can demonstrate to the satisfaction of the Supervisor of Scaling that the applicant possesses the skills of scaling in accordance with the scaling manual;

(d) can demonstrate to the satisfaction of the Supervisor of Scaling that the applicant possesses knowledge of the Act and these regulations;

(e) successfully completes a scaling refresher course in Nova Scotia.

Licence fees

5 The Minister shall set the fee for each type of licence issued in accordance with Section 7 of the Act.

Complaints

6 (1) Complaints regarding scaling arising out of the Act, scaling manual, or these regulations shall be directed to the Supervisor of Scaling.

(2) When a written complaint is submitted to the Supervisor of Scaling, the Supervisor of Scaling shall

(a) conduct an investigation;

(b) document all findings, which shall be open to inspection by the parties affected; and

(c) advise the parties and the Board in writing of any recommendations that should be considered by the parties and any action that will be taken by the Supervisor of Scaling.

(3) The Supervisor of Scaling may refer a complaint to the Board for directions at any time and the Board may outline what action, if any, is to be taken.

Suspension or revocation of licence

7 (1) The Supervisor of Scaling may request that the Board be convened to

(a) review the results of a complaint investigation carried out by the Supervisor of Scaling; and

(b) make a recommendation to the Minister to suspend or revoke a licence.

(2) A recommendation by the Board pursuant to subsection (1) shall be in writing and a copy shall be served upon the scaler against whom the complaint was made.

(3) The Minister may suspend or revoke a licence upon the recommendation of the Board by serving a notice on the scaler against whom the complaint was made.

(4) A notice under subsection (3) may be published in any manner the Minister considers necessary.

(5) A person whose licence has been revoked shall not be eligible for reinstatement as a scaler until

(a) a period determined by the Minister has elapsed since the date of revocation of the licence; and

(b) the person has successfully completed a scaling refresher course.

(6) A person whose licence has been suspended shall not be eligible for reinstatement as a scaler until

(a) a period determined by the Minister has elapsed from the date of the suspension of the licence; and

(b) the person has demonstrated to the satisfaction of the Supervisor of Scaling that the person possesses the skills of scaling in accordance with the scaling manual.

(7) A person whose licence has been revoked or suspended may appeal to the Appeal Division of the Supreme Court of Nova Scotia within 30 days from the date the notice of licence revocation or suspension was served on the person.

Records

8 (1) Every scaler shall keep such books and records and prepare such returns as directed by the Minister and as described in the scaling manual.

(2) Books, records and returns shall be open for inspection by the Minister or an officer or agent of the Minister, and copies of them and other relevant information shall be made available when requested by the Minister or an officer or agent of the Minister, including the Supervisor of Scaling.

(3) The Minister may suspend or revoke the licence of a scaler who fails to comply with subsection (1).

APPENDIX III

TREE SYMBOLS RECOMMENDED BY C.S.A. STANDARD SCALING ROUNDWOOD

Canadian Standard Common Name (English)	Recommended Symbol	Symbol Accepted For Field Exam	Scientific Name
Softwood Species			
Eastern White Pine	EWP	P	Pinus strobus **L.**
Red Pine	RP	P	Pinus resinosa **Ait.**
Jack Pine	JP	P	Pinus banksiana **Lamb.**
Tamarack	TL	TL	Larix lariciana **(Du Roi) K. Koch**
White Spruce	WS	S	Picea Glauca, **(Moench) Voss**
Red Spruce	RS	S	Picea rubens **Sarg.**
Black Spruce	BS	S	Picea mariana **(Mill.) B.S.P.**
Eastern Hemlock	EH	EH	Tsuga canadensis **(L.) Carr.**
Balsam Fir	BF	BF	Abies balsamae **(L.) Mill.**
Hardwood Species			
Trembling Aspen	TA	A	Populus tremuloides **Michx.**
Large Tooth Aspen	LTA	A	Populus grandidentata **Michx.**
Yellow Birch	YB	B	Betula alleghaniensis **Britton.**
White Birch	WB	B	Betula papyrifera **March.**
American Beech	BE	BE	Fagus grandifolia **Ehrh.**
Red Oak	RO	O	Quercus rubra **L.**
White Elm	WE	E	Ulmus americana **L.**
Sugar Maple	SM	M	Acer saccharum **March.**
Red Maple	RM	M	Acer rubrum **L.**
White Ash	WAS	AS	Fraxinus americana **L.**
Black Ash	BAS	AS	Fraxinus nigra **March.**

APPENDIX IV

METRIC TO CANADIAN YARD/POUND UNIT CONVERSIONS

Factors for Converting Yard/Pound Units to metric (SI) Units		**Factors for Converting Metric (SI) Units to Canadian Yard/Pound Units**	
Length		**Length**	
inches x 2.54	= cm	cm x 0.393701	= inches
feet x 0.3048	= m	m x 3.28084	= feet
yards x 0.9144	= m	m x 1.09361	= yards
chains x 20.1168	= m	m x 0.0497097	= chains
miles x 1.60934	= km	km x 0.621371	= miles
Area		**Area**	
square inches x 6.4516	= cm^2	cm^2 x 0.155	= square inches
square feet x 0.092903	= m^2	m^2 x 10.7639	= square feet
square yards x 0.836127	= m^2	m^2 x 1.19599	= square yards
acres x 0.404686	= ha	ha x 2.47105	= acres
square miles x 2.58999	= km^2	km^2 x 0.386102	= square miles
Volume or Capacity		**Volume or Capacity**	
cubic feet x 0.0283168	= m^3	m^3 x 35.3147	= cubic feet
gallons x 4.54609	= L	L x 0.219969	= gallons
cords x 3.62456	= m^3(stacked)	m^3/(stacked) x 0.275896	= cords
cunits x 2.83168	= m^3	m^3 x 0.353147	= cunits
*cords (8 ft. swd. pulp) x 2.208712	= m^3	*m^3 (2.44 m swd) x 0.452753	= cords
**cords (8 ft. hwd.) x 1.982177	= m^3	**m^3 (2.44 m - hwd) x 0.504496	= cords
***board feet (NB Log Rule) x 0.00564972	= m^3	***m^3 x 177	= board feet (NB Log Rule)
Mass Weight		**Mass Weight**	
ounces x 28.3495	= g	g x 0.035274	= ounces
pounds x 0.453592	= kg	kg x 2.20462	= pounds
tons x 0.907185	= t	t x 1.10231	= tons
Ratios		**Ratios**	
cords per acre x 8.95647	= m^3(stacked)/ha	m^3(stacked)/ha x 0.111651	= cords per acre
*cords per acre (8 ft.Swd) x 5.457838	= m^3/ha	*m^3/ha (2.44 m - swd) x 0.183223	= cords per acre
**cords per acre (8 ft.Hwd) x 4.898058	= m^3/ha	**m^3/ha (2.44 m - hwd) x 0.204163	= cords per acre
***board feet (NB Log Rule) per acre (logs) x 0.0139607	= m^3/ha	***m^3/ha (logs) x 71.6295	= board feet (NB Log Rule) per acre
square feet per acre x 0.229568	= m^2/ha	m^2/ha x 4.356	= square feet per acre
cubic feet per acre x 0.0699725	= m^3/ha	m^3/ha x 14.2913	= cubic feet per acre
tons per acre x 2.24170	= t/ha	t/ha x 0.446090	= tons per acre
pounds per acre x 1.12085	= kg/ha	kg/ha x 0.892179	= pounds per acre
Imperial gallons per acre x 11.23332	= L/ha	L/ha x 0.0890208	= Imperial gallons per acre
miles per gallon x 0.354006	= km/L	km/L x 2.82481	= miles per gallon

* Based on 60.9 % solid content per cord

** Based on 54.7 % solid content per cord

*** Based on 5.663 m^3/Mfbm

For a list of mathematical factors for converting mass or volume from one common unit of measure to another, contact the Nova Scotia Department of Natural Resources, Scaling Program, PO Box 68, Truro, Nova Scotia, B2N 5B1 or by fax at (902) 893-6102.

APPENDIX V

ROUNDING RULES

In this Regulation the following rules shall apply for rounding numerical data when calculating volumes:

(a) When the first digit dropped is less than five, the last digit retained should not be changed.

Ie. 3.54 = 3.5 and 3.44 = 3.4

(b) When the first digit dropped is greater than five, or if it is a five followed by at least one digit, that is not a zero, the last digit retained should be increased by one.

Ie. 3.56 = 3.6 and 3.551 = 3.6

(c) When the first digit dropped is exactly five followed only by zeros, the last digit retained should be increased by one if it is odd, but not changed if it is even.

Ie. 3.55 = 3.6 and 3.550 = 3.6 and
3.45 = 3.4 and 3.450 = 3.4

APPENDIX VI

LIMITS OF ERROR OF TAPES

Indicated Length m	Limits of Error Over or Under Indicate Length mm
0.2	0.2
1.0	0.6
3.0	1.5
10.0	3.0
20.0	4.0
30.0	5.5

The limits of error set out in this table shall apply to all metal or woven types graduated in Metric Units when supported on a horizontal surface.

APPENDIX VII

NEW BRUNSWICK LOG RULE

Issued by Nova Scotia Department of Natural Resources

	LENGTH IN FEET																
RULE		**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
OF	**3**	3	3	3	3	4	4	5	5	6			In Nova Scotia logs longer than 18 feet are to be scaled in two or more lengths.				
THUMB	**4**	4	5	5	6	7	7	8	9	9							
L - 2	**5**	6	7	8	9	10	11	12	13	14	15	16					
L + 3	**6**	10	11	12	14	15	17	18	19	20	22	23					
2 x L - 1	**7**	15	17	19	21	23	25	27	29	31	33	35					
2.5 x L	**8**	20	23	25	28	30	33	35	38	40	43	45	48	50	53	55	58
3 x L	**9**	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69
4 x L	**10**	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92
5 x L	**11**	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115
6 x L	**12**	48	54	60	66	72	78	84	90	96	102	108	114	120	126	132	138
7 x L	**13**	56	63	70	77	84	91	98	105	112	119	126	133	140	147	154	161
8 x L + 2	**14**	65	74	82	90	98	106	114	122	130	139	147	155	163	171	179	188
	15	75	84	93	102	112	121	131	140	150	159	168	177	187	196	205	214
	16	85	96	107	117	128	138	149	159	170	181	192	202	213	223	234	245
	17	99	111	124	136	149	161	174	186	198	210	223	235	248	261	275	286
	18	115	129	143	158	172	186	200	215	229	244	258	272	286	301	315	330
	19	131	147	163	180	196	212	228	245	261	278	294	310	326	343	359	376
	20	150	168	187	206	225	243	262	281	300	318	337	356	375	393	412	431
	21	164	185	206	227	247	268	288	308	327	349	370	391	411	432	453	474
	22	181	204	227	250	272	295	317	340	362	385	408	431	453	476	498	521
	23	188	223	248	272	297	317	336	356	376	411	445	470	495	519	544	569
	24	216	243	270	297	324	352	380	406	432	459	486	513	540	569	594	621
	25	238	268	298	328	358	388	419	448	477	507	537	566	596	620	656	685
	26	253	285	317	348	380	411	444	475	507	538	570	602	634	665	697	729
	27	273	307	341	375	410	444	478	512	546	580	615	649	683	717	751	785
	28	307	345	384	422	460	498	537	575	614	652	690	728	767	805	844	882
	29	329	370	410	452	495	535	575	616	657	698	739	780	820	862	903	944
	30	353	397	441	485	530	574	618	662	706	750	795	839	883	927	971	1015

APPENDIX VIII

NOVA SCOTIA CUBIC METRE LOG SCALE - LENGTH CLASS EVEN

Dia.	Log Length																				
	1.8	2 .0	2 .2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6
8	.012	.014	.015	.017	.019	.021	.024	.026	.028	.031	.033	.036	.038	.041	.044	.047	.050	.054	.057	.061
10	.018	.020	.023	.025	.028	.031	.034	.037	.040	.043	.047	.050	.054	.058	.062	.066	.070	.074	.078	.083
12	.025	.028	.031	.035	.038	.042	.046	.050	.054	.059	.063	.068	.072	.077	.082	.087	.092	.098	.103	.109
14	.033	.037	.041	.046	.051	.055	.060	.065	.071	.076	.082	.087	.093	.099	.105	.111	.118	.125	.131	.138
16	.042	.047	.053	.058	.064	.070	.076	.083	.089	.096	.102	.109	.117	.124	.131	.139	.147	.155	.163	.171
18	.052	.059	.065	.072	.079	.087	.094	.102	.110	.118	.126	.134	.143	.151	.160	.169	.179	.188	.198	.208
20	.064	.071	.080	.088	.096	.105	.114	.123	.132	.142	.151	.161	.171	.182	.192	.203	.214	.225	.236	.248
22	.076	.085	.095	.105	.115	.125	.136	.146	.157	.168	.180	.191	.203	.215	.227	.239	.252	.265	.278	.291
24	.090	.101	.112	.123	.135	.147	.159	.172	.184	.197	.210	.223	.237	.251	.265	.279	.293	.308	.323	.338
26	.105	.117	.130	.144	.157	.171	.185	.199	.213	.228	.243	.258	.273	.289	.305	.321	.338	.354	.371	.389
28	.120	.135	.150	.165	.180	.196	.212	.228	.244	.261	.278	.295	.313	.331	.349	.367	.385	.404	.423	.443
30	.138	.154	.171	.188	.206	.223	.241	.259	.278	.297	.316	.335	.355	.375	.395	.415	.436	.457	.479	.500
32	.156	.174	.193	.213	.232	.252	.272	.293	.313	.334	.356	.377	.399	.422	.444	.467	.490	.513	.537	.561
34	.175	.196	.217	.239	.261	.283	.305	.328	.351	.374	.398	.422	.446	.471	.496	.521	.547	.573	.599	.626
36	.196	.219	.242	.266	.291	.315	.340	.365	.391	.417	.443	.469	.496	.524	.551	.579	.607	.636	.665	.694
38	.217	.243	.269	.295	.322	.349	.377	.405	.433	.461	.490	.519	.549	.579	.609	.640	.671	.702	.734	.766
40	.240	.268	.297	.326	.355	.385	.415	.446	.477	.508	.540	.572	.604	.637	.670	.703	.737	.771	.806	.841
42	.264	.295	.326	.358	.390	.423	.456	.489	.523	.557	.592	.626	.662	.697	.733	.770	.807	.844	.881	.919
44	.289	.323	.357	.392	.427	.462	.498	.535	.571	.608	.646	.684	.722	.761	.800	.839	.879	.920	.960	1.002
46	.315	.352	.389	.427	.465	.504	.543	.582	.622	.662	.703	.744	.785	.827	.869	.912	.955	.999	1.043	1.087
48	.342	.382	.423	.463	.505	.547	.589	.631	.674	.718	.762	.806	.851	.896	.942	.988	1.034	1.081	1.129	1.177
50	.370	.414	.457	.502	.546	.591	.637	.683	.729	.776	.823	.871	.919	.968	1.017	1.066	1.116	1.167	1.218	1.269
52	.400	.447	.494	.541	.589	.638	.687	.736	.786	.836	.887	.938	.990	1.042	1.095	1.148	1.202	1.256	1.310	1.365
54	.431	.481	.531	.582	.634	.686	.739	.792	.845	.899	.953	1.008	1.064	1.120	1.176	1.233	1.290	1.348	1.406	1.465
56	.462	.516	.570	.625	.680	.736	.792	.849	.906	.964	1.022	1.081	1.140	1.200	1.260	1.321	1.382	1.444	1.506	1.569
58	.495	.553	.611	.669	.728	.788	.848	.908	.969	1.031	1.093	1.156	1.219	1.282	1.347	1.411	1.476	1.542	1.609	1.675
60	.529	.591	.652	.715	.778	.841	.905	.970	1.035	1.100	1.166	1.233	1.300	1.368	1.436	1.505	1.574	1.644	1.715	1.786
62	.564	.630	.696	.762	.829	.897	.965	1.033	1.102	1.172	1.242	1.313	1.384	1.456	1.529	1.602	1.675	1.749	1.824	1.899
64	.601	.670	.740	.811	.882	.954	1.026	1.099	1.172	1.246	1.320	1.396	1.471	1.547	1.624	1.702	1.780	1.858	1.937	2.017
66	.638	.712	.786	.861	.936	1.012	1.089	1.166	1.244	1.322	1.401	1.481	1.561	1.641	1.723	1.804	1.887	1.970	2.053	2.138
68	.677	.755	.833	.913	.992	1.073	1.154	1.236	1.318	1.401	1.484	1.568	1.653	1.738	1.824	1.910	1.997	2.085	2.173	2.262
70	.716	.799	.882	.966	1.050	1.135	1.221	1.307	1.394	1.481	1.569	1.658	1.747	1.837	1.928	2.019	2.111	2.203	2.296	2.390
72	.757	.844	.932	1.021	1.110	1.199	1.290	1.381	1.472	1.564	1.657	1.751	1.845	1.939	2.035	2.131	2.227	2.325	2.423	2.521
74	.799	.891	.984	1.077	1.171	1.265	1.360	1.456	1.552	1.650	1.747	1.846	1.945	2.044	2.145	2.246	2.347	2.450	2.553	2.656
76	.842	.939	1.036	1.134	1.233	1.333	1.433	1.534	1.635	1.737	1.840	1.943	2.047	2.152	2.257	2.364	2.470	2.578	2.686	2.795
78	.886	.988	1.091	1.194	1.298	1.402	1.507	1.613	1.720	1.827	1.935	2.043	2.152	2.262	2.373	2.484	2.596	2.709	2.823	2.937
80	.932	1.039	1.146	1.254	1.363	1.473	1.584	1.695	1.806	1.919	2.032	2.146	2.260	2.376	2.492	2.608	2.726	2.844	2.963	3.082

Lengths are shown to 0.2 m classes. Diameters are shown in 2 cm classes. Volumes are shown to 0.001 m^3. Logs longer than 5.6 m (metres) in length will be scaled in two or more sections. Log volumes with a taper allowance of 1 cm of taper for every 0.75 m of length (see formula on page 35).

APPENDIX IX

NOVA SCOTIA CUBIC METRE LOG SCALE - LENGTH CLASS ODD

Dia.	Log Length																		
	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.9	5.1	5.3	5.5
8	.013	.015	.016	.018	.020	.022	.025	.027	.029	.032	.034	.037	.040	.043	.046	.049	.052	.055	.059
10	.019	.021	.024	.027	.030	.032	.035	.039	.042	.045	.049	.052	.056	.060	.064	.068	.072	.076	.081
12	.026	.030	.033	.037	.040	.044	.048	.052	.056	.061	.065	.070	.075	.079	.084	.090	.095	.100	.106
14	.035	.039	.044	.048	.053	.058	.063	.068	.073	.079	.084	.090	.096	.102	.108	.115	.121	.128	.135
16	.044	.050	.056	.061	.067	.073	.079	.086	.092	.099	.106	.113	.120	.128	.135	.143	.151	.159	.167
18	.055	.062	.069	.076	.083	.090	.098	.106	.114	.122	.130	.138	.147	.156	.165	.174	.183	.193	.203
20	.067	.075	.084	.092	.101	.110	.118	.128	.137	.147	.156	.166	.176	.187	.197	.208	.219	.230	.242
22	.081	.090	.100	.110	.120	.130	.141	.152	.163	.174	.185	.197	.209	.221	.233	.246	.258	.271	.284
24	.095	.106	.118	.129	.141	.153	.165	.178	.191	.203	.217	.230	.244	.258	.272	.286	.301	.315	.330
26	.111	.124	.137	.150	.164	.178	.192	.206	.221	.235	.250	.266	.281	.297	.313	.329	.346	.363	.380
28	.128	.142	.157	.173	.188	.204	.220	.236	.253	.270	.287	.304	.322	.339	.358	.376	.395	.414	.433
30	.146	.163	.180	.197	.214	.232	.250	.269	.287	.306	.325	.345	.365	.385	.405	.426	.447	.468	.489
32	.165	.184	.203	.222	.242	.262	.282	.303	.324	.345	.367	.388	.410	.433	.455	.478	.502	.525	.549
34	.186	.207	.228	.250	.272	.294	.317	.339	.363	.386	.410	.434	.459	.484	.509	.534	.560	.586	.613
36	.207	.231	.254	.278	.303	.328	.353	.378	.404	.430	.456	.483	.510	.537	.565	.593	.621	.650	.679
38	.230	.256	.282	.309	.336	.363	.391	.419	.447	.476	.505	.534	.564	.594	.624	.655	.686	.718	.750
40	.254	.283	.311	.341	.370	.400	.431	.461	.492	.524	.556	.588	.620	.653	.686	.720	.754	.788	.823
42	.279	.311	.342	.374	.407	.439	.473	.506	.540	.574	.609	.644	.679	.715	.752	.788	.825	.863	.900
44	.306	.340	.374	.409	.445	.480	.516	.553	.590	.627	.665	.703	.741	.780	.820	.859	.899	.940	.981
46	.333	.370	.408	.446	.484	.523	.562	.602	.642	.682	.723	.764	.806	.848	.891	.934	.977	1.021	1.065
48	.362	.402	.443	.484	.526	.568	.610	.653	.696	.740	.784	.828	.873	.919	.965	1.011	1.058	1.105	1.153
50	.392	.436	.479	.524	.569	.614	.660	.706	.752	.800	.847	.895	.943	.992	1.042	1.091	1.142	1.192	1.243
52	.423	.470	.517	.565	.613	.662	.711	.761	.811	.862	.913	.964	1.016	1.069	1.121	1.175	1.229	1.283	1.338
54	.456	.506	.557	.608	.660	.712	.765	.818	.872	.926	.981	1.036	1.092	1.148	1.204	1.261	1.319	1.377	1.436
56	.489	.543	.598	.653	.708	.764	.821	.877	.935	.993	1.051	1.110	1.170	1.230	1.290	1.351	1.413	1.475	1.537
58	.524	.582	.640	.699	.758	.818	.878	.939	1.000	1.062	1.124	1.187	1.251	1.314	1.379	1.444	1.509	1.575	1.642
60	.560	.621	.684	.746	.809	.873	.937	1.002	1.068	1.133	1.200	1.267	1.334	1.402	1.471	1.540	1.609	1.679	1.750
62	.597	.663	.729	.795	.863	.931	.999	1.068	1.137	1.207	1.278	1.349	1.420	1.492	1.565	1.639	1.712	1.787	1.862
64	.635	.705	.775	.846	.918	.990	1.062	1.135	1.209	1.283	1.358	1.433	1.509	1.586	1.663	1.740	1.819	1.898	1.977
66	.675	.749	.823	.899	.974	1.051	1.127	1.205	1.283	1.362	1.441	1.521	1.601	1.682	1.763	1.846	1.928	2.012	2.095
68	.716	.794	.873	.952	1.033	1.113	1.195	1.277	1.359	1.442	1.526	1.610	1.695	1.781	1.867	1.954	2.041	2.129	2.218
70	.758	.840	.924	1.008	1.093	1.178	1.264	1.350	1.438	1.525	1.614	1.703	1.792	1.882	1.973	2.065	2.157	2.250	2.343
72	.801	.888	.976	1.065	1.154	1.244	1.335	1.426	1.518	1.611	1.704	1.798	1.892	1.987	2.083	2.179	2.276	2.374	2.472
74	.845	.937	1.030	1.124	1.218	1.313	1.408	1.504	1.601	1.698	1.796	1.895	1.994	2.094	2.195	2.296	2.398	2.501	2.604
76	.890	.988	1.085	1.184	1.283	1.383	1.483	1.584	1.686	1.788	1.891	1.995	2.100	2.205	2.310	2.417	2.524	2.632	2.740
78	.937	1.039	1.142	1.246	1.350	1.455	1.560	1.666	1.773	1.881	1.989	2.098	2.207	2.318	2.429	2.540	2.653	2.766	2.880
80	.985	1.092	1.200	1.309	1.418	1.528	1.639	1.750	1.862	1.975	2.089	2.203	2.318	2.434	2.550	2.667	2.785	2.903	3.022

Lengths are shown to 0.2 m classes. Diameters are shown in 2 cm classes. Volumes are shown to 0.001 m^3. Logs longer than 5.6 m (metres) in length will be scaled in two or more sections. Log volumes with a taper allowance of 1 cm of taper for every 0.75 m of length (see formula on page 35).

APPENDIX X

CUBIC METRE ROT VOLUMES

Ave Dia. (cm)	Length of Defect in Metres											
	0.5	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**
2	----	----	----	----	----	----	0.001	0.001	0.001	0.001	0.001	0.001
4	----	0.001	0.001	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.004
6	0.001	0.001	0.002	0.003	0.004	0.004	0.005	0.006	0.006	0.007	0.008	0.008
8	0.001	0.003	0.004	0.005	0.006	0.008	0.009	0.010	0.011	0.013	0.014	0.015
10	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024
12	0.003	0.006	0.008	0.011	0.014	0.017	0.020	0.023	0.025	0.028	0.031	0.034
14	0.004	0.008	0.012	0.015	0.019	0.023	0.027	0.031	0.035	0.038	0.042	0.046
16	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050	0.055	0.060
18	0.006	0.013	0.019	0.025	0.032	0.038	0.045	0.051	0.057	0.064	0.070	0.076
20	0.008	0.016	0.024	0.031	0.039	0.047	0.055	0.063	0.071	0.079	0.086	0.094
22	0.010	0.019	0.029	0.038	0.047	0.057	0.066	0.076	0.085	0.095	0.104	0.114
24	0.011	0.023	0.034	0.045	0.057	0.068	0.079	0.090	0.102	0.113	0.124	0.136
26	0.013	0.027	0.040	0.053	0.066	0.080	0.093	0.106	0.119	0.133	0.146	0.159
28	0.015	0.031	0.046	0.062	0.077	0.092	0.108	0.123	0.138	0.154	0.169	0.185
30	0.018	0.035	0.053	0.071	0.088	0.106	0.124	0.141	0.159	0.177	0.194	0.212
32	0.020	0.040	0.060	0.080	0.100	0.121	0.141	0.161	0.181	0.201	0.221	0.241
34	0.023	0.045	0.068	0.091	0.113	0.136	0.159	0.181	0.204	0.227	0.250	0.272
36	0.025	0.051	0.076	0.102	0.127	0.153	0.178	0.203	0.229	0.254	0.280	0.305
38	0.028	0.057	0.085	0.113	0.142	0.170	0.198	0.227	0.255	0.283	0.312	0.340
40	0.031	0.063	0.094	0.126	0.157	0.188	0.220	0.251	0.283	0.314	0.345	0.377
42	0.035	0.069	0.104	0.138	0.173	0.208	0.242	0.277	0.312	0.346	0.381	0.415
44	0.038	0.076	0.114	0.152	0.190	0.228	0.266	0.304	0.342	0.380	0.418	0.456
46	0.042	0.083	0.125	0.166	0.208	0.249	0.291	0.332	0.374	0.415	0.457	0.498
48	0.045	0.090	0.136	0.181	0.226	0.271	0.317	0.362	0.407	0.452	0.497	0.543
50	0.049	0.098	0.147	0.196	0.245	0.294	0.343	0.393	0.442	0.491	0.540	0.589

*Volume (m^3) = ½ A*L
where A is end area in m^2 (0.000 078 5 D^2)
where D is defect diameter measured in cm, and L is length of defect measured in 0.5 m increments.

APPENDIX XI

DEDUCTION TABLE IN METRIC UNITS FOR SOFTWOOD PULPWOOD

Diameter Class	*m^3 (stacked)	m^3 (stacked)	*tonnes	tonnes
8		0.01		0.01
10	0.02	0.02	0.01	0.01
12		0.02		0.01
14		0.03		0.02
16		0.04		0.02
18		0.05		0.03
20	0.07	0.06	0.04	0.03
22		0.07		0.04
24		0.09		0.05
26		0.10		0.05
28		0.12		0.06
30		0.14		0.07
32	0.17	0.16	0.09	0.08
34		0.18		0.09
36		0.20		0.10
38		0.22		0.12
40		0.24		0.13
42		0.27		0.14
44	0.31	0.30	0.16	0.16
46		0.32		0.17
48		0.35		0.19
50		0.38		0.20
52		0.42		0.22
54		0.45		0.24
56	0.50	0.48	0.26	0.25
58		0.52		0.27
60		0.55		0.29
62		0.59		0.31
64		0.63		0.33
66		0.67		0.35
68		0.71		0.37
70	0.75	0.75	0.40	0.40
72		0.80		0.42
74		0.84		0.44
76		0.88		0.47
78		0.93		0.49
80		0.98		0.52
82		1.03		0.54
84	1.08	1.08	0.57	0.57
86		1.13		0.60
88		1.19		0.63
90		1.24		0.66

* Deduction for grouped diameter classes.

Formula for deductions in m^3 (stacked) = $(0.0000785\ D^2) \times 1.22 \times 1.60$

Formula for deductions in Mass (t) = $(0.0000785\ D^2) \times 1.22 \times 1.60 \times 0.528$

Note : Make deductions on both faces of 2.44 m wood and one face of 1.22 m wood.

APPENDIX XII

DEDUCTION TABLE IN METRIC UNITS FOR HARDWOOD PULPWOOD

Diameter Class	*m^3 (stacked)	m^3 (stacked)	*tonnes	tonnes
8		0.01		0.01
10	0.02	0.02	0.01	0.01
12		0.02		0.01
14		0.03		0.02
16		0.04		0.02
18		0.05		0.03
20	0.08	0.07	0.04	0.04
22		0.08		0.05
24		0.10		0.06
26		0.11		0.07
28		0.13		0.08
30		0.15		0.09
32	0.18	0.17	0.11	0.10
34		0.19		0.11
36		0.22		0.13
38		0.24		0.14
40		0.27		0.15
42		0.30		0.17
44	0.34	0.32	0.20	0.19
46		0.35		0.20
48		0.39		0.22
50		0.42		0.24
52		0.45		0.26
54		0.49		0.28
56	0.55	0.53	0.31	0.30
58		0.56		0.32
60		0.60		0.35
62		0.64		0.37
64		0.69		0.40
66		0.73		0.42
68		0.78		0.45
70	0.82	0.82	0.48	0.47
72		0.87		0.50
74		0.92		0.53
76		0.97		0.56
78		1.02		0.59
80		1.07		0.62
82		1.13		0.65
84	1.19	1.18	0.68	0.68
86		1.24		0.71
88		1.30		0.75
90		1.36		0.78

* Deduction for grouped diameter classes.

Formula for deductions in m^3 (stacked) = $(0.0000785\ D^2) \times 1.22 \times 1.75$

Formula for deductions in Mass (t) = $(0.0000785\ D^2) \times 1.22 \times 1.75 \times 0.576$

Note : Make deductions on both faces of 2.44 m wood and one face of 1.22 m wood.

APPENDIX XIII

WOOD MOISTURE, FIBRE CONTENT AND DENSITY

Wood moisture and fibre content are important considerations when scaling primary forest products by weight. Understanding the relationship between moisture and fibre in various species and their determination is essential when establishing and/or maintaining an accurate and equitable weight scaling system.

Wood Moisture

Moisture in wood is commonly referred to as moisture content and is represented as a percentage of either the green weight (current condition) or the oven-dry weight of the wood.

Moisture content green weight base is calculated as follows...

$$MCgw = \left(\frac{Ww}{Wg}\right) \times 100$$

Where MCgw = moisture content as a percentage of the green weight
Ww = weight of the water in the sample
Wg = current weight of the sample

Moisture content oven-dry base is calculated as follows...

$$MCod = \left(\frac{Ww}{Wo}\right) \times 100$$

Where MCod = moisture content as a percentage of the oven-dry weight
Ww = weight of the water in the sample
Wo = oven-dry weight of the sample

NOTE: In living trees, Ww may exceed Wo and consequently MCod can exceed 100 percent when using the oven-dry formula.

For both types of moisture contents, the green weight (Wg) is determined by weighing the sample in its current condition. The oven-dry weight (Wo) is determined by weighing the sample after all the moisture has been removed from the sample (usually by placing the sample in the oven set at 105 degrees Celsius until no further weight loss occurs). The weight of the water (Ww) is calculated by subtracting Wo from Wg (Ww= Wg-Wo).

Moisture content green weight is commonly used by industry while moisture content ovendry based is used by the scientific community.

Tree species native to Nova Scotia have standing moisture contents ranging from 40% MCgw for certain hardwood species to 60% MCgw for certain softwoods. The average standing MCgw for species native to Nova Scotia can be found in Table 8.

Table 8. Standing moisture content and relative density (wood content) for trees native to Nova Scotia.

Species		Standing Moisture Content (%MCgw)	Relative Density (Rd)
Coniferous			
Eastern White Pine	Pinus strobus Linn.	51.5	0.30
Red Pine	Pinus resinosa Ait.	59.3	0.36
White Spruce	Picea glauca (moench) Voss	52.5	0.39
Red Spruce	Picea Rubens Sarg.	47.6	0.40
Black Spruce	Picea Mariana (Mill) BSP	44.0	0.44
Eastern Hemlock	Tsuga canadensis (Linn.) Carr.	56.5	0.39
Balsam Fir	Abies balsamea (Linn.)	51.5	0.38
Deciduous			
Trembling Aspen	Populus tremuloides Michx.	45.5	0.42
Yellow Birch	Betula alleghaniensis Britt.	40.5	0.56
White Birch	Betula papyrifera Marsh.	40.9	0.56
American Beech	Fagus grandifolia Ehrh.	40.9	0.62
Red Maple	Acer rubrum Linn.	41.0	0.52
Sugar Maple	Acer sacharrum March.	37.1	0.62

Note: The above values were determined by Scott Paper Company on Nova Scotia trees.

All MCgw based moistures can be converted to MCod based moistures by using the following formula...

$$MCod = \frac{MCgw}{1 - \frac{MCgw}{100}}$$

The following is an example of the mathematical process used to determine the moisture content of a balsam fir sample, dried at 105 degrees Celsius and weighed prior to and after drying.

Wg = 69.0 grams
Wo = 38.7 grams

Solution: Ww = Wg - W0
= 30.3 grams

$$MCgw = \left(\frac{Ww}{Wg}\right) \times 100 = 43.9\%$$

$$MCod = \left(\frac{Ww}{Wo}\right) \times 100 = 78.3\%$$

Comparing the results of MCgw = 43.9% to the moisture content of balsam fir in Table 8 indicates that considerable moisture loss has occurred.

When collecting wood samples for moisture determination it is extremely important that the sample represent the ratio of sapwood to heartwood as it exists in the trees, as the sapwood is physiologically active and has a much higher moisture content than the heartwood. Collecting a one inch thick disc from the tree bole and cutting a wedge shape section from the disk minimizes the size of the sample to be dried and provides the correct proportion of sapwood to heartwood.

Wood Fiber

Relative density is the term used to describe the wood fiber content in a particular species. The density of the wood fiber of any species is relative to the moisture content of the wood as wood shrinks as moisture loss occurs. Shrinkage begins in most species at moisture contents less than 23% MCgw or 30% MCod. This is known as the fiber saturation point. Moisture levels below this are uncommon in most marketable primary wood products.

The formula for determining relative density is...

$$Rd = \left(\frac{Wo}{Vg}\right)$$

Where Rd = relative density
Wo = oven-dry weight of sample (grams)
Vg = volume of the sample (cm^3)

Relative density values for some important commercial species native to Nova Scotia are listed in Table 8.

Wood Density

Wood density is comprised of moisture and wood fiber. For any sample of wood, the density can vary due to changes in moisture content. The wood fiber content, on the other hand, will always remain constant after cutting (excluding rot). However the moisture content will constantly change due to ambient temperature and relative humidity variations. Therefore, wood does not possess a single density value. It has as many different densities as it has moisture contents. Because of this is important to specify the moisture content when dealing with the density of any species.

The formula for determining the density of a species at a specified moisture content is displayed below...

$$Dmc = Rd + Ww$$

Where: Dmc = density at the specified moisture content
Rd = grams/cm^3 of wood fiber
Ww = grams/cm^3 of water at the specified moisture content

The value for Rd is obtained from the previously mentioned table. This value does not depend on the moisture content and is static. Ww is slightly more difficult to obtain. The moisture content that is provided will be, in all likelihood, based on the green weight of the wood, MCgw (a value not known at this point). However the oven-dry weight is known, as it is equivalent to the relative density. By converting the moisture content to a oven-dry based value (MCod) using the conversion formula stated earlier and multiplying this percentage by the relative density, the weight of the water (Ww) can be determined.

For example, if a sample of balsam fir was collected from a pile of roadside wood and found to possess a moisture content of 43.9% green weight based, the density of this wood would be calculated as follows.

Step 1. Convert the MCgw to MCod using the conversion formula.

$$MCod = \frac{MCgw}{1 - \frac{MCgw}{100}}$$

= 43.9 / (1 - 43.9/100)
= 78.3%

Step 2. Determine the grams/cc of water in the sample by multiplying the MCod by the Rd for balsam fir.

$$Ww = \frac{MCod}{100} \times Rd$$

= 78.3 /100 x 0.38
= 0.30 grams/cm^3

Step 3. Calculate the density at that moisture content using the density formula.

$$Dmc = Rd + Ww$$

= 0.38 + 0.30
= 0.68 grams/cm^3

The density of the balsam fir sample at a Mcgw of 43.9% is 0.68 grams/cm^3 or 680kg/m^3

Application

Most situations dealing with weight scaling and moisture content fluctuation are concerned with determining weight loss between the time of felling and scaling. The previous example has determined the density of balsam fir at a moisture content of 43.9%. From the average green moisture content table, standing balsam fir has a moisture content of 51.5%. It can be concluded that 43.9% represents balsam fir after being cut for some period of time. In order to determine the change in density, the scaler must calculate the density of balsam fir in both moisture content states. From the above example it is known that the density of balsam fir at 43.9% moisture is 680 kgs/m^3. Using the same process the scaler can calculate the density of balsam fir at 51.5%, yielding a density of 780 kgs/m^3 = 100 kgs/m^3

$$780 \text{ kgs/m}^3 - 680 \text{ kgs/m}^3 = 100 \text{ kgs/m}^3$$

In most scaling applications it is desired to know the adjustment factor to bring wood back up to green condition. This is accomplished by dividing the lower density value into the higher density value. The adjustment factor for this example would be...

$$\frac{780 \text{kg/m}^3}{680 \text{kg/m}^3} = 1.147$$

Therefore, if a load of balsam fir has a net weight of 23 tonnes at a moisture content of 43.9%, then its weight at 51.5% moisture would be...

$$23 \text{ tonnes} \times 1.147 = 26.38 \text{ tonnes}$$

NOTE: Most buyers of primary wood products purchase on a delivered weight basis. Adjustments for moisture loss may be negotiated between buyer and seller.