Scaling Standard

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Saskatchewan

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PREFACE

The practice of measuring or estimating round-wood, in what is now part of Canada, officially began in 1762, when the grand jury for each county within the Province of Nova Scotia was given the authority to appoint annually, fit persons to serve as cullers and surveyors of dry and pickled fish, barrel staves, shingles, clapboards, hoops and cordwood. From this early legislation, the definitions, measurement practices, and traditions that govern the scaling of wood in each province have been developed. Because it is a provincial responsibility carried out under legislation or regulations affecting the management of forest land, the methods and log rules developed for volume determination evolved in different ways. Thus while the cord, cubic foot, board foot, and ton were accepted as measure of primary wood products, the quantities were often computed in a different manner depending upon the methods used in each province.

In 1970, the federal government released the White Paper in Metric Conversion in Canada. It outlined government policy in the conversion process and proposed means of study and consultation whereby the pace and methods of change would be determined in the national interest. For the forestry profession and wood-using industry, the change to the metric system presented the occasion for a comprehensive review of scaling procedures and the opportunity to develop minimum wood measurement standards for Canada.

In 1973, Section Committee 8.1 Forestry, of the Metric Commission of Canada formed a Technical Committee on Scaling. The committee was expanded and in 1974 was established as the Canadian Standards Association Technical Committee on Scaling of Primary Forest Products. Its major purpose was to prepare a National Standard for Canada on scaling. The CSA Technical Committee membership represents each province and the territories, the major wood-using industries, independent operators and private producers as well as the universities the federal government and members of other Countries.

-From the Preface to "Scaling Roundwood/Measurement of Woodchips, Tree Residues, and Byproducts",
National Standard of Canada-
CAN 3 - 0302.1 -00/0302.2-00

This standard formally was approved by the Canadian Standards Association and the Standards Council of Canada in 1977, and portions of the Standard provide the basis for the Saskatchewan Scaling Standard. The fourth edition of this standard was published in March 2009.

1. INTRODUCTION

1.1 Purpose of the Scaling Standard

The standard is designed to ensure uniform scaling practices for the measurement of Crown timber that is be harvested under the authority of The Forest Resources Management Regulations (FRMR).

The standard defines standards that must be used for the measurement of Crown timber, as well as standards for the training and licensing of scalers in Saskatchewan. The standard outlines the obligations of those that hold licenses to harvest timber with respect to measurement of Crown timber, related record keeping and reporting. The standard also outlines the obligations of persons that hold a license to scale.

1.2 Key Legislation

Section 19.1 of The Forest Resources Management Act (FRMA) makes it a requirement for all licensees, including licensed scalers to comply with the Saskatchewan Environmental Code (code) unless otherwise specified in a licence or an approved plan.

Section 52 of FRMA specifies who is authorized to scale or measure forest products.

The Forest Resources Management (Saskatchewan Environmental Code Adoption) Regulations provide for the adoption of:

a) the Forest Products Scaling Chapter; and
b) the Scaling Standard pursuant to the Adoption of Standards Chapter.

Sections 42 to 57 of The Forest Resources Management Regulations (FRMR) outline the scaling obligations of licensed scalers and licensees. Other obligations and requirements with respect to scaling are also found in other provisions of FRMA and FRMR. For specific legal requirements individuals are advised to consult FRMA and FRMR. They are available online from the Queen’s Printer at: www.qp.gov.sk.ca

1.3 Principles of Scaling

Crown dues payable for wood harvested under the authority of FRMA shall be based upon measurements made and recorded by a scaler or scalers who must hold the appropriate interim license or license to scale, as issued by the Government of Saskatchewan to scale such wood. Under no circumstances is the holder of an interim licence or licence to scale, authorized to scale material other than as specified on the interim licence or licence to scale.

When establishing or adjusting a scaling system for payment of Crown dues, the purchaser of the wood must first obtain approval from the Ministry of Environment for the proposed technique. This must be done prior to any sampling that may be used in the determination of any conversion factors that may be associated with the proposed technique.

When scaling Crown timber, a scaler is measuring the amount of government property passing into private ownership, and the amount of revenue payable to the Crown or Forest Management

Fund from the sale of that property. It is his or her duty to measure those amounts fairly and accurately.

No assurance will be made to any person, persons, or organizations, other than that the Scaler will make a **fair** scale of **sound** material of the **product** measured. The amount of the manufactured product may not coincide with the scaling returns; however, the Scaler must not alter the application of the Scaling procedures as described in this Standard.

A Scaler has the right to refuse to scale poorly piled or poorly manufactured wood. Scaling will not be done in any place dangerous to life and limb.

The government will make periodic check scales from time to time, and/or will make special check scales in cases of serious disagreements when payment of Crown dues and or forest management fees is involved.

The government reserves for its own marking use the crayon color red, and no one else may use this color unless specifically authorized in writing to do so.

To get an accurate measure of the wood leaving government property and entering into private ownership, it must be scaled. To ensure that all Scalers within the province achieve a high level of accuracy, consistency and competency, all persons must successfully complete scaling examinations before being eligible to apply for a licence to scale as authorized by this standard. It is the Scaler’s responsibility to ensure their licence to scale is valid and renewals are completed before the expiry of the licence to scale. Scalers will not be allowed to scale after the expiry date of their licence if they have not successfully renewed their licence to scale.

2. ADMINISTRATION

2.1 Training and Licence Requirements

Scaling courses of instruction and practical training are offered on a regular basis and are conducted by the Forest Service. With permission of the chief scaler courses may be offered by other agencies. The courses are segmented in such a fashion that candidates need attend only those portions of the courses for which he or she requires a licence, endorsement, or permit.

The holder of a valid Saskatchewan Scaler's Licence is authorized to scale individual logs, either singly, or in piles, to determine the total sound wood in cubic metres of those logs. In order to apply other scaling techniques, the holder of a Saskatchewan Scalers Licence must obtain an endorsement for each scaling technique. Endorsements are available for:

1. Tree length
2. Stacked wood
3. Mass
4. Pencil bucking

Scaling or refresher courses will be offered at least once per year in a location to be determined by the chief scaler. If a candidate does not successfully complete a portion of the scaling course, one written or one practical reexamination will be given for the licence and each of the endorsements. Specific times will be set by the chief scaler for the administration of these examinations.

2.1.1 Licence to Scale

Saskatchewan licences and endorsements currently available are as follows:

2.1.1.1 Licences

1. Scaling Licence
   Passing requirements
   - obtain 75% or better on a written examination and within ± 3% on a practical scaling exam; and
   - obtain 75% or better on a tree species identification examination.

   Entitlements
   - is valid for 5 years or as specified by chief scaler;
   - authorizes scaler to scale Crown timber that is transferring into private ownership;
   - authorizes licence holder to scale individual logs or piled logs. A valid licence and completion of the appropriate endorsement course is required for other methods of scaling.

   Application and renewal
   - upon successful completion of a written and practical examination, application for a new licence or a renewal must be made according to section 53 of FRMR. The applicant must provide the following information via a sworn affidavit supplied by the Government of Saskatchewan:
     - name, address and phone number;
     - endorsements being applied for;

    - any additional information the chief scaler may require.
- the annual registration fee is in effect for the fiscal period from April 1 until March 31 of the following year. The fee is to be paid in full prior to scaling;
- licence renewal can be obtained through successful completion of an approved course given by the Government of Saskatchewan;
- may be granted to an out of province scaler providing that he/she is licenced for the technique to be used in another jurisdiction and can demonstrate knowledge of FRMR, the current Saskatchewan Scaling Standard and the applicable scaling methods.

2. Interim Scaling licence

Passing requirements

With a course:

- obtain a minimum of 50% on a written scaling examination taken during a scaling course offered by the Government of Saskatchewan and within ±3% on a practical scaling exam; and
- obtain 75% or better on a tree identification exam.

Without a course:

- obtain 75% or better on an interim scaling licence examination; and
- obtain 75% or better on a tree identification exam; and
- has worked directly with an appropriately licensed Scaler for a minimum of ten full days in the thirty day period, immediately prior to, or following the application for the permit.

Entitlements

- valid for a maximum of 1 year;
- authorizes scaler to scale any Crown timber that is transferring into private ownership;
- upon successful completion of the appropriate interim endorsement exam, authorization for the applicable scaling endorsement may be obtained;
- may be granted to an out of province scaler providing that he/she is licenced for the technique to be used in another jurisdiction and is familiar with FRMR and the current Saskatchewan Scaling Standard. Practical and written examinations may be waived by the chief scaler.

Application and renewal

- upon successful completion of a written and practical examination, application to issue a new licence or a renewal must be made according to section 55 of FRMR. The applicant must provide the following information via a sworn affidavit supplied by the Government of Saskatchewan:
    - name, address and phone number;
    - where the applicant has not attended a scaling course, proof that he/she has been trained for a minimum of 10 days within 60 days of passing the exam;
    - endorsements being applied for;
    - any additional information the chief scaler may require.
- the annual registration fee is in effect for the fiscal period from April 1 until March 31 of the following year. The is to be paid in full prior to scaling.

2.1.1.2 Endorsements

In order to apply other scaling techniques, the holder of a Saskatchewan Scaling licence must obtain an endorsement for each scaling technique. Interim licence holders may obtain each of these endorsements by obtaining a mark of 75% or better on an interim exam specific to the endorsement they wish to obtain.

1. Stacked

   Passing requirements
   - obtain 75% or better on a written examination and within ±3% on a practical stacked scaling examination.

   Entitlements
   - valid for 5 years or as specified by the chief scaler;
   - entitles the holder of a stacked scaling endorsement to stack scale any Crown timber in a pile either on trucks, railway cars or on the ground.

   Application and renewal
   - upon successful completion of a stacked scaling endorsement exam and practical exam, application to include this endorsement with the applicants licence must be made;
   - stacked endorsement renewal can be obtained through successful completion of an approved course.

2. Mass

   Passing requirements
   - obtain 75% or better on a written examination.

   Entitlements
   - valid for 5 years or as specified by the chief scaler;
   - entitles the holder of a mass endorsement to weigh Crown timber.

   Application and renewal
   - upon successful completion of a mass endorsement exam, application to include this endorsement with the applicants licence must be made;
   - mass endorsement renewal can be obtained through successful completion of an approved course.

3. Tree Length
   Passing requirements
   - obtain 75% or better on a written examination and within ±3% on a practical tree length scaling examination.
   Entitlements
   - valid for five years or as specified by the chief scaler;
   - entitles the holder of a tree length endorsement to scale any Crown timber, in tree length form.
   Application and renewal
   - upon successful completion of a tree length endorsement and practical exam, application to include this endorsement with the applicants licence must be made;
   - tree length endorsement renewal can be obtained through successful completion of an approved course.

4. Pencil Bucking
   Passing requirements
   - 75% or better on a written examination.
   Entitlements
   - valid for five years or as specified by the chief scaler;
   - entitles the holder of a pencil bucking endorsement to scale any Crown timber, in a form conducive to pencil bucking.
   Application and renewal
   - upon successful completion of a pencil bucking endorsement and practical exam, application to include this endorsement with the applicants licence must be made;
   - pencil bucking endorsement renewal can be obtained through successful completion of an approved course.

2.2 Duties and Responsibilities of a Scaler

Persons who have successfully obtained a licence to scale have agreed to make a fair scale of sound material for the product being measured. The following section outlines a number of associated duties and responsibilities.

1. Hold a valid licence, licence and endorsement, or interim licence appropriate for the type of material to be measured.
2. Scale fairly and accurately and abide by any amendments to FRMR, the Scaling Standard or the approved scaling plan, as well as any written instruction as may be issued by the Minister.
3. Fully understand the conditions of the harvesting authorization or scaling plan which may be in force for the wood being measured; for example:
    1. allowable species;
    2. log size limitations;
    3. scaling technique to be applied;
    4. transportation restrictions;
    5. wood volume limitations;
    6. minimum approved top diameter;
    7. sampling requirements.
4. Report illegal or wasteful practices to the chief scaler.

5. Ensure that all scaling equipment is adequate and accurate for the scaling technique to be used. Recalibration of any electronic scaling equipment must be completed at least once a month or as required.
6. Ensure that all necessary forms and stationery are available and in adequate supply.
7. Maintain accurate and adequate records.
8. Ensure that all the information on the scaling form is completed and that all scaling returns, as prescribed by the chief scaler, are submitted to the appropriate location within acceptable time limits (section 2.3.4 of this standard).
9. Be able to identify in log or bolt form the commercial tree species common to the area he/she is employed.
10. All scaling techniques/procedures conform to the current version of the Saskatchewan Scaling Standard and approved company's scaling plan.
11. Become familiar with any new techniques or methodologies that may have been developed since he/she was licensed.
12. Successfully complete all refresher and certification programs as may be required from time to time in order to keep licence to scale updated and current.
13. If scaling for the purposes of conversion factors through an established sampling program, ensure that:
    1. all sample loads are chosen in a random or random-systematic method;
    2. no sample loads are substituted or canceled without express written permission of the chief scaler;
    3. the sampling program complies with the conditions laid out in the approved scaling plan;
    4. ensure that no person tampers with the selection of the sample loads(s);
    5. when using sampling cards provided by the Ministry, the scaler is solely responsible for pulling the tabs, tabs must be removed one at a time in a manner that will not alter the adjacent tabs. The scaler is also responsible to ensure the sampling cards are available at all times and in adequate supply. Cards must be returned to the Forest Service Scaling Unit when completed.
14. Ensure that by April 1st of each year, the applicable annual renewal fee for the upcoming fiscal year is paid in full.

2.3 Scaling Requirements

2.3.1 Time Frame for Scaling and Marking of Scaled Parcel

FRMR specifies the amount of time in which a scaler can take to scale timber and when the results of this scale must be turned in to the chief scaler. The regulations state that "Scaling must be completed within 90 days after the date of harvest", with the following exceptions:

1. It is otherwise stated in the approved scaling plan;
2. An officer has supplied written notice to have the timber scaled within 30 days of receipt of the notification;
3. Written authorization from an officer allowing a longer time frame.

Once the parcel of timber has been scaled, the scaler must distinguish the load as being scaled. At a place on the face of one of the logs in the parcel of timber, on a card stapled to the pile or by another method that can be identified by a check scaler, the scaler must mark the SC01 number, the date and time the scale was completed, the harvest authority (permit, term supply licence or agreement number), parcel number and area identifier. The parcel of timber must also be crown marked to identify the logs measured in the parcel.

The SC01 number must be clearly marked on the pile in at least three locations, each end and the middle of the pile face. The SC01 number must be marked in a manner that will remain legible until the parcel has been transported.

If the logs are spread out and scaled the method for numbering non-piled timber must be applied (Appendix R).

In addition, the volume of the pile must be determined and marked on the pile. Should a scaler decide that he/she does not wish to do the calculations immediately, or mark the volume on the pile, a copy of the field notes or computer spread sheet must be faxed/emailed to Forest Service Branch in order for the pile to be designated as scaled. The pile will be considered scaled when the Forest Service receives the fax or email. The 48 hour time limit for the pile to remain intact will not start until the Forest Service receives the fax or email.

The parcel must be marked in a manner that will remain legible for a minimum of 48 hours. This will allow the check scaler to know which logs were scaled, when they were scaled and by whom.

Note: This above requirement for marking parcels of timber does not apply to timber being scaled prior to unloading, at the entrance to a processing facility or storage area.

Appendix S contains tags that may be used to mark piles or designate that the data will be faxed.

2.3.2 Time Frame to Allow for Check Scale

Once the load has been scaled, FRMR state the requirement that the parcel of timber must remain, in its original form, for a period of 48 hours to allow for a check scale to be completed. This requirement will not apply when:

1. Timber is scaled at the entry to a processing facility, as in the case of a company who weighs the wood or stack scales the timber on the truck.
2. Timber has been set aside for a sample load. In this instance the time frame which the load will be required to remain will be stated in the scaling plan.
3. Written authorization by an officer has been given to move the parcel of timber.

4. A dispute has arisen respecting the payment of dues and fees, in which case the officer may require that the load remain for a period longer than 48 hours but not longer than 5 days.

The 48 hour time period begins when the scaled volume has been marked on the pile. Should the scaler decide that he/she does not wish to do the calculations immediately, or mark the volume on the pile, a copy of the field notes or computer spread sheet must be faxed/emailed to Forest Service Branch in order for the pile to be designated as scaled. The 48 hour time period will begin when the Forest Service receives the field notes/spreadsheet.

2.3.3 Dues Classes

Once the volume of the scaled timber has been calculated, the dues and forest management fees payable may be determined.

Methods for determining the volume distribution by dues class when sampling, will be dealt with in the appropriate sections of this standard.

2.3.3.1 Determination of S1a, S1b, S1ad, S1bd, S2, S3 Timber Classes

Part 1, Table 1 (Section 99) of FRMR describe the dues classes and the amount of dues payable for each class of timber. Size and species are used to determine the class of softwood timber. The class of timber dictates the dues class must be applied. The diameter split is based upon an exact diameter measurement, and not on a diameter class.

<u>Softwood</u>	
White spruce, black spruce, lodgepole pine	>15 cm classified as S1a
All species of softwood other than white spruce, black spruce and lodgepole pine	>15 cm classified as S1b
White spruce, black spruce, lodgepole pine with defect[1]	>15 cm classified as S1ad
All species of softwood other than white spruce, black spruce and lodgepole pine with defect[1]	>15 cm classified as S1bd
All softwood species	≤15 and >10 cm classified as S2
All softwood species	≤ 10 cm classified as S3
<u>Hardwood</u>	
All hardwood species	>10 cm classified as H1
All hardwood species	≤10 cm classified as H2

[1]Contains defects in excess of the tolerances established for Classes S1a and S1b timber as described in Section 6.3

2.3.4 Reporting Requirements

As part of the collection and monitoring of all scaling activities in the province, scalers who are scaling Crown timber passing into private ownership are required to submit all scale data in a format determined by the chief scaler. This section will deal with these requirements.

2.3.4.1 Measurement of Annual Cumulative Volumes of Less Than 250 m^3

Licensees who have an **annual cumulative** volume that is less than 250 m^3 do not require a scale to be completed on the timber by a licensed scaler. The licence to harvest will set out the manner in which this timber must be measured by the licensee, and when this information must be returned. Appendices S and T describe methods for measurement, and includes the forms and tables required.

2.3.4.2 Forest Management Agreement and Term Supply Licence Holders

A licensee holding a Forest Management Agreement (FMA) or Term Supply Licence (TSL) must submit scaling returns within 20 days after the end of the month in which the scale was completed. The scaling return must be in a format approved in the scaling plan.

2.3.4.3 Forest Product Permit Holder Harvesting 250 m^3 or More Annually

The licence to harvest will set out when the scaling returns must be submitted, and the form they must be submitted in. This will depend on the volume permitted and when the scaling is being carried out. For small volumes, scaling returns may be submitted after harvesting with the return of the permit. For larger volumes, or where permit holders are paying monthly or quarterly based on the amount of timber scaled during that period, scale returns must be submitted at the same time as the payments.

2.3.4.4 Scaler's Reporting Requirements

When a scaler is commissioned to scale timber for a licensee, the resulting volume, diameter distribution, and the raw scale data must be submitted within 20 days after the end of the month in which the timber was scaled. Scalers will be required to use and submit an SC01 form on all timber being scaled at staging areas or where written authorization has been given to transport and store timber prior to scaling. They will not be required where timber is being scaled at the entrance to a processing facility or timber storage area prior to unloading, or where timber is being stored prior to being scaled at the entrance to a processing facility.

Scalers are required to keep scaling records, copies of SC01 forms, tallies and raw scale data for a period of not less than three years, and must produce the above records, SC01 forms, tallies and data when requested by an officer to do so.

2.3.5 The SC01 Form

The SC01 form is to be used to scale timber at the staging area and in some cases the processing facility yard if permission has been given to move the timber prior to scaling.

> Appendix L and figure 1 show the SC01 form and Appendix M shows a series of data collection forms for each of the techniques outlined in this standard. Only those forms, specific to the scaling technique being used, need to be completed and submitted with the SC01 form. Each scaler will be given a copy of these forms and will be required to photocopy them as needed. Calculations required for each of these techniques may be done using computer software programs, but the resulting answers and field data tallies must be supplied on these forms. A copy of the SC01 form may be obtained in digital form from Forest Service Branch however its format may not be altered from the original.

All information applicable to the type of scaling being done must be completed on the SC01 form. Incomplete forms will be returned to the scaler to be completed properly and may result in enforcement actions being taken.

Once the data on the particular parcel of timber has been determined, it is the duty of the scaler to ensure that the copies are supplied to the appropriate parties within the required time limits. Copies are sent to the licensee, the area office in which the licence to harvest was issued and the chief scaler; one copy is kept by the scaler for his/her records.

2.3.5.1 How to Fill Out the SC01

1. SC01 number – This number is unique and must never be duplicated. The SC01 number is made up of the scaler number plus a consecutive number issued each time the scaler scales a parcel of timber.
2. Total # of Pages – The total number of pages attached to the SC01 form, including the SC01 form.
3. Scale date – the date which the parcel was scaled.
4. Scaler number – this is the licence number issued by the chief scaler upon completion of the scaling course.
5. Authorization – under what authorization is the wood being scaled, FMA, TSL or Permit.
6. Permit number – if the wood is harvested under the authority of a Forest Product Permit this is the permit number.
7. Agreement number – if the wood is being scaled under the authority of a TSL or FMA, this is the agreement number.
8. Forest – the name of the forest where the timber is being scaled according to the operating plan.
9. Division – the name of the division where the timber is being scaled according to the operating plan.
10. Area – the name of the area where the timber is being scaled according to the operating plan.
11. Block – the name of the block where the timber is being scaled according to the operating plan.
12. Pile number – this is a unique incremental number given to each pile scaled. It is specific to the licence to harvest, and forest, division, area, block if applicable.

13. Scaling plan number – the number issued by the approving office once the scaling plan has been approved.
14. Method of Scale – the method of scaling that was used.
15. Cull Table Number – if a company has unique cull tables, the appropriate number is written here.
16. Tree Length Table Number – this is the number which appears on the tree length table that the scaler used to perform the calculations.
17. Square Samples – the number of samples used in determination of pile volume for tree length and stacked with 1 m^2 sample techniques.
18. Pile Length – the length of the pile used in the scale, if applicable.
19. Average Pile Height – the average height of the pile, if applicable.
20. Average Pile Width – the width of the pile used in the scale, if applicable.
21. Multiplier – the number used in tree length calculations for determination of pile volume.
22. Stacked to solid conversion – the conversion factor used to convert volumes from stacked cubic metres to solid cubic metres.
23. Total Gross Volume – the total gross volume of the parcel of timber.
24. Total Defect Volume – the total volume of all defects.
25. Total Net Volume – the total net volume of the pile.
26. Dues Class, Species Product and Net Volume – the net solid volume in the pile by dues, class, and species.
27. Signature of Scaler – place for scaler to sign the form and declare the information on the SC01 and attached forms is unbiased and accurate.

2.3.5.2 Data Collection Forms

The forms in Appendix M allow for the collection of data for each of the specific scaling techniques. Multiple copies of a specific form can be used as required and attached to the SC01 form. The subsequent volume calculations are performed using these forms and recorded on the SC01.

Ministry of Environment

SCO1
(Complete one page per pile)
SC01Number _______

Total # of Pages _______

Date of Scale _____________ Scaler Number ________ Authorization _____________
(Day/month/year) (FMA, Permit or TSL)

Permit Number _____________ Agreement Number __________

Forest_____________________

Division ___________________Area Name ______________Block______________

Pile Number ______________ Scaling Plan Number ________________________

Method of Scale:

□ Stacked with 1m squares □Individual Logs □Logs in Piles □Tree length – tree count
□Tree length - Pile face □Tree Length - Total population □Other specify____________

Cull table number(s) ____-____ Tree Length Table number(s) ____-____
____-____ ____-____
____-____ ____-____

Square Sample(s) ___________Pile Length ___________m Average Pile Height ______
Average Pile Width ___________m Multiplier ____________

Stacked to solid conversion _________m^3/m^3(stacked)

Summary of Volumes:

Total Gross Volume ____________m^3

Total Defect Volume ____________m^3

Total Net Volume ____________m^3

Dues Class	Species	Product	Dues Reduction Category	Net Volume

To the best of my knowledge, the information on this ticket is accurate and has not been biased. ________________________

Signature of Scaler

Attach copies of all forms and distribute as follows: Forest Service Prince Albert; Licensee; License issuing office; Scalers file

Figure 1 SC01 Form

2.3.6 Requirements to Sample

As required by FRMR, certain instances will require timber to be sampled to determine coefficients, these include:

1. Timber that is scaled using mass or stack scale techniques.
2. Harvesting more than 30,000 m^3 annually and have it scaled using the tree length technique.
3. Those intending to determine what proportion of softwood timber volume harvested has a diameter, with the bark removed:
   (i) greater than 15 centimetres;
   (ii) greater than 10 centimetres and less than or equal to 15 centimetres; and
   (iii) less than or equal to 10 centimetres;
   those intending to determine what proportion of hardwood timber volume harvested has a diameter, with the bark removed:
   (i) greater than 10 centimetres; and
   (ii) less than or equal to 10 centimetres
4. Timber scaled using any other technique that requires coefficients to determine timber volumes.

Sampling intensities, as approved in the scaling plan, will generate a number of loads to be scaled for the determination of coefficients. These loads will be scaled using the techniques approved in the scaling plan and the collection of the data will be completed in a format approved in the scaling plan. The scaling plan will state when the resulting data will be supplied to the chief scaler, usually within 20 days after the end of the month in which the sample was scaled. Sampling of timber is discussed in depth in the applicable sections of this standard.

2.3.7 Electronic Submission of Data

In certain instances, the use of hand held data recorders and electronic submission of scale returns would greatly improve the efficiency of the scaling process. Written approval from the chief scaler must be obtained prior to the commencement of data collection with this type of instrument. The approval letter will outline the method of collection and the software packages to be used in the collection and processing of the data. This is necessary to ensure the smooth transfer of data between Forest Service Branch and the licensee.

2.4 New Technology

All new electronic measurement/collection tools must be approved by the chief scaler prior to use. If approval is given, it should be noted that there may be conditions attached to the approval.

All standards, conditions and formats will be set, in writing, by the chief scaler.

2.5 Maintenance of Scaling Records

All scaling records must be maintained for a period of not less than three years and must be provided to an officer upon request.

2.6 Amendment, Suspension and Cancellation of a Scaling Licence

Under the authority of FRMR, section 57(1), the chief scaler may amend, suspend or cancel a licence to scale or interim licence if the scaler:

a) fails to scale or measure forest products in accordance with procedures and standards specified in the terms of the licence or standard;
b) is in contravention of any term of the licence or standard;
c) provides false information, or fails to provide information to the chief scaler when requested to do so;
d) submits a return that varies by more than 5% from a check scale completed for the same timber; or
e) acts in any other manner that, in the chief scaler's opinion, warrants amendment, suspension or cancellation.

As per section 57(2) of FRMR, prior to the amendment, suspension or cancellation of a licence the chief scaler will supply the licence holder, in writing, with reasonable notice of the intended action. An opportunity will be made available to make representation to the chief scaler at a time agreeable to both parties. The decision of the chief scaler is final.

2.7 Demerit Point System

When scalers within the province of Saskatchewan are not scaling with accuracy and consistency or are not meeting their duties and responsibilities, they may have demerit points levied against them by a check scaler. The severity of the offence and number of times that the offence was committed, will affect the number of points to be levied. The demerit points are one tool that is used to ensure compliance by scalers in the province, and will affect the frequency that a check scale is performed on his/her scale.

Demerit points shall be levied against a scaler according to Table 1 dependent upon the number of times he/she committed each of the offence(s). Demerit points are in affect for a period of four years from the date that the point(s) is levied against the scaler.

At the discretion of the chief scaler, a licence to scale may be suspended or canceled using the demerit point system as follows:

- the fourth time a scaler is awarded demerit points for the same offence, the chief scaler **may** suspend the licence to scale for a period not exceeding three years;
- for accumulating more than 20 demerit points, the licence to scale will be canceled for a period not exceeding three years.

Should a scaler not apply for the renewal of his/her licence, the demerit points obtained during the term of his/her last licence will remain in effect until application is made to have the licence reinstated. At this time, the accumulation and/or cancellation of demerit points will continue as though no time had been missed.

Table 1 Type of Offence and Demerit Points by Level of Occurrence

Type of Offence	Demerit Points		
	1st Offence	2nd Offence	3rd* Offence
Failure to follow an approved scaling plan	1	3	4
Greater than 5% variance from a duly authorized check scale	1	3	4
Failure to complete returns properly or failure to submit returns in approved time frame	1	3	4
Failure to follow terms of a licence to scale	1	2	3
Scaling without proper endorsements	2	5	7
Failure to fully understand the conditions of the harvesting authorization or scaling plan	1	3	4
Failure to report illegal or wasteful practices to the chief scaler	1	2	3
Providing another person with your licence to scale, or licence number to use for the purposes of scaling	21	---	---
Failure to ensure that all scaling equipment is adequate and accurate for the scaling technique to be used	1	2	3
Failure to produce scaling records, notes or tallies when requested	2	4	6
Failure to ensure that all necessary forms and stationary, including sampling pull tab cards are available and in adequate supply	1	2	3
Failure to maintain accurate and adequate records	1	2	3
Failure to follow procedures and/or techniques as described in the current version of this standard	1	4	5
Failure to know the commercial species specific to your area of operation	1	2	3
Failure to clear excessive snow and mud from the weigh scale deck	1	4	5
Failure to frequently zero a weigh scale as required	1	4	5
Failure to ensure that the weigh scale deck is free and not binding against side of the pit	1	4	5
Failure to report any unreasonable values which may indicate that the weight scale is not weighing accurately	1	4	5

* For more than 3 offences, the number of points attributed under this column will be used

2.8 Appeal Process

If a scaler receives demerit point(s) or an amendment, suspension or cancellation to his/her licence to scale which he/she feels is not justified, the scaler may make written representation to the chief scaler to have the demerit point(s) canceled and/or the amendment, suspension or cancellation of the licence removed. Written representation must be made within 30 days of the date of the demerit point(s) being levied, and/or the notice of the amendment, suspension or cancellation.

The affected licence holder shall outline to the chief scaler, in writing, the reasons they feel the demerit point(s) should be canceled or the licence should be reinstated. After review and/or investigation into the appeal, the chief scaler will determine whether or not the action was unjust. Within 30 calendar days of the receipt of the appeal, the affected licence holder shall be notified in writing of the decision of the chief scaler. The decision of the chief scaler is final.

2.9 Check Scaling

The check scaler is an officer authorized by the chief scaler and will be the standard to which all scalers work will be compared against for the purposes of maintaining a uniform level of performance and providing a control over human error associated with scaling.

Check scales will be:

- random and unannounced whenever possible.
- conducted using the same scaling technique and with the wood in the same form, preferably in the same location, as for the original scale.
- set by volume scaled, licensee history, and the scalers past performance:
  - increased frequency if experience or performance is weak;
    it is doubted that wood condition will produce an accurate scale and;
    volumes at the site are high;
  - decreased frequency if volumes to be scaled are low or;
    scalers past performance is strong.
- recorded so that a performance record can be kept on individual scalers and licensee;
- considered the correct scale should a variance of greater than +5% occur between the check scale and the scaler being checked.
  - if the check scale replaces the original scale, a copy of the new scale will be sent to the licensee, chief scaler, area office in which the licence to harvest was issued and one will be left with the scaler.
- conducted to ensure that all scalers are complying with the duties and responsibilities of the scaler as laid out in sections 2.2 of this standard, as well as all provisions of the Standard, and applicable sections of FRMA and FRMR.
- conducted to ensure that all scale returns and sample scale data are filled out correctly and that all scaling equipment and electronic data collection/processing equipment are working satisfactorily.

Although the check scale is conducted to ensure that all wood is being scaled consistently and accurately, it is not meant to be intimidating to the scaler whose work is being checked.

Should a rescale of wood that has been check scaled be requested, the chief scaler for Forest Service Branch will be the sole arbiter and his/her findings will be binding.

If it is found through check scales that the scaler has been consistently scaling incorrectly and the parcels of timber are still intact, with written direction, the wood will be rescaled.

Check scales will not be conducted to settle disputes between:

- licensees and a union;
- licensees;
- licensees and contractors.

Check scales will only be conducted where scalers are scaling for the payment of Crown dues and forest management fees and for depletion volumes.

3. UNITS OF MEASUREMENT

All measurement units used in the application of this standard must be:

1. Base, supplementary, and derived units of SI (the International System of Units) and their decimal multiples, and submultiples; they include the millimetre, centimetre, decimetre, metre, square metre, cubic centimetre, cubic metre, gram, and kilogram.
2. Units outside SI, but recognized by CIPM (the International Committee of Weights and Measures) as having to be retained, because of their practical importance for use with those of SI; they include tonne.
3. Units outside SI, but accepted temporarily by CIPM because of existing practices, for use with those of SI.

There are six types of measurements a scaler may make in order to estimate wood quantities; these measurements are: log diameter and length; pile height, length and width, and mass. Wood volumes are estimated from one of, or a combination of, these measurements, and are to be expressed in cubic metres or stacked cubic metres.

3.1 Diameter Measurement

Diameters are to be measured and recorded in centimetres, as determined with a scale stick or tape measure across the end or ends of the piece or with a caliper across the piece, of roundwood. The measurement must be taken along a plane perpendicular to the longitudinal axis of the piece. All diameters must be measured inside bark where possible; however, when a diameter can only be determined from elsewhere than the end of a piece, the diameter outside bark must be measured and bark thickness must be measured or estimated, to calculate the appropriate inside bark diameter.

3.2 Length Measurement

Lengths are to be measured and recorded in metres as determined with a tape measure or scale stick. Piece length is the straight distance between the geometric centres of the ends of the piece of round wood. The techniques for measuring pile length, width, and height are described in the appropriate section of this standard.

3.3 Mass Measurement

Mass is to be determined and recorded in kilograms or tonnes, as determined by the use of scales or other appropriate weighing machines that conform to the *Weights and Measures Act* and the *Weights and Measures Regulations* and this standard.

3.4 Size Class Intervals

The size class intervals to be used with each scaling technique are specified in the description of that technique. However, in general, the limits of any size class interval are as follows:

$$a < f(x) \leq b$$

Where a = lower class boundary determined by subtracting one half the size class interval from the class midpoint;
b = upper class boundary determined by adding one half of the size class interval to the class midpoint;
F(x) = any value of x between the lower and upper class boundaries;
X = measurement of diameter, circumference, or length.

For example:
a 2.0 diameter class with an 8 cm midpoint would be described thus:
7.0 cm D^{8} cm 9.0 cm

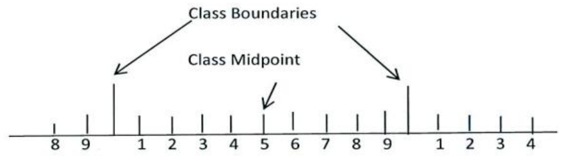
and the next higher class, with a 10 cm midpoint would be described thus:
9.0 cm D^{10} cm 11.0 cm

That is, a scaled piece that falls within a class interval shall be said to belong to that size class; a scaled piece that coincides with the boundary of two class intervals shall be said to belong to the lower size class.

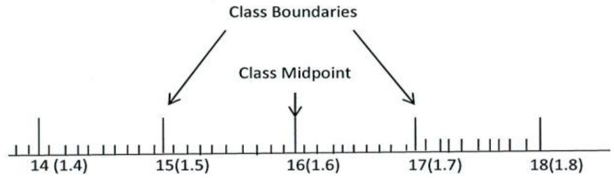
The boundaries of the size classes coincide with the whole unit of the interval. For example, if the units are centimetres, then the class boundaries fall on the full centimetre (Figures 2 and 3). As examples of this principal, portions of the 1 cm and 2 cm diameter classes herein are illustrated:

1 cm classes			2 cm classes		
Lower Boundary	Midpoint	Upper Boundary	Lower Boundary	Midpoint	Upper Boundary
0.0	D_1	1.0	1.0	D_2	3.0
1.0	D_2	2.0	3.0	D_4	5.0
2.0	D_3	3.0	5.0	D_6	7.0
3.0	D_4	4.0	7.0	D_8	9.0
4.0	D_5	5.0	9.0	D_{10}	11.0

Figure 2 Class Intervals



Class Interval	Boundary	Midpoint	Upper Class Boundary	Class Name
0.1 cm	10.0	10.05	10.1	10.1
1.0 cm	10.0	10.5	11.0	11
0.01 m	2.00	2.005	2.01	2.01
0.1 m	2.00	2.05	2.10	2.1



Class Interval	Boundary	Midpoint	Upper Class Boundary	Class Name
2.0 cm	15.0	16.0	17.0	16
0.2 m	1.50	1.60	1.70	1.6

Figure 3 Class Boundaries

3.5 Precision

Scaling precision required varies with the purpose for which the scale is to be used; this precision is controlled by the selection of the appropriate tolerance level which specifies size class intervals, maximum log lengths, and procedure for the determination of the extent of defects.

The scaler is responsible for ensuring that the correct tolerance level is applied during each scaling operation.

Diameters and lengths are recorded by the class name for each of the tolerance levels. For calculation of volume, the midpoint of the corresponding class is used.

3.5.1 Tolerance Level One

This tolerance level provides the maximum scaling precision for individual logs when the available data consists of measurements of two end diameters, and length. This precision seldom is required, but may be necessary for the development of standard volume equations and tables.

The diameter of each end is to be determined from a measure of circumference, with a precision of 0.1 cm; since the diameters are to be determined inside bark, it is necessary to remove the bark at the measurement points.

Length is to be measured with a precision of 0.01 m; maximum log length is 1.30 m.

The size class is taken from the upper class boundary for both diameter and length.

When there is visible indication of defect in a log; the log is to be sectioned so as to expose the extent of the defect.

The figures for the volume of each log are to be calculated to have at least three significant digits;

examples: 0.000146
0.00146
0.0146
0.146

At this tolerance level, accuracy can be expected to be within ± 1% for each scaled log. This is based on a log 20 cm in average diameter, 1.3 in length (Appendix E).

3.5.2 Tolerance Level Two

This tolerance level usually would be used for measurements of small quantities of individual logs for the development of volume tables, and for determining the solid volume recovery from wood originally scaled using stacked wood, mass, or tree length techniques.

The diameter of each end is to be measured inside bark with a precision of 1 cm.

Length is to be measured with the precision of 0.1 m; maximum log length is 2.5 m.

The size class is taken from the upper class boundary for both diameter and length.

When there is visible indication of defect in a log, that log is to be sawn into two logs if necessary to help determine the extent of the defect.

The volume of each log is to be calculated with a precision of 0.001 m^3.

At this tolerance level, accuracy can be expected to be within ±10% for each scaled log. This is based on a log 20 cm in average diameter, 2.5 m in length (Appendix E).

3.5.3 Tolerance Level Three

This tolerance level would be used for scaling large quantities of individual logs.

The diameter of each end is to be measured inside bark with a precision of 2 cm. Note that the size class boundaries fall on the odd centimetres, and that the size class midpoints and names coincide at the even centimetres.

Length is to be measured with a precision of 0.2 m; maximum log length is 5.0 m class; logs longer than 5.1 m are to be measured as two or more logs; note that bark thickness must be subtracted from mid-log diameters measured outside bark.

Deductions for defects are to be based on external indication of the extent of the defect. A defect visible only at one end of a log should be assumed to extend one-half the length of the log. If one-half the log length is a class boundary, the defect is increased to the next higher length class. Butt-rot is assumed to extend five times the average diameter of the decayed area, in the absence of any indication to the contrary.

The volume of each log is to be calculated with a precision of 0.001 m^3.

At this tolerance level, accuracy can be expected to be within ±15% for each scaled log. This is based on a log 20 cm in diameter, 5.0 m in length (Appendix E).

3.6 Trim Allowances

In terms of scaling roundwood, there are no formally recognized trim or broomage allowances. It should be noted that an implicit trim allowance is defined by the size class interval specified for use with each scaling technique. For example, a scaling technique which state the length measurements must be recorded in increments of 0.2 m, implies that the actual log may be 0.1 m longer or shorter than the recorded length.

4. THE SCALING LICENCE

4.1 Solid Volume of Individual Logs

The solid sound cubic quantity of wood in any log can be determined by:

1. Measuring the external dimensions of the log to obtain an estimate of gross volume;
2. Measuring or estimating the dimensions of any defective portion of the log to determine defect volume;
3. Subtracting the defect volume from the gross volume to determine net volume.

4.1.1 Measurements

4.1.1.1 Whole Log

1. Diameter

   Diameters are to be measured inside bark at both ends of the log. Where a diameter cannot be measured inside bark as in the case of a mid-log diameter measurement the diameter outside bark and bark thickness are to be measured to calculate diameter inside bark.

   Size class intervals should be those necessary for the tolerance level required.

   Diameters of logs with a non-circular cross section are to be determined from an average of at least two measurements taken at right angles to each other across the face of the log. In the case of butt swell in a log, the diameter of the large end inside bark is to be measured in line with the normal taper of the log (Figure 4).

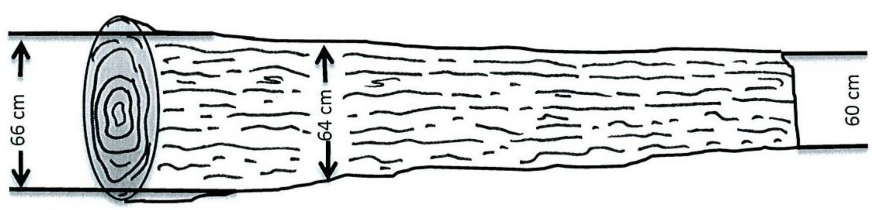


Figure 4 Butt Swell

   In the case of an abnormal protuberance at the point of diameter measure, such as is caused by a burl, branch whorl, fork or disease swelling, the diameter is to be reduced to what it would be if there was no protuberance (Figure 5).

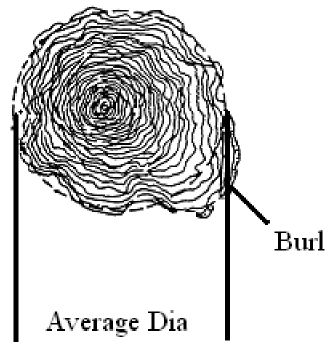


Figure 5 **Abnormal Protuberance**

2. Length
   Length is to be measured and recorded using the size class intervals necessary for the tolerance level required.

4.1.1.2 Defects

The only defects for which volume deductions are to be made are advanced decay, charred wood, and missing wood. The dimensions of defects are to be measured, and recorded using the same class intervals that were used to determine the dimensions of the whole logs.

1.1.2 Volume Calculation

4.1.2.1 Gross Volume

All volumes are to be expressed in cubic metres, as determined from the following formula:

$$V = \frac{0.7854 \times \frac{(D^2 + d^2)}{2}}{10{,}000} \times L$$

Where V = volume in m^3
D = large-end diameter in cm
d = small-end diameter in cm
L = length in m

4.1.2.2 Defect Volume

The formula used to calculate defect volume is to be that for the geometric solid which nearest approaches the shape of the defect. Specific formulas to be used are:

1. Rectangular solid

$$V = \frac{W \times T \times L}{10{,}000}$$

Where V = volume in m^3
W = width of the defect in cm
T = thickness of the defect in cm
L = length of the defect in m

2. Cylinder

$$V = \frac{0.7854 \quad D^2}{10{,}000} \quad \times \quad L$$

Where V = volume in m^3
D = average diameter of the defect in cm
L = length of the defect in m

3. Cone

$$V = \frac{0.7854 \quad D^2}{30{,}000} \quad \times \quad L$$

Where V = volume in m^3
D = average diameter of the base of the defect in cm
L = length of the defect in m

4. Sector

$$V = \frac{D \times K}{40{,}000} \quad \times \quad L$$

Where V = volume in m^3
D = average diameter of the log in cm
K = average arc length of the sector in cm $\frac{(K1 + K2)}{2}$
L = length of the defect in m

4.1.3 Volume Tables

The volume of logs and cylindrical defects can be determined directly from the tables in Appendix J. The diameter and length dimensions are exact; therefore, in order for the tables to be applicable directly, the class midpoints must coincide with the stated dimensions. To determine volumes for size class intervals with midpoints that fall midway between the tabular dimensions; adjacent tabular volumes may be averaged with insignificant error (Appendix F).

4.1.4 Determination of Dues Class Distribution on an Individual Log

The volume associated with each dues class (ie. S1a, S1b, S1ad, S1bd, S2, S3, H1, H2 or undersize timber) is based on the diameters of the log (Section 2.3.3.1 of this standard). Should it be necessary to determine the volume associated with a particular diameter split (i.e. 15 cm fall half way up the log), it will then be necessary to treat this particular bolt as two separate bolts. In this way the associated volume can be placed in its corresponding dues class.

4.2 Solid Volume of Piled Logs

This technique could be used to scale piles of logs of any uniform length up to 5.1 m except when each log may be positively identified and examined for defect, in which case the techniques for scaling individual logs may be used.

Pile heights must not exceed 2.5 m.

4.2.1 Procedures

Logs are measured from one end of each skid way or pile. If a series of similarly sized piles of logs have a preponderance of butts, tops, defects, or rejects on the same side, then alternate sides of successive piles may be scaled. In the case of an individual pile of logs with a preponderance of these, then both sides should be scaled, and the results average for the pile.

4.2.1.1 Diameter Measurement

Unless otherwise stated in the scaling plan, diameters are to be measured inside bark in 1 cm classes.

Note: When scaling for dues class distribution, diameters **must** be measured inside bark in 1 cm classes with the class midpoint used for calculations.

Diameters of logs with a non-circular cross section are to be determined from an average of at least two measurements taken at right angles to each other perpendicular to the longitudinal axis of the log.

Deductions are to be made for butt swell at the measured end of the log.

In the case of an abnormal protuberance at the measured end of the log, such as is caused by a burl, branch whorl, or disease swelling, the diameter is to be reduced to what it should be if there was no protuberance (Figure 5).

4.2.1.2 Length Measurement

Unless otherwise stated in the scaling plan, log lengths are to be measured in 0.1 m classes

Since the bolts are in piles, only a sample of logs can be measured to establish a length class for each pile. The average bolt length is determined by taking a number of measurements across the top of the pile. For piles which are less than or equal to 10 m, a minimum of 10 bolt lengths must be taken. For piles greater than 10 m in length, a bolt length must be taken every metre. The average length class will be determined.

If greater than 20% of the logs in the pile fall outside the established length class, then the logs must be placed in piles of similar lengths before scaling. Logs that differ from the average length class by more than one length class must be measured individually.

Length measurements are to be made with either scale stick or tape measure.

4.2.1.3 Defect Measurement

Measurable defects are advanced decay including white spec, char, or missing wood evident at the scaled end of each log. Defect volume is determined as the cross-sectional area of the defect, expressed as the diameter of a circle of equivalent area times the length of the log. That is:

$$\text{Volume } (m^3) = \frac{0.7854\ (D^2)\ x\ L}{10{,}000}$$

Where D = is the diameter of the equivalent circle, in cm
Where L = is the length class of the pile in m

4.2.2 Using the Logs in Piles Technique for Sample Scaling

The procedures for using piled logs in the determination of a stacked to solid conversion or a weight to volume conversion are the same as the procedures for production scaling. Use of this technique for determination of a conversion, requires an improvement to the precision with which the logs in piles are scaled. Unless otherwise stated in the scaling plan, the precision level with which the logs are to be scaled are as follows:

- diameters measured inside bark in 1 cm classes;
- log lengths measured to 0.1 m.

The midpoint of the class will be used for all calculations.

4.2.3 Determination of Dues Class Distribution for Logs in Piles

In order to determine the dues classes for the payment of Crown dues referred to in section 2.3.3.1 of this standard, logs in piles must be measured in 1 cm classes.

For dues classes referred to in section 2.3.3.2 of this standard, the appropriate diameter class must be used in order to differentiate between dues classes and determine the correct volume for payment of dues and fees.

If the logs in the pile are piled in such a manner as an even mix of tops and butts is obtained, the volume associated with each dues class is based on the diameters of the logs on the measured side of the pile. The volume for each dues class is determined by summing the volume associated with the corresponding diameter. For piles where a preponderance of butts or tops is on one side of the pile, the volume associated with each dues class is based on the measurement of the diameters on each side of the pile, and the final volume results on each side of the pile being averaged.

5. PENCIL BUCKING

5.1 Pencil Bucking

The volume of a tree length stem, without physically bucking the stem into individual logs, is determined by a procedure called pencil bucking.

Figure 6 Using Pencil Bucking in Sample Scaling

5.1.1 Procedures

As the tree stem is in its complete form, the measurements being taken are necessary for calculation of total tree volume. In order that an accurate volume can be calculated, the scaling of tree stems is conducted by breaking the tree stem into multiple individual logs (bolts) without the physical bucking of the tree stem.

The pencil bucking of the tree length stems is a very systematic method of scaling and it is imperative that all information be measured and recorded on an approved tally sheet. As the bolts within the tree stem are considered to be individual logs, the procedures for scaling of these stems will be in accordance with section 4.1 of this standard with a couple of additional measurements being taken.

The following additional diameter measurements may be taken on the tree stem:

1. Minimum Butt Diameter – determined from the sawn surface of the butt, it is the shortest measurement through the geometric centre of the butt end surface (figure 7), disregarding abnormal depressions or protuberances. This diameter measurement shall be along a plane that is perpendicular to the longitudinal axis of the tree length;

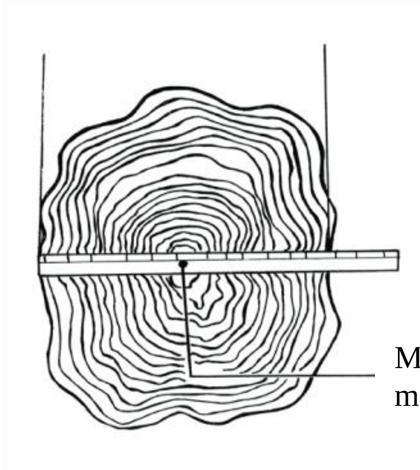


Figure 7 Measurement of the Minimum Butt Diameter

2. Diameter at 1 m – 1 m up the tree stem from the butt, an outside bark diameter measurement is determined ignoring any abnormal protuberance; and/or
3. Mid log diameter – an outside bark measurement is determined at exactly one half the length of the first bolt ignoring any abnormal protuberance.

5.1.2 Diameter Measurement

Where possible, diameters will be measured inside bark. Where an inside bark diameter is not possible, an outside bark diameter will be measured. Inside and outside bark diameters will be measured to the nearest 1 cm unless otherwise stated in the scaling and/or sampling plan.

When an outside bark measurement is taken, two times the average bark thickness is subtracted from the midpoint of the outside bark diameter class to determine the inside bark measurement. This inside bark measurement is considered to be an exact diameter for calculation of bolt volume.

Outside bark diameters are determined using the same techniques as outlined in section 4.1.1.1 of this standard.

Every diameter must have a measurement type. The letter “e” signifies that the diameter measurement is an exact measurement. The letter “c” signifies that the diameter measurement is recorded in a class.

5.1.3 Bark Thickness

From a number of measurements on a sawn surface, the bark thickness is determined to the nearest millimeter at the butt and the top of the tree. Average bark thickness will be determined from an average of these two measurements. If multiple sawn surfaces are available along the stem of the tree, bark thickness must be measured at these points also. Average bark thickness will be determined from an average of the bark thickness taken on each end of the segment, or as an average of all measured bark thicknesses.

5.1.4 Length Measurement

Unless otherwise stated in an approved scaling plan, the length measurement of each individual piece is taken to the nearest 0.01 m. The maximum log length is 5.10 m. All length measurements with the exception of the top length and length for dues class determination will be considered exact measurements.

Every length must have a measurement type. The letter “e” signifies that the length measurement is an exact measurement. The letter “c” signifies that the length measurement is recorded in a class.

5.1.5 Log Position

In order to facilitate reconstruction of the tree stem, it is crucial that each bolt’s position in the tree stem be recorded. If the first bolt is a butt log, it will be recorded as a “B” under log position on the tally sheet, otherwise it will be recorded as “M1”. Each subsequent log will have a prefix of “M” followed by the next consecutive number until the top of the tree stem is reached. The last bolt in the tree stem will be recorded as a “T1”.

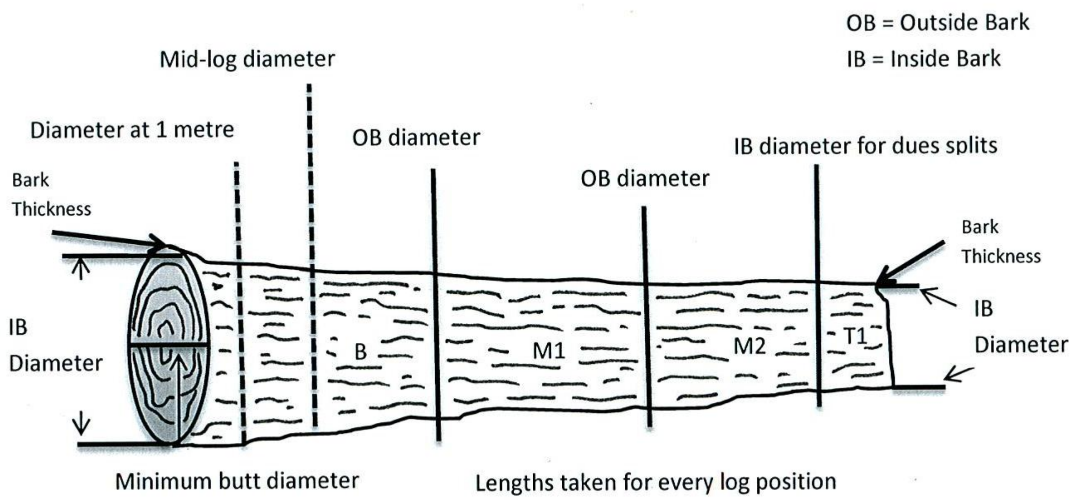


Figure 8 **Measurements to be Taken When Using Pencil Bucking**

5.2 Determination of Defects

Allowable defects are those stated in section 6 of this standard. As the tree stems are in their complete form, defects will only be visible on the sawn surfaces of the tree. If it is felt that there is enough defect to warrant further sampling, it may be to the purchasers benefit to have the logs sawn into individual logs and the defects measured in their entirety. Over a period of time, this additional sampling for defect may lead to the development of cull tables specific to the operation.

5.3 Volume Calculations

Calculation of gross, defect and net volumes are conducted using the same procedures as outlined in section 4.1.2 of this standard. Unless the inside bark diameter has been calculated from an outside bark measurement, calculations will be performed using the tolerance level approved in the scaling plan.

5.3.1 Determination of Dues Class Distribution

The volume associated with each dues class, for example S1a, S1b, S1ad, S1bd, S2, S3, H1, H2, is based on the diameters of the log. Should it be necessary to determine the volume associated with a particular diameter split, for example 15 cm falls halfway up the bolt, it will then be necessary to treat this particular bolt as two separate bolts. As the diameters are being taken outside bark, the location of the diameter class split is determined by adding two times the average bark thickness to the exact diameter of the dues class. For example: an average bark thickness of 5 mm times two equals 1 cm, the split between S1a or S1b and S2 is 15 cm inside bark, 15 cm plus 1 cm equals 16 cm. Measure along the tree until 16 cm outside bark is reached, at this point the inside measurement shall be assumed to be 15 cm (**exactly**). When recording the splits between dues classes the exact measurements must be recorded. An “e” for exact must be used beside any exact measurement.

6. DEFECTS

6.1 Types of Defects

6.1.1 Sap Rot

Definition - outer portion of log is decayed, often around the complete circumference of the log;
- frequently indicative that a log has been lying on or near the ground for a considerable period of time.

Deduction - net sound wood scale is determined from the average diameter of the sound core.

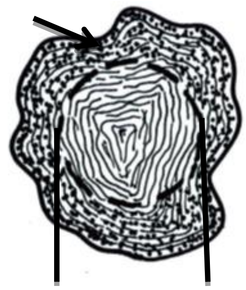


Figure 9 Sap Rot

6.1.2 Butt Rot

Definition - soft, punky wood, or missing wood surrounded by advanced decay, at the large end of butt logs only; frequently indicative of over maturity.

Deduction - in the absences of indications to the contrary, butt rot is to be considered cone shaped and to extend five times the average diameter of the decayed area;
- butt rot that extends the full length of the log is to be treated as though it is heart rot.

Figure 10 Butt Rot in a White Spruce Log

6.1.3 Heart Rot

Definition - decayed heartwood in logs other than butt logs; may be visible at one or both ends of the log; usually circular or semi-circular in cross direction.

Deduction - visible only at one end of the log in the absence of indications to the contrary, scale as a cylinder extending one-half the length of the log; visible at both ends of the log, scale as a log.

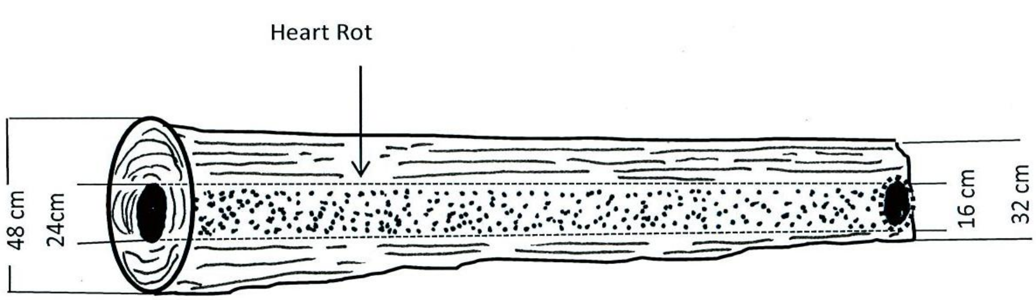


Figure 11 Heart Rot

6.1.4 Ring Rot or Shake

Definition - interior advanced decay or shake in the form of a ring around the path, enclosing a core, and enclosed by a shell, of sound wood.

Deduction - length is determined as for heart rot; scale the ring as heart rot; then reduce the amount of the deduction by the volume of the sound core.

- Net Volume = Gross Volume minus the volume of ring rot and sound core plus the volume of the sound core.

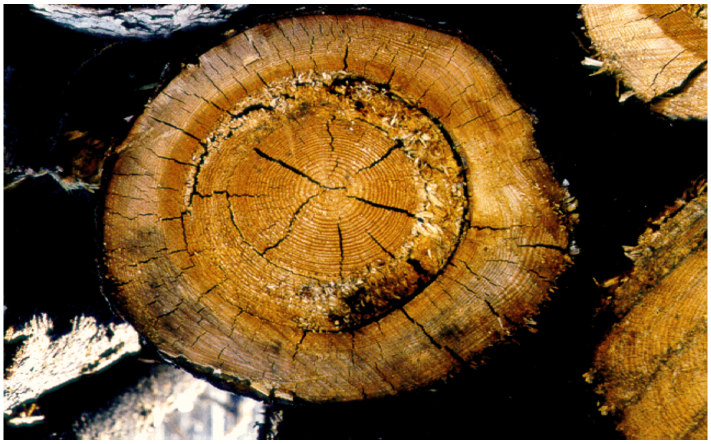


Figure 12 Ring Rot in a Fire Killed Jack Pine Bolt

6.1.5 Pipe and Pocket Rot

Definition - interior advanced decay other than butt rot or heart rot; frequently occurs at several locations of the same cross section of the same log.

Deduction - length is determined as for heart rot; each segment of advanced decay is scaled either as a rectangular solid or a cylinder.

Figure 13 Pipe or Pocket Rot

6.1.6 Rotten or Missing Side

Definition - advanced decay extending from the surface to the pith, enclosed approximately by lines of radius.
Deduction - scale as sector, using average log diameter, average arc length, and measured or estimated defective length along the log.

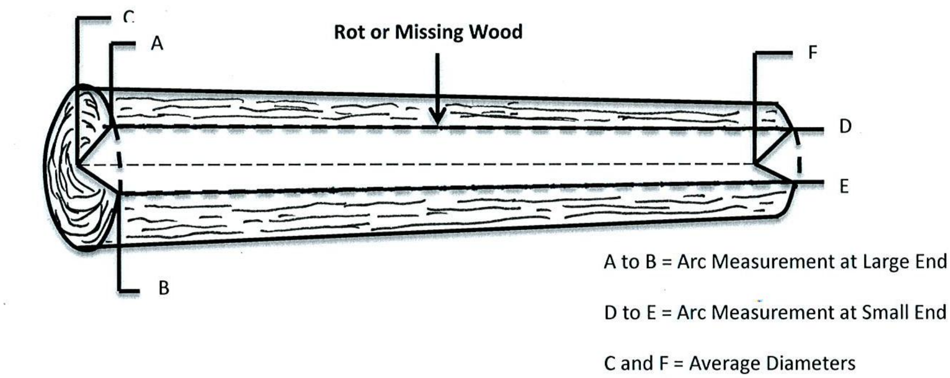


Figure 14 Rotten or Missing Side

6.1.7 Cat Face or Fire Scar

Definition - dead portion of the outer surface of the log that the tree failed to rejuvenate following some old disturbance.
Deduction - scale as rectangle of averaged dimensions extending the visible length of the defect.

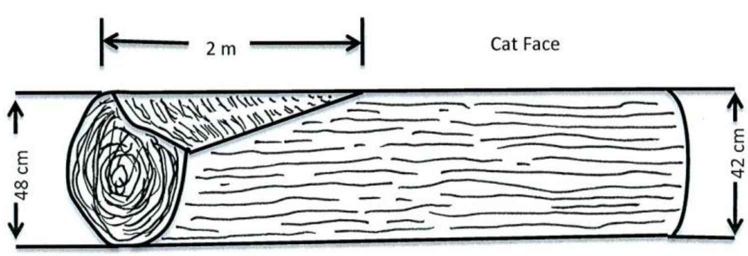


Figure 15 Fire Scar

6.1.8 Insect Damage

Definition - insect burrows sufficiently excessive so as to result in a significant loss of sound wood. Treat as a cylinder or rectangle.

Deduction - apply one of the above techniques that best suits the extent of the damage.

Figure 16 Insect Damage in a White Spruce Log

6.1.9 White Fleck

Definition - primarily a heart rot of living trees which enters the tree through branch stubs and causes a trunk rot. It may occasionally enter through basal scars, causing a butt rot; in the early stage of decay the wood shows a pinkish to purplish-red discoloration and as the decay progresses, small, white lens-shaped pockets develop parallel to the grain. The wood between these pockets is discolored but firm; advanced stages of decay result in the discoloration becoming soft and punky.

Deduction - deduction is made as for heart rot; no deduction is made for the discoloration unless the wood is soft and punky or white fleck is present.

Figure 17 White Fleck in a Jack Pine Log

6.1.10 Forks and Multiple Stems

Definition - weather conditions or damage from neighboring trees has resulted in the main leader being damaged and two or more lateral leaders take over as the main leader.

Deduction - there is no actual deduction for this type of defect. When bucking up a tree with this deformity, it is necessary to eliminate the deformity as best as possible. As long as the forks or multiple stems meet minimum size standards, scale as single trees.

6.1.11 Mechanical Defects

There is no deduction for any defects that are caused by improper handling or harvesting of timber. The bolt will be scaled as though the damaged portion was present.

6.2 External Indications of Rot

Figure 18 External Indication of Rot in a White Spruce Log

In order to determine the length of the rot in a bolt, external indications are used. Scaler experience will be an asset, but some of the indications may be:

6.2.1 Lightning Scar

Definition - lightning may damage a tree enough to provide an entrance of fungal spores or cause other structural defect.

Deduction - if the rot can be seen, the length is measured and the defect is deducted as for a missing side or fire scar, whichever best suits the defect; if the rot cannot be seen on the side of the bolt but can be seen in the butt end, the length of the defect is that of the scar.

Depth Measurement - the depth is obtained by averaging the depth of the scar at both ends of the bolt. If the depth can only be seen at one end of the bolt, it is assumed to be the same depth as measured where visible.

Width Measurement - the width is obtained by averaging the width of the scar at both ends of the bolt. If the width can only be seen at one end of the bolt, it is assumed to be the same width as measured where visible.

6.2.2 Bark Seam, Frost Crack

Definition - after a tree has split from frost, it most often heals leaving a seam of ingrown bark. On occasion, decay organisms will invade the wound, causing rot.

Deduction - if rot is present, deductions will be made using the deduction that best suits the defect; as an indicator of defect length; if rot is seen in the butt, the defect length will be that of the seam.

Depth Measurement - the depth is obtained by averaging the depth of the scar at both ends of the bolt. If the depth can only be seen at one end of the bolt, it is assumed to be the same depth as measured where visible.

Width Measurement - the width is obtained by averaging the width of the scar at both ends of the bolt. If the width can only be seen at one end of the bolt, it is assumed to be the same width as measured where visible.

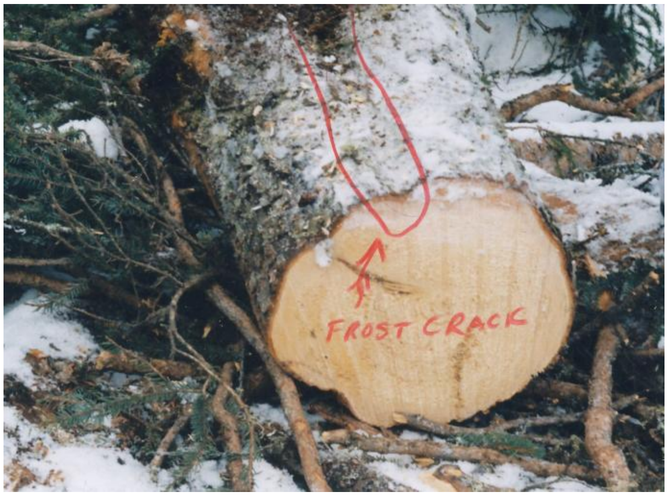


Figure 19 Example of Frost Crack

6.2.3 Conks

Definition - conks and conk knots are used as a definitive indication of the presence and/or length of a particular defect; defect length is measured to the last visible conk or conk knot unless there are indications to the contrary. Scaler experience is extremely valuable in determining the length of the defect using conks as indicators.

6.2.4 Burls

Definition - swelling or abnormal growth on the bole of the tree, rot may be associated with this defect.
Deduction - internal rot seldom travels more than 1 m above and below goiter; firm wood loss is based on scaler experience and judgment.

6.3 Standards for Determination of S1ad and S1bd Timber

S1ad and S1bd timber classes account for the diminished value of large diameter softwood logs that contain defects in the form of rot or sweep that exceed the tolerances established for Class S1a and S1b timber.

For the purposes of dues allocation, the following procedures shall be used to determine S1ad and S1bd classes of timber:

The following procedures will be applied when scaling Crown timber.

Rot:

Logs longer than 2.6 metres must be measured as 2 or more logs.

Rot as defined in Section 6.1 that is evident at the scaled end of the log shall be measured using procedures outlined in this standard for the technique being used.

If the area of rot exceeds the tolerances described in Appendix B – Maximum Allowable Rot by Size, that log will be classified as an S1ad or S1bd category log according to the species.

Sweep:

As a result of site, weather conditions or damage from neighboring trees, a tree may grow in a manner that causes a gradual curve in the tree or log.

Sweep cannot be applied to logs in a pile unless the sweep can be visibly identified and measured along the length of the log.

Sweep determination will be applied to the log being scaled to a maximum of 2.6 metres.

If the log is longer than 2.6 metres the sweep must be measured as 2 or more logs.

Sweep is determined using a straight line between the geometric centre of each end. There must be a minimum of 5.0 cm between the centre line and the edge of the log along the entire length of the log.

ass Determination Based on Sweep Measurement

If the amount of sweep exceeds the tolerances described above, that log will be classified as an S1ad or S1bd category log according to the species.

7. STACKED ENDORSEMENT

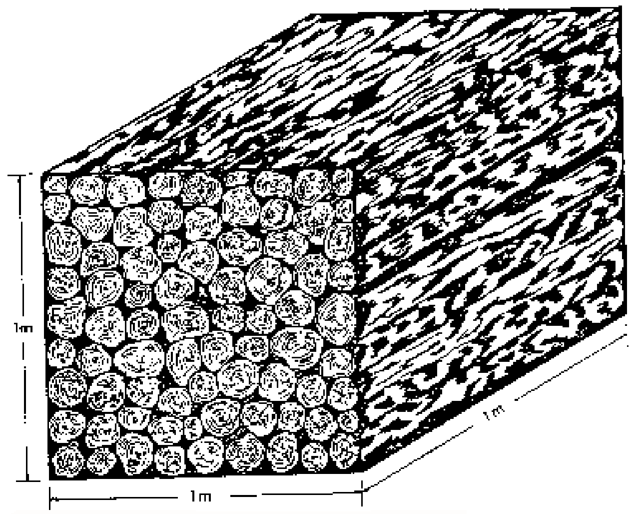


Figure 21 Stacked Cubic Metre

7.1 Stacked Volu

The apparent volume of any uniformly stacked pile of logs may be determined by:

1. measuring the length and height of the stack, and the length of the logs in the stack;
2. determining the volume of defects and voids in the stack, from diameter measurements;
3. subtracting the volume of defects and voids from the gross volume to determine net volume.

7.2 Measurement and Volume Units

Stack length, stack height, and log length are to be determined in metres.

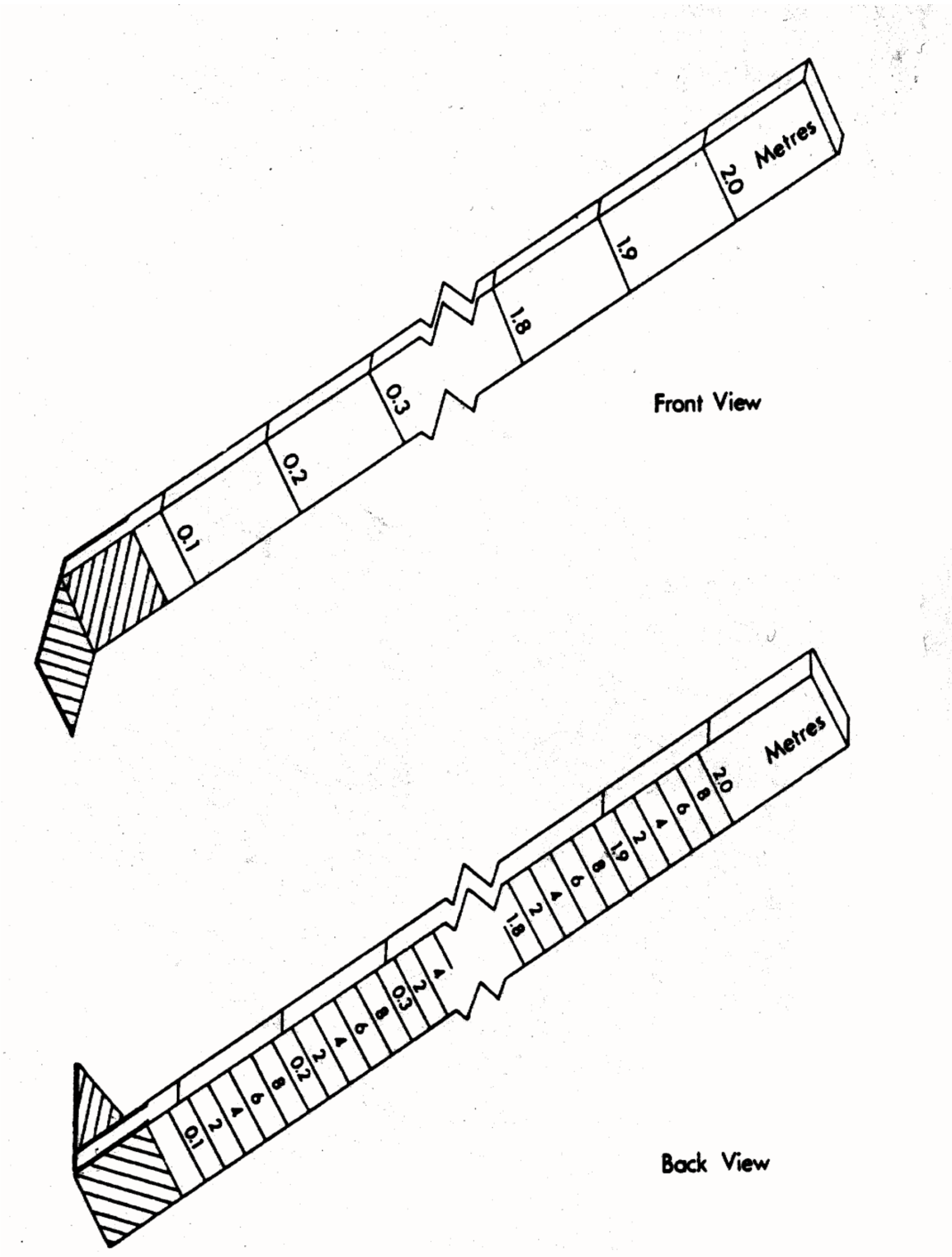


Figure 22 **Stack Scaling Stick**

7.2.1 Preparation of Stack for Scaling

1. Piles must not exceed 2.5 m in height.
2. Where practical all bolts are to be piled on skids of non-merchantable material so as to be off the ground and beyond the reach of rising water.
3. The immediate surroundings of each pile must be cleared and a lane of at least 1.5 m left between piles
4. Stacked wood is not to be piled against standing trees.
5. Piles are to be made so as to present one even vertical face and contain only bolts of the same length class.
6. The bottoms of each pile should be as level and horizontal as possible.
7. Bolts must be trimmed of all limbs and knots evenly with the surface of the bolt.

7.2.2 General Procedures

Measure the length, height, and width of the pile; note that the width of the pile is in fact the bolt or log length. Determine the allowable deductions that may be deducted from the pile.

Figure 22 shows the front and back view of a stack scaling stick. The back view illustrates the 2 cm size classes to be used for measuring the length and height of the pile. The front view illustrates of 0.1 and 0.2 m classes to be used for bolt or log length.

Piles are to be measured from one side only. If a series of similarly sized piles have a preponderance of butts, tops, defects or rejects on the same side, then alternate sides of successive piles should be scaled. In the case of an individual pile of logs with a preponderance of these, then both sides should be scaled, and the results averaged for the pile.

In addition to the requirements for marking timber in section 2.3.1 of this standard, reject bolts must be marked clearly with an “X”. A ring is to be drawn around all deducted defects. The information recorded on each pile is necessary to indicate that the pile has been scaled and to facilitate a check scale.

Figure 23 Marking of Stack

7.2.2.1 Stack Scaling on Trucks and Railway Cars

When stacked wood is piled on a vehicle in such a fashion that all or most of the sawn surfaces of the logs on the vehicle are readily visible, then the general stack scaling procedures are to be applied.

When all or most of the sawn surfaces of the logs on the vehicles are not readily visible, then the following special procedures must be applied:

1. Bulk-end railway cars

If the bolts are piled lengthwise (parallel to the longitudinal axis of the car) in this type of car, no sawn surfaces are readily visible. Pile length is determined by summing the average distances between side stakes for each tier of wood. The average distances between side stakes must be checked, with the trailer loaded, a minimum of twice per year unless any alterations have been made to the trailer. In which case, the average distances must be checked immediately. Pile height is determined as the average of all measured heights take at mid-log length for each tier on both sides of the railway car. Deductions are determined by off loading one tier of logs, measuring the deductions, and multiplying the number of tiers.

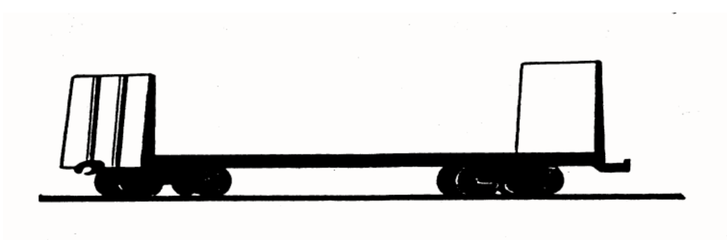


Figure 24 Bulk-end Railway Car

2. Gondola railway cars

If the bolts are piled lengthwise on this type of car, scale as for Bulk-end cars.

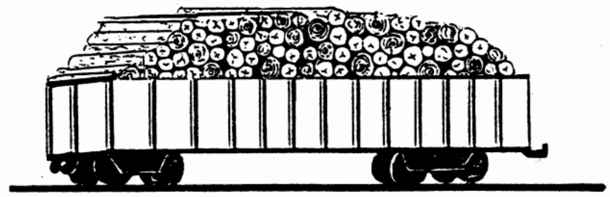


Figure 25 **Gondola Railway Car**

If the bolts are piled across the car (perpendicular to the longitudinal axis of the car), then the pile length and pile height can be measured directly. However, since the railway car has short sides, the sawn surfaces below these sides are not visible and deductions cannot be measured. Therefore, the total deduction volume is determined from:

$$V = \frac{H}{h_1} \times DEDh_1$$

Where

V	=	total volume of defect in the load
H	=	average total pile height
h_1	=	height of pile above the sides of the rail
$DEDh_1$	=	deductions from the logs visible above the sides of the railway car

3. Flat-bed trucks

If the bolts are piled lengthwise in tiers on the truck, and the sawn surfaces of the logs in the first and last tiers only are readily visible, then pile length and pile height are determined as for bulk-end railway cars, and the total deduction is determined as the average deduction from the first and last tiers, multiplied by the number of tiers.

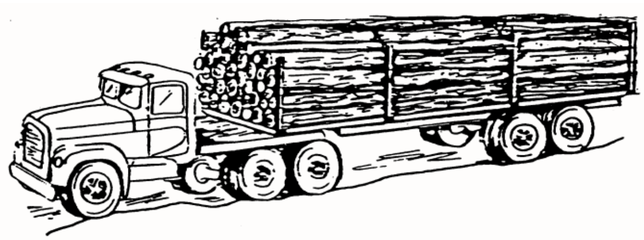


Figure 26 **Flat-bed Truck**

7.3 Dimensions

7.3.1 Length

1. Instruments and Size Classes

The length of a stack is to be measured in 2 cm classes, using either a scale stick or a tape measure, and recorded in metres. The boundary between size classes is on the odd centimetre; the midpoints and the names of the size classes are derived from the even 2 cm classes.

2. Measurements

When pile-end supports are vertical, measure between the supports; if the supports lean in or out, take several measurements and determine the average length or measure the length at one-half the stack height (Figure 27). These measurements are taken with the vehicle loaded.

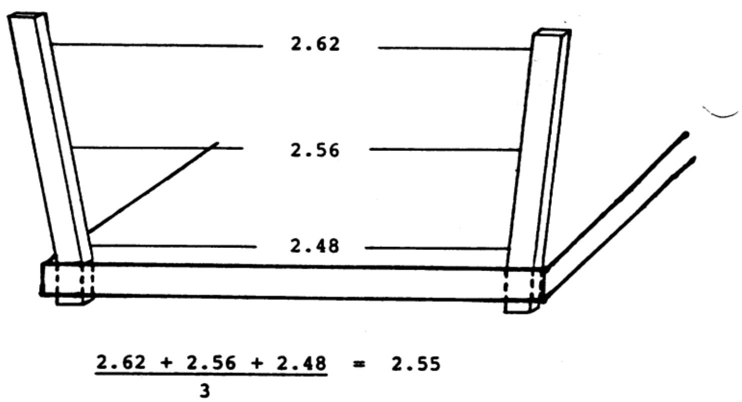


Figure 27 Length Measurement With End Stakes

When a pile of round wood drops off in height at one or both ends to form a slope, the length measurement is to be taken one of two ways:

1. to a point where one-half the height of the stack intercepts the line of the slope (Figure 28, 29).

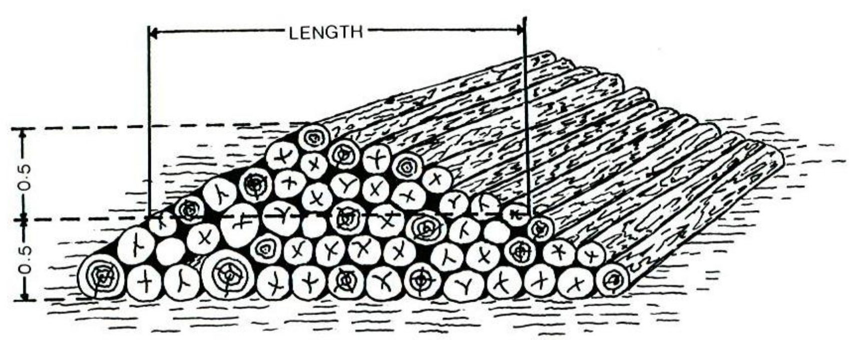


Figure 28 #1 One-half the Height Intercepts the Line of the Slope

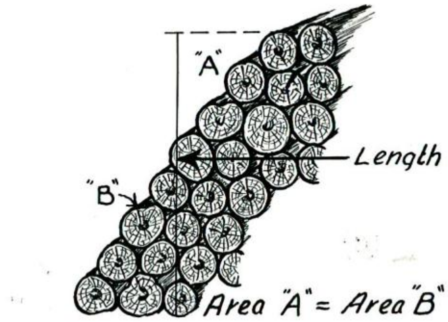


Figure 29 Area B should Fit into the Space of Area A

2. To the points that include maximum length of the stack (Figure 30).

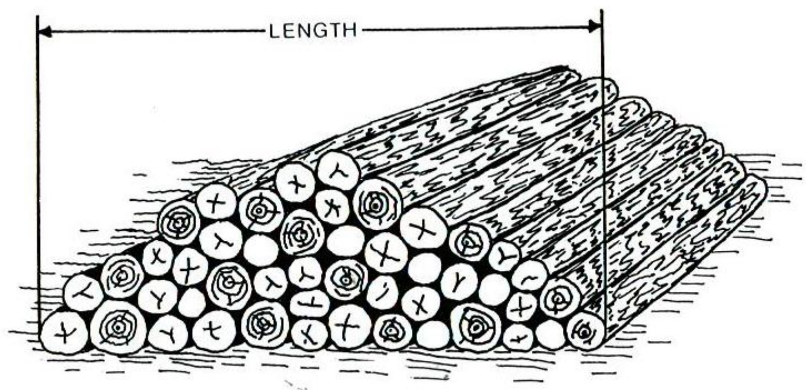


Figure 30 #2 Length of Stack Measured at Points That Define the Maximum Length

When the pile is greater than 10 m in length, or the end slope is regular or constant, method 1 should be used.

When the pile is less than 10 m in length and the end slope is irregular, method 2 should be used.

The scaler is accorded some judgment in the applicability of the proper method.

When a stack is piled on a hillside or slope, the length of the pile is to be measured parallel to the slope of the stack (Figure 31).

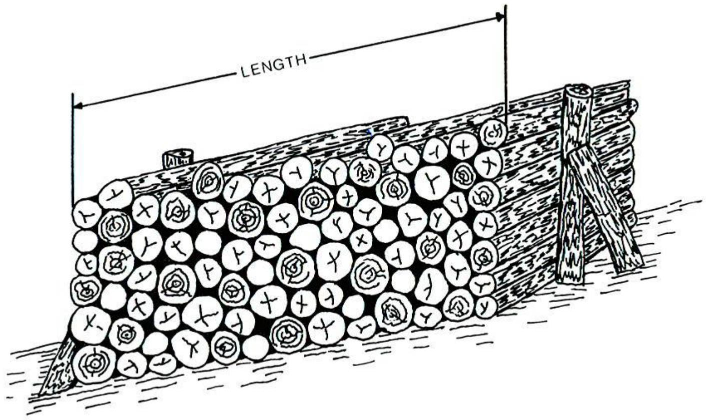


Figure 31 Length of Stack Parallel to Slope of Ground

For piles longer than 10 m, length should be determined with a tape measure.

Piles longer than 30 m must be scaled as two or more sections, each section not to exceed 30 m in length. Each section is to be measured, recorded and marked as a separate stack, and the division between sections clearly marked.

7.3.2 Height

1. Instrument and Size Classes

The height of a stack is to be measured in 2 cm classes, using a scale stick, and recorded in metres. The boundary between size classes is on the odd centimetre; the midpoints and the names of size classes are derived from the even 2 cm classes.

2. Measurements

Stack height is the most critical measurement when measuring piles of stacked wood. Stack height is to be determined from an average of several measurements taken at **equal intervals** along the length of the pile. Ensuring the intervals are equal in length is extremely important. More measurements are required for stacks with irregular heights than for stacks with regular or consistent heights.

As a general guide, for short stacks of regular height or long stacks of irregular height, measurements should be taken at about every double step; for short piles of irregular height, measurements should be taken about every single step (Table 2). Although every person's steps may very slightly in length the principle of equal intervals will still apply for each individual as long as they do not alter the length of their step.

A more precise method for ensuring equal intervals is using a tape measure to mark out exactly where each height measurement will be taken.

Table 2 Number of Pile Heights Taken for Various Pile Lengths

PILE LENGTH	NUMBER OF HEIGHT MEASUREMENTS REGULAR STACKS	IRREGULAR STACKS
5	3	6
10	6	12
15	8	12
20	10	12
25	10	15
30	12	18

Each height measurement is taken between the top of the skid and the point where the top of the uppermost bolt intercepts the scale stick; if the scale stick falls in a normal opening between uppermost bolts then the height measurement is to be taken at the point that the center of the scale stick intercepts a tangent common to two adjacent bolts in the opening (Figure 32).

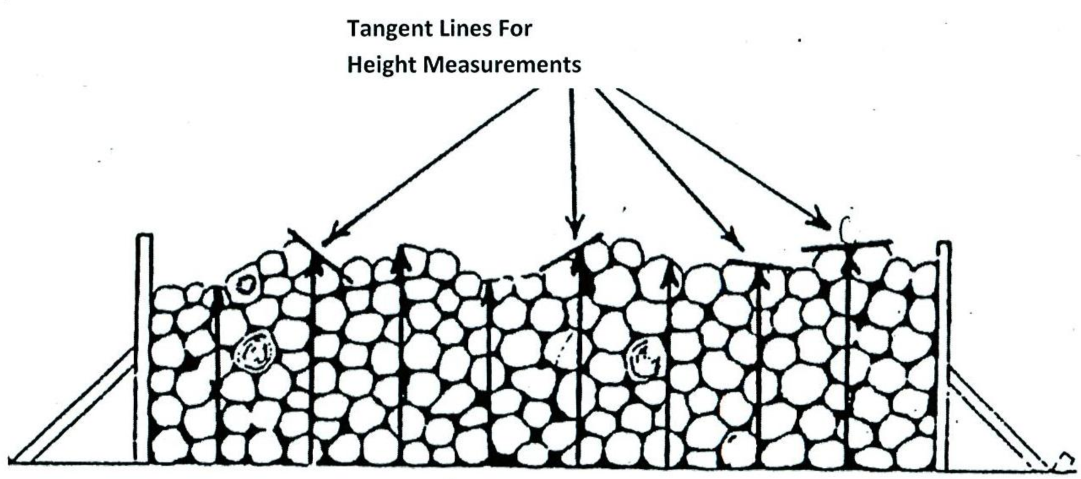


Figure 32 Pile Heights Using Tangent Method

Height measurements must be related to the type of length measurement employed. If the total length of the stack is measured, the heights must be taken at equal intervals throughout the full length of the stack with the first height measurement being taken at the midpoint of the first interval (Figure 33).

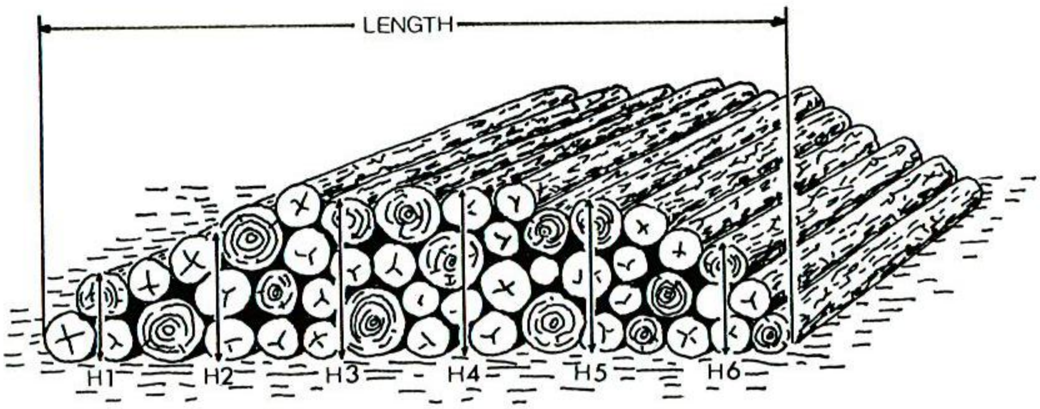


Figure 33 Height of Stack with Total Length and Uneven Sloping Ends

If the length of the stack has been estimated at less than total length, then height measurements must be taken between tops of the end slope with the first height measurement being taken at the top of the slope (Figure 34).

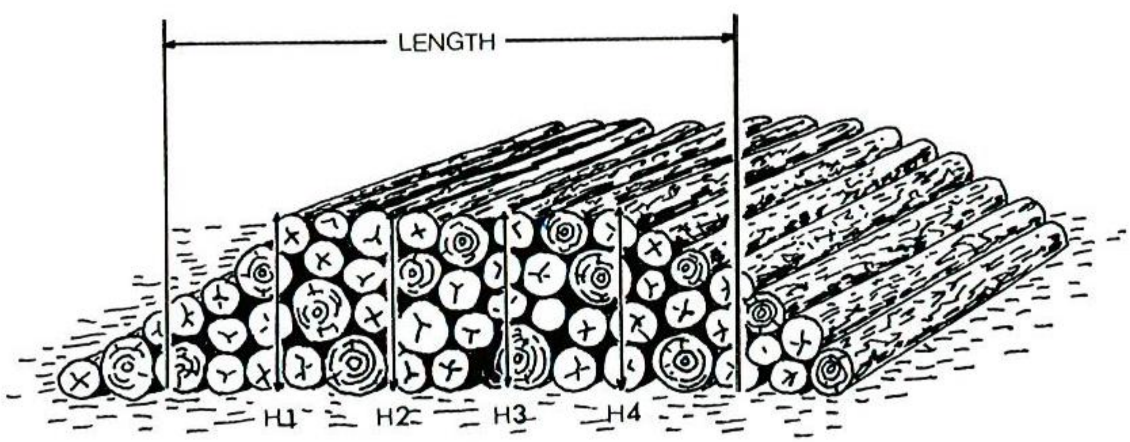


Figure 34 Heights with Length Estimated at Less Than Total and Even Sloping End

If both methods are used on opposite slopes of the pile, the first height measurement must be taken at the end where total length was taken.

If a stack is piled on a slope, the height measurement is taken perpendicular to the slope (Figure35).

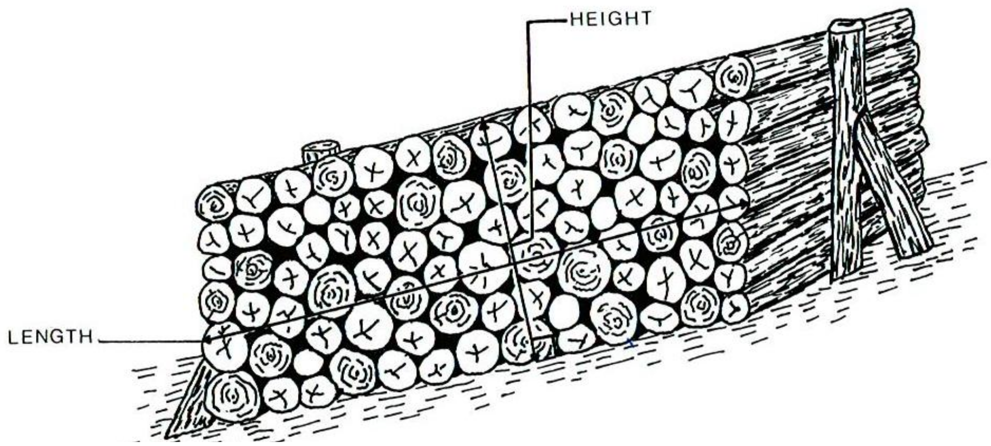


Figure 35 Height of Stack Supported on a Slope

7.3.3 Width

1. Instrument and Size Class

The width of a stack is the length of the logs in the stack. Unless stated otherwise in the scaling plan, the pile width shall be measured in 0.1 m classes, using a scale stick, and recorded in metres. Maximum log length to be measured using this technique is 5.1 m. Size classes to be used are to be based on Table 3.

Table 3 Size Classes to be Used for Various Bolt Length

Average Bolt Length	Size Class	Class Boundary
≤ 1.10 m	1 cm	full centimetre
>1.10 m	0.1 m	0.1 m

2. Measurement

Since the bolts are in piles, only a sample of logs can be measured to establish a length class for each pile. The average bolt length is determined by taking a number of measurements across the top of the pile. For piles that are less than or equal to 10 m, a minimum of 10 bolt lengths must be taken. For piles greater than 10 m in length, a bolt length must be taken every metre. The average length class will be determined.

If greater than 20% of the logs in a pile fall outside the established length class, then the logs must be placed in piles of similar lengths before scaling. Logs that differ from the average length class by more than one length class must be measured individually.

Calculations will be performed using the midpoint of the width (log length) class.

7.4 Deductions

1. Instruments and Size Classes

Allowable deductions are to be measured with a cube scaling stick, metric ruler or tape measure in 1 cm classes. The volume of the deduction(s) is calculated using the cylinder formula and calculated to the nearest 0.001 m^3.

2. Measurements

Deductions for missing wood within a bolt and butt swell shall be determined for the pile. Butt swell is only deducted when it is in the face of a pile and affecting the external dimensions of that face. All deductions are considered to extend the full width of the pile.

3. Voids

Voids are unnecessary air spaces in the face of the pile large enough to accommodate the diameter of the average size piece in the pile. The volume deduction for a void is calculated using the diameter of the average size piece of the pile. Note that, although the average size piece is determined outside the bark, the volume deduction is determined inside the bark.

In large voids, a deduction is made for all average-sized pieces that would fit inside the air space. (Figure 36)

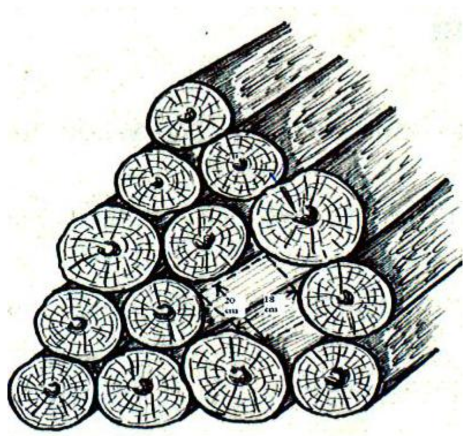


Figure 36 **Example of a Void**

7.5 Volume Calculations

7.5.1 Gross Volume Stacked

Gross volume in stacked cubic metres is to be calculated using the following formula:

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

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

Note: Although L and H are measured with a precision of 0.02 m, averages are calculated with a precision of 0.01 m.

7.5.2 Gross Solid Volume

The gross volume stacked is converted to solid cubic metres using a stacked to solid conversion. The resulting answer is expressed in cubic metres, rounded to the nearest 0.001 m^3.

7.5.3 Deduction Volume

Deduction volume is the summation of volumes for all butt swell and voids in the pile. It is expressed in cubic metres and is deducted from the gross solid volume.

7.5.4 Gross Volume Minus Deductions

The gross volume minus deductions is determined by subtracting the deduction volume from the gross solid volume.

7.6 Volume of Solid Wood

Factors Affecting the Solid Wood Content of Stacked wood are:

1. Species – softwoods usually are straighter and smoother, and thus yield more solid wood per m^3 (stacked) than hardwoods.
2. Bolt Length – short bolts pack tighter and thus yield more solid wood per m^3 (stacked) than long bolts.
3. Bolt Diameter – larger diameter bolts yield more solid wood per m^3 (stacked) than small diameter bolts.
4. Bark – peeled bolts yield more solid wood per m^3 (stacked) than rough bolts.
5. Piling Method – bolts piled in a “hexagonal” fashion occupy less air space and thus yield more solid wood per m^3 (stacked) than bolts piled in a “square” fashion; Bolts hand piled usually yield more solid wood per m^3 (stacked) than bolts that are machine piled.
6. Limbs and Knots – limbs and knots left in bolts prevent even piling and cause unnecessary air spaces that may not be large enough to qualify as voids.

7.6.1 Converting From Stacked Volume to Solid Volume

When scaling stacked wood, it is often necessary to express the volume in solid cubic metres. The following steps outline the procedures necessary to obtain a stacked to solid wood conversion factor.

7.6.1.1 Total Sample Method

If the net volume for each species in the pile is required, then the volume of lesser species is obtained. The volume of the predominant species in the pile then is determined by subtracting the net volume of all lesser species from the net pile volume.

Sample loads must be selected in a random or systematic random design from the total population of loads.

Note: Paragraph 9.4 of "CSA Scaling Roundwood 0302.1-09", provides formulas necessary to compute the sample size.

These loads must be stack scaled and a gross and a deduction volume in stacked cubic metres obtained using the procedures set out in the stack scaling portion of this standard (Section 7). The loads must then be cube scaled using the individual log or solid volume of logs in piles procedures, procedures for sample scaling (Section 4.1 or 4.2), to obtain a gross, defect and net volume in cubic metres.

The stacked to solid conversion is as follows:

$$\frac{\text{Gross volume solid } (m^3)}{\text{Gross volume stacked } [m^3 \text{ (stacked)}]} = m^3/m^3 \text{ (stacked)}$$

Example: $$\frac{.650\ m^3 \text{ solid wood}}{1.00\ m^3 \text{ (stacked)}} \quad .650\ m^3/m^3 \text{ (stacked)}$$

If proportion of bark and air spaces are needed they are calculated separately:

Example: m^3 solid wood outside bark
minus m^3 solid wood inside bark
m^3 bark

Volumes of bark, solid wood, and air spaces are obtainable:

Example: .770 m^3 outside bark
- .650 m^3 inside bark
.120 m^3 bark

.650 m^3 solid wood
.120 m^3 bark

$+ \underline{.230\ m^3 \text{ air space}}$
$1.000\ m^3$ (stacked)

See Appendix K for tables of solid wood volumes converted to m^3 (stacked) for various diameter classes and log length classes. The conversion used for these tables is based upon the above example.

7.6.1.1.1 Defect Measurement

Unless stated otherwise in the scaling plan, defect measurements are taken to the same precision levels as outlined for the diameter measurement. For dues class determination, all defects need to be recorded with the appropriate diameter for which the defect was present. These diameters are then converted to a volume and are expressed as a per cent of the entire gross volume of the sample by the dues class. The per cent defect is then applied to the gross solid volume of all delivered loads for the specific dues class distribution.

$$\% \text{ defect by dues class} = \frac{\text{Volume of defect by dues class in sample}}{\text{Gross volume by dues class in sample}} \times 100$$

If the dues class distribution is not required, then the amount of defect is expressed as a percentage of the sample. Defect volume in solid cubic metres is then derived by applying the per cent defect to the gross solid volume of all loads.

7.6.1.1.2 Dues class distribution for total sample method

The dues class distribution will be obtained by totaling the volumes obtained from the individual log or logs in piles scale of all samples as per the diameter class distribution described in section 2.3.3 of this standard. The dues class distribution is expressed as a percentage of the entire sample volume. It is calculated as follows:

$$\text{Dues class percentage} = \frac{\text{volume per dues class of all samples}}{\text{Total volume of all samples}} \times 100$$

Once the net volume in cubic metres of all wood brought to the processing facility is obtained, the volume of each dues class is determined by multiplying the net volume of all loads times the dues class percentage. The resulting value is the total net volume of all loads for each specific volume class.

Example: Total volume of all piles 245,564 m^3 (stacked)
From sampling - Stacked to solid conversion: 0.549 m^3/m^3(stacked)
Sla: 55%
S2: 35%
S3: 10%

Total solid volume of all piles = Total volume of all piles x conversion
= 245,564 x 0.549
= 134,814.636 m^3

Total volume of S1a	= Total solid volume of all piles x per cent of S1a = 134,814.636 x 55% = 74,148.050 m^3
Total volume of S2	= 134,814.636 x 35% = 47,185.123 m^3
Total volume S3	= 134,814.640 x 10% = 13,481.464 m^3

7.6.1.2 One Square Metre Sample Method

Sampling using this method must be completed in the bush or staging area prior to the trucking of the timber. It may not be used when scaling is carried out on vehicles at the entrance to a processing facility or storage area prior to unloading.

All piled wood is to be stacked according to the techniques outlined in section 7.2.2 of this standard. Based on a sampling of approximately 10% of the pile face area, a stacked to solid conversion factor unique to the pile will be determined. This conversion will convert the stack volume of the pile to a solid volume.

The face area of the pile will be determined by multiplying the average pile height times the pile length. The required number of 1m by 1m squares will be determined by multiplying the pile face area times 10% and the resulting answer will be rounded to the nearest whole number. The determined number of squares is then randomly painted across the pile face so as to represent the log size distribution of the pile, species distribution and defect distribution (Figure 37). The required number of squares can be applied in any manner as long as the same amount of face area is sampled. For example, if two 1 m x 1 m samples are required, the scaler may place four 0.5 m x 1 m samples across the face of the pile.

Once the number of squares have been determined and painted on the pile face, the solid wood content of the squares will be determined by scaling the diameters to the nearest 1 cm and the length of the bolts will be the average pile width as determined from section 7.3.3. All diameters where the face is more than halfway into the sample area are to be considered part of the sample.

The stacked to solid conversion for the pile will be determined by dividing the gross solid wood volume of the samples by the gross stacked volume of the 1 m by 1 m samples.

The solid volume of the pile is then determined by multiplying the stacked volume of the pile times the stacked to solid conversion.

Figure 37 **Placement of Square Metre Sample**

7.6.1.2.1 Defect Measurement

Defect measurements are measured at the precision levels outlined for the diameter measurements.

Defects must be measured one of two ways:

- The defects may be measured in the entire pile and the resulting volume, by dues class, subtracted from the gross volume of the pile.
- The defects within the square metre samples may be measured by dues class, and applied to the pile.

For **softwood species** you must measure the defects based on the entire pile.
For **hardwood species** you may use either the whole pile or square metre sample method to determine defect volume.

If the defects are measured from the square metre samples, the volume of defect will be expressed as a per cent of the gross volume of the sample(s). For dues class determination, all defects need to be recorded with the appropriate diameter for which the defect was present. These diameters are then converted to a volume and are expressed as a per cent of the entire gross volume of the sample(s) by dues class. The per cent defect is then applied to the gross solid volume of all delivered loads for the specific dues class distribution.

$$\% \text{ defect by dues class} = \frac{\text{Volume of defect by dues class in sample(s)}}{\text{Gross volume of sample(s)}} \times 100$$

If the dues class distribution is not required, then amount of defect is expressed as a percentage of the sample(s). Defect volume in solid cubic metres is then derived by applying the per cent defect to the gross solid volume of all loads.

7.6.1.2.2 Dues Class Distribution for One Metre Square Method

The dues class distribution will be determined by dividing the total volume per dues class of all samples, based on diameter distribution as per section 2.3.3 of this standard, by the total sample volume times 100. The resulting percentage will be applied to the solid wood volume of the pile.

Example:

Pile width = 2.40 m
Pile length = 12.64 m
Average pile height = 2.64 m

Pile area = length x average pile height
= 12.64 m x 2.64 m
= 33.37 m^2 times 10.0% = 3.3 or 3 1 m squares will be painted across the pile face.

Scaled solid wood volume of the 3 squares = 3.566 m^3.

To determine stacked to solid conversion:
Solid wood volume = 3.566 m^3
Stacked volume of 1 m by 1 m squares = length x width x height x number of squares
= 1 m x 2.35 m x 1 m x 3
= 7.05 m^3 (stacked)

Therefore stacked to solid conversion = solid volume divided by stacked volume
= 3.566 m^3 ÷ 7.05 m^3
= 0.506 m^3/m^3 (stacked)

Gross Solid volume of pile = stacked volume of pile x conversion
= 78.42 m^3 (stacked) x 0.506 m^3/m^3 (stacked)
= 39.681 m^3

To determine volume by dues class: example S1a, S2 and S3:

Volume of all logs in sample greater than or equal to 15 cm (S1a) = 2.623 m^3
Volume of all logs in sample less than 15 cm but greater than or equal to 10 cm DIB (S2)
= 0.821m^3
Volume of all logs in sample less than 10 cm = 0.122 m^3
Note: if top size payable for Forest Management Fees is less than 10 cm, the volume of S3 and S3us will need to be determined.

To determine percentage of S1a, S2 and S3:

%S1a = volume of S1a wood divided by volume of samples x 100
= 2.623 ÷ 3.566 x 100
= 73.6%

%S2 = 0.821 ÷ 3.566 x 100

= 23.0%

% S3 = 0.122 ÷ 3.566 x 100
=3.4%

These percentages are then applied to the solid wood volume of the pile as follows:
Gross volume of S1a wood = total pile volume x S1a percentage
= 39.681 m^3 x 73.6%
= 29.205 m^3

Gross volume of S2 wood = total pile volume x S2 percentage
= 39.681 m^3 x 23.0%
= 9.127 m^3

Gross volume of S3 wood = total pile volume x S3 percentage
= 39.681m^3 x 3.4%
= 1.349 m^3

To determine Defect volume pile:
Volume of defect measured on S1a logs in samples = 0.020 m^3
Volume of defect measured on S2 logs in samples = 0.134 m^3

These volumes are then converted to a % of the samples and applied to the corresponding dues class volume in the pile:

% S1a Defect = defect volume in S1a logs divided by S1a gross volume of sample x 100
= 0.020 m^3 ÷ 2.623 m^3 x 100
= 0.8%
S1a Defect Volume in pile = volume of S1a wood in pile X % S1a defect divided by 100
= 29.205m^3 x 0.8% ÷ 100
= 0.234 m^3

% S2 Defect = defect volume in S2 logs divided by S2 gross volume of samples x 100
= 0.134 m^3 ÷ .821 m^3 x 100
= 16.3%
S2 Defect volume in pile = volume of S2 wood in pile X % S2 defect divided by 100
= 9.127 m^3 x 16.3% ÷ 100
= 1.488 m^3

Net volume of pile, by dues class, is determined by subtracting the defect volume of each dues class from the gross volume of each dues class.
Net volume of S1a = 29.205 m^3 - 0.234 m^3
= 28.971 m^3
Net volume of S2 = 9.127 m^3 - 1.488 m^3
= 7.639 m^3
Net volume of S3 = 1.349 m^3 - 0.000 m^3
= 1.349 m^3

When classifying timber scaled as S1ad or S1bd dues classes based on rot appearing on the face of the pile the scaler must measure the defective pieces based on the whole face of the pile and not based on the square samples. The volumes of S1ad and/or S1bd are then deducted from the S1a and S1b volumes respectively to determine the final S1a and S1b volumes.

8. MASS SCALING

Weighing of wood can be a quick and precise method for determining its volume. By using a weight-volume relationship, the mass of wood can be converted directly to volume.

This section covers the minimum requirements necessary for the establishment of an approved weigh scale operation for the determination of roundwood mass, including tree length, loaded on transports such as trucks or trailers. Also included are methods used in determining factors, which convert mass into solid volume.

Figure 38 Weigh Scale Operation

8.1 Requirements

The *Weights and Measures Act* and the *Weights and Measures Regulations* are the governing body for the installation and operation of all weigh scales. Compliance with the *Weights and Measures Act* and the *Weights and Measures Regulations* as it pertains to mass scaling, FRMA and FRMR and this standard are the responsibility of the licensee.

8.2 Installation

8.2.1 General Requirements

When a licensee is considering the installation of a weigh scale (attended or unattended) to be used to weigh the amount of Crown timber passing in private ownership, a number of requirements must be met. Specific requirements as they pertain to attended and unattended weighing devices, will be dealt with later in this standard. In general, the licensee is responsible for ensuring the following:

1. All weighing machines, including vehicle scales, must conform to the *Weights and Measures Act* and the *Weights and Measures Regulations*.

2. The scales must be of sufficient capacity to determine the total mass of the vehicle and its load in one operation.
3. The scales should be positioned so the vehicle and its load can be weighed, and then immediately after unloading the vehicle can be re-weighed.
4. If the scale is located at a processing or storage facility, the scale must be located at the entrance to the facility.
5. The weight scale operator must have a minimum mass endorsement with a timber scalers licence or an interim scaler's permit. When sampling for a mass to volume conversion factor, the scaler must be licensed for the technique to be used.
6. All records, digital or otherwise, documents, and programs relevant to the operation of the weigh scale and the weighing of Crown timber are provided to an officer upon request.
7. Any unacceptable differences in the section test or malfunction of the weigh scale and its subsequent repair and /or certification shall be immediately reported to the chief scaler.
8. Regular section tests as per section 8.4.2 are conducted. These tests are recorded in a scale ledger as a record of scale performance and shall be made available.
9. That all certification, maintenance, testing and reporting requirements as identified in this section of the standard are followed.
10. The licensee should watch for any unreasonable values indicating that something has gone wrong with the scale. Immediately upon noticing that the weigh scale has ceased to operate normally, the licensee shall perform a section test as outlined in section 8.4.2 of this standard. Being familiar with the average truck and load mass is important.

8.2.2 Attended Scales

An attended scale is defined as a scale in which an appropriately licensed Saskatchewan scaler is responsible for the weighing in and the weighing out of all trucks and trailers. When a licensee installs and/or utilizes an attended scale, the licensee responsible to ensure the following:

1. The scaler complies with the relevant *Weights and Measures Act* and *Weights and Measures Regulations*. A Measurement Canada certificate authorizing the scale must be visibly displayed in the scale house.
2. The scaler is present to weigh the loads as well as the tare weights for loads containing Crown timber.
3. An up to date ledger is maintained in the scale house outlining all information regarding the testing, repair, maintenance and recertification of the weigh scale.
4. If using a computerized system for determination of samples or storing of weights as they are entered, the computer must be secure so that no tampering of individual weights or sample load selection can be done. If this level of security is not available prior approval from the chief scaler must be obtained for the scale to be used for weighing Crown timber and a computerized log of all computer activity must be maintained.
5. If using a computerized system for the determination of samples, ensure that all sample loads are chosen according to the approved scaling plan.

8.2.3 Unattended Scale

Conditions for the use of an unattended scale differ from those for an attended scale.

An unattended vehicle scale shall be used only if it is part of an installation that has:

(a) an automatic means to indicate to a vehicle operator that the indicating element of the scale has returned to zero and that the operator may drive onto the weighbridge;
(b) a printer that automatically prints, for each weighing, a ticket bearing the information required in section 8.5.1; and
(c) an automatic means of preventing weight indications and printing of a ticket unless
    i. the scale has returned to zero prior to weighing a vehicle, and
    ii. the load being weighed if fully supported on the weighbridges.

When a licensee installs an unattended scale or converts an attended scale into this type of weighing operation, the licensee is responsible to ensure the following:

1. The scale and installation complies with the *Weights and Measures Act* and the *Weights and Measures Regulations* as it pertains to unattended vehicle scales. A Measurement Canada certificate authorizing the unattended scale must be visibly displayed in the scale shack.
2. If a scale was previously certified as an attended scale and is converted to an unattended scale, it must be recertified by Measurement Canada before being used to weigh Crown timber.
3. The computerized system for determination of samples or storing of weights as they are entered is designed in such a way so as to prevent any tampering of individual weights or sample load selection.
4. A night and day contact number is posted at the scale house stating who is responsible for dealing with any complications which may arise during the operation of this scale.
5. When the weight information is downloaded, the weight information should be monitored for unreasonable values which may indicate that something has gone wrong with the weighing device or its computerized components.
6. All sample loads were chosen in a random or random-systematic method and set down as per the licensee’s approved scaling plan. No sample loads are to be substituted or canceled without express written permission of the chief scaler.
7. Any unacceptable differences in the section test or a malfunction of the weigh scale and its subsequent repair and/or recertification shall be immediately reported to the chief scaler.

8.3 Scale Inspection and Maintenance Records

All scale inspection and maintenance results must be maintained at the scale house and immediately available to an officer upon request. The scale check records must include, but are not limited to, the following information:

1. company owner;
2. make, model and serial number of the scale;
3. if more than one scale, the scale the information pertains to;
4. date and time of section test;

5. weight of "known weight";
6. section test results;
7. for unattended scales, test results for "zeroing the scale" and for "full support of the load being weighed";
8. printed name and signature of scaler who performed the section test;
9. date and time of scale malfunction;
10. explanation of scale malfunction corrective action;
11. name and Address of repair and/or recertification company;
12. certification date and time;
13. any additional information requested by the Minister.

8.4 Operation and Maintenance

As part of the day to day operation of an attended or unattended scale, the weighing device must perform within precision levels set out in this standard and the *Weights and Measures Act* and the *Weights and Measures Regulations*. In order to ensure that the sectional accuracy is within "the in-service limits of error", the following procedures, frequency and recording of section tests must be adhered to.

8.4.1 Weigh Scale Tests

At a minimum, the scale inspection procedures outlined in this section must be conducted as follows:

1. Once per week from November 1 to March 31.
2. Once per two week period from April 1 to October 31, unless more than 50 loads per week are weighed on the scale. In which case, the scale shall be checked once per week.

8.4.2 Section Tests

A weigh scale is constructed of a scale deck with load cells spread out beneath the deck. The cells must all be working properly in order to obtain the correct weight of a load. In order to verify the cells are registering the correct pressure readings the following procedure must be part of the maintenance program for every scale used to weigh Crown timber.

In order to conduct an accurate section test, each section must be tested with a testing vehicle or known weight, herein called the "test apparatus" in the following manner:

1. The test apparatus should weigh at least 10,000 kg of the scale's capacity.
2. Zero the scale before proceeding.
3. Place the test apparatus on the first section of the weighing platform as close to the end as possible without touching any stationary rails, etc. Print the weight on the slip.
4. Move the testing apparatus to the next section of the weighing platform above the next cell. Print the weight on the slip.
5. Continue testing each section of the weighing platform until all sections have been tested. If using a testing vehicle for a test apparatus, it is necessary that the testing vehicle drive off the scale platform in order to "zero" the scale readout. The testing vehicle will then turn around and travel the weighing platform in the opposite direction, printing the weights on the slip at each section.

6. Record the findings of the section test in the ledger.
7. Determine if the section tests are within acceptable limits of error as per the *Weights and Measures Regulations*. The error is determined by taking the lowest weight and subtracting it from the highest weight found on the section tests. The difference between these two weights is the found error on the scale. An acceptable limit of error is defined as being not greater or less than the weight of the testing apparatus by an amount in excess of the amount set out in the *Weights and Measures Regulations* for that weight. Should the section test show an unacceptable limit, the scaler shall immediately notify the weigh scale owner of the difference.
8. If the scale being tested is an unattended scale, the mechanisms for ensuring the scale has returned to zero prior to weighing a vehicle must be observed to be in proper working order. The mechanisms for ensuring that the load being weighed is fully supported on the weighing platform must be observed to be in normal working order. A check of this mechanism must be performed by blocking the mechanism on each end of the weighing platform. If the mechanism is in proper working order, a registration of the weight of the testing apparatus should not be possible.

Although the licensee is responsible for conducting the section tests, daily monitoring is required to ensure that each section is working properly. Being familiar with the average truck and load mass is important. If the scales or a section of the scale comes into doubt as to its accuracy, the weigh scale shall immediately be tested with the testing apparatus as specified above.

8.4.3 Scale Certification

The initial installation of the scale must receive certification from a company endorsed by Measurement Canada.

Following the initial certification, the licensee will ensure that all the weigh scales used for the weighing of Crown timber are calibrated a minimum of twice per harvest year. One of the calibrations must be conducted prior to the commencement of the main haul. The months in which these calibrations will occur shall be identified in the companies scaling plan.

In addition to all tests done on the scale by the certification company, the company will ensure that a strain test is done on the scale using a base weight sufficient enough to reflect the average loaded truck weight that is weighed. A strain test must be done each time the calibration of the scale is completed.

Once the calibration of the scale is completed, a copy of the signed calibration report shall be submitted to the Ministry of Environment, Forest Service Scaling Staff within 5 business days of the calibration.

8.4.4 Malfunctioning Scale

The following procedures for dealing with a malfunctioning scale shall be followed if one or more of the following is determined:

1. Section test results are outside the in-service limits of error.
2. The seals placed on the scale by the installer or equivalent, Measurement Canada, or an officer with Ministry of Environment, have been broken or removed.
3. Loaded weights of trucks appear to be unreasonable.

Should any of the above be noted, the licensee is responsible for ensuring:

1. The chief scaler be notified of the discrepancy immediately.
2. If the weight difference exceeds the allowed weight by more than 3 times the limit, then scale must not weigh anymore trucks until the scale has been repaired.
3. Repair of the weigh scale must be conducted by the installing company or equivalent within 30 calendar days of the difference being reported to the chief scaler. A longer or shorter time frame may be authorized, in writing, by an officer.
4. Once the repairs have been completed, the chief scaler will be informed.
5. With the written request of an officer, the licensee will perform a reconcile of the weights conducted from the time the difference in the weigh scale was first noted until its subsequent repair was completed.
6. A complete weigh scale recertification be conducted on the scale in question.

8.4.5 Maintenance of the Weigh Scale

As a part of the licensees responsibility that comes with the use and operation of the weigh scale, a regular maintenance program is imperative to ensure:

- down time due to weigh scale malfunction is eliminated or reduced;
- weigh scale closure is avoided;
- accuracy of the weigh scale is maintained.

To ensure that the above occur, the licensee is responsible to ensure that at a minimum, the following occur:

1. Movement of the leveling bars can occur through normal use. When the section tests are performed an inspection of the leveling bars should occur to ensure that they are centered on the brackets that hold them to the piling.
2. Foreign material, such as ice, snow and mud are removed from around the leveling bars.
3. Wind can have a very extreme effect on the accuracy of the weigh scale. In a stationary mode, with no stress or strain on the scale, if wind causes the scale indicator to fluctuate by ±40 kg or ±0.04 tonnes, a wind break will be constructed which is sufficient to drop the fluctuation down to an acceptable level.
4. All excessive snow and mud is cleared from the scale’s deck.
5. The deck should be checked periodically to ensure it is free and not binding against the sides of the pit. Foreign objects, such as rocks, should be removed or driven through to the pit, if they cause binding.
6. If the licensee operates an “In” and “Out” scale, a comparison of testing apparatus weights shall be within acceptable limits of error.

7. Following any severe environmental factors such as, but not limited to, wind, extreme temperature, vibration and electromagnetic or electrostatic fields, that may adversely affect the weigh scales performance or durability, a section test will be performed as per section 8.4.2 of this standard.
8. A common problem in the winter is water freezing on the scale mechanism. Steam cleaning should also be part of the regular maintenance particularly during melting and freezing situations.
9. Periodic testing of all sensors should be conducted.

Figure 39 Certified Company Conducting Testing and Maintenance

8.5 Data Capture Requirements

In order to facilitate the consistent, accurate reporting of information about the origins, profile and destination(s) of a load of Crown timber, it is necessary to ensure that specific information is collected. This information is typically captured within the computer attached to the weighing device, but in some cases is written on the weigh scale slip after the load of timber is weighed.

8.5.1 Minimum Requirements

At a minimum the following weigh information about each load of Crown timber must be printed at time of weighing, saved and printed later or written on the load slip:

1. date in;
2. scale slip;
3. load slip;
4. harvest authorization (FMA/TSL/permit#/private/federal);
5. forest product permit/term supply licence holder, allocation holder, landowner name;
6. stratum;
7. sample (yes/no);
8. source forest;

9. source unit/division;
10. source area;
11. source block;
12. destination site;
13. genus;
14. species;
15. product;
16. form – tree length, cut to length etc;
17. condition – green, burnt, etc;
18. truck licence plate number;
19. scaler number;
20. Harvest Date;
21. gross weight (kgs);
22. tare weight (kgs), and
23. net weight (kgs).

8.5.2 Additional Requirements

In addition to the minimum requirements identified in section 8.5.1, the following information may be printed onto the ticket at the time of weighing. It must be stored for later submission to the Ministry of Environment. This information includes, but is not limited to the following:

1. fiscal year;
2. sample identifier;
3. sample number;
4. unloader ID.

8.6 Weight Data Submission

Once a load is weighed and the information about each load is stored in a computerized format, it is the responsibility of the licensee to submit the data to the Ministry of Environment on a timely basis as identified in their plan.

8.7 Precision

Mass is to be measured and recorded in kilograms or tonnes, as determined by the type of weighing machine. Included with the gross mass of sound wood, are, if present, foreign material, moisture, bark and rot. The mass shall be measured with a precision of 10 kg or 0.01 tonnes.

8.8 Scaler's Duties and Responsibilities as They Pertain to Mass Scaling

1. Must ensure that excessive snow and mud has been cleared from the scale's deck.
2. The scale should be balanced to zero prior to a truck entering the weighing platform.
3. The deck should be checked periodically to ensure it is free and not binding against the sides of the pit. Foreign objects, such as rocks, should be removed or driven through to the pit, if they cause binding.
4. The scaler or scale operator should watch for any unreasonable values indicating that something has gone wrong with the scale. Immediately upon noticing that the weigh scale has ceased to operate normally, report the malfunction to the Licensee and perform a section test as outlined in section 8.4.2 of this standard. Being familiar with the average truck and load mass is important.
5. Successfully complete all courses that may be required from time to time in order to keep his/her scaler's licence or endorsement updated and current.
6. When sampling for conversion from weight to volume, ensure that:
   - all sample loads are chosen in a random or random-systematic method, and
   - no sample loads are substituted or canceled without express written permission of the chief scaler.
7. Be able to identify the commercial tree species in bolt form harvested under the authority of the licensee.
8. Ensure that proper section tests are conducted as per section 8.4.2 of this standard.
9. Make the results of all section tests available for inspection by an officer, upon request.
10. Immediately inform the licensee of any unacceptable section test results.

8.9 Determination of Mass

The mass of the loaded vehicle is determined upon entering the yard, and the vehicle is reweighed immediately after unloading. The mass of the load is then determined by subtracting the mass of the empty vehicle (tare weight), from the mass of the loaded vehicle. This value is called the gross mass. The gross mass is converted to net volume with the use of a weight-volume conversion factor. This conversion factor can be determined by using one of the following two mass-volume sampling methods.

8.10 Mass-Volume Conversion Factor

8.10.1 Oven-dry Mass

1. The sampled mass consists of all logs or tree lengths, contained in that particular sample load.
2. Factors Affecting Mass – The most important factors affecting mass per cubic metre of solid wood are moisture content and relative density, however, other factors will affect the mass-volume relationship.
   a. Foreign Material – Foreign material is defined as anything not related to roundwood such as earth, ice, snow and branches which add mass to the load. It is calculated by unloading the truck and removing all of the foreign material. The roundwood is then reloaded onto the truck and re-weighed. The difference between this new mass and the original mass is the mass of the foreign material.

$$Pf = \frac{Sg - St}{Sg} \times 100$$

Where Pf = Per cent foreign material
Sg = Gross mass of sample
St = Mass of sample less foreign material

Deductions for the mass of foreign material should be made from the gross mass of the load.

b. Moisture and Bark Content – Sampling for moisture and bark content can be done together. Wood discs approximately 3 cm thick shall be sawn from logs or tree lengths selected at random from the loads of the population. The log shall be sampled at the three points which would be necessary to divide the log into four equal parts. The bark is then separated from the discs with the use of a sharp knife. Before any loss of moisture has occurred, both the bark and the wood discs are weighed together, to determine the total mass of the sample. The peeled discs and bark are placed in a drying oven at 103 ± 2º C until no further loss of mass is noted. The mass of the oven-dry discs and bark are then determined separately. All weights are determined to the nearest gram. Moisture content is expressed as a percentage. It is a ratio of the difference between the total mass and oven-dry mass of the sample.

$$Pm = \frac{St - So}{St} \times 100$$

Where Pm = Per cent moisture in wood and bark
St = Mass of Sample
So = Oven-dry mass of sample

Bark content is also expressed as a percentage. It is ratio of the oven-dry mass of bark and the oven-dry mass of the sample.

$$Pb = \frac{Sb}{So} \times 100$$

Where Pb = Per cent Bark
Sb = Oven-dry mass of bark
So = Oven-dry mass of sample

c. Species Composition – The species composition of a load, or various loads, will affect the mass per cubic metre of solid wood. This effect is taken into consideration with the sampling method use. If a species composition is desired, it is determined on a volumetric basis and not on the basis of its mass.

d. Density – Density is expressed as grams per cubic centimetre or tonnes per cubic metre.

Refer to Appendix G for the relative densities of the thirteen native species of Saskatchewan. It is important to note that a variety of factors, some being growth site and location of the sampled tree, affect the relative density of a species. The values given in Appendix G are only an approximation and do not necessarily represent accurate values for areas within Saskatchewan. For a useful method of determining relative density, see Appendix I.

e. Decay – Discs that contain rot are examined separately from the discs with all sound wood. The volume of rot is determined using the methods described in section 4.1

Cavities in the wood due to rot are not taken into account as they do not add mass to the load.

The total volume of the sound discs are added to the volume of the discs that contain rot. The percentage of rot is then determined during the following formula:

$$Pr = \frac{Vr}{Vs + Vdr} \times 100$$

Where
- Pr = per cent rot
- Vr = Volume of rot in discs
- Vs = Volume of sound wood discs
- Vdr = Volume of discs with rot

3. Net Oven-dry Mass – Deductions for tare, foreign material, moisture and bark from the mass of the loaded vehicle will determine the net oven-dry mass of the load is calculated as follows:

Example: load of jack pine

	100,000 kg	Mass of vehicle and load
–	10,000 kg	Tare of mass vehicle

	90,000 kg	Gross mass of load
–	900 kg	Foreign material (1%)

	89,100 kg	Mass of wood and bark
–	35,640 kg	Moisture content (40%)

	53,460 kg	Oven-dry mass of wood and bark
–	5,346 kg	Oven-dry bark percentage (10%)

	48,114 kg	Net oven-dry mass of wood

4. Gross Solid Volume – The gross solid volume is calculated as follows:

$$GV = \frac{GM}{RD}$$

Where GV = Gross volume in cubic metres
GM = Gross oven-dry mass (kg or tonnes)
RD = Relative density (kg or tonnes/m^3
RD for JP = 0.42 tonnes/ m^3

$$GV = \frac{48,114 \text{ kg}}{420 \text{ kg/m}^3}$$

$$= 114.557 \text{ m}^3$$

5. Defect Volume – The defect volume is calculated as follows:

$$DV = GV \times PR$$ PR for load 5%

Where DV = Defect Volume
GV = Gross Volume
PR = Per cent Rot

$$DV = 114.557 \text{ m}^3 \times 0.05$$
$$= 5.728 \text{ m}^3$$

6. Total Net Volume – Calculation of Total Net Volume in cubic metres is determined by subtracting the rot (m^3) from the gross volume (m^3).

$$NV = GV – DV$$
$$= 114.557 – 5.728$$
$$= 108.829 \text{ m}^3$$

8.10.1.1 Determination of dues class distribution of oven-dry mass

The dues class distribution, expressed as a percentage, is determined on a volumetric basis and applied to the net volume of the loads. The wood is bucked and using logs in piles (section 4.2), pencil bucking (section 5.1) or individual logs technique (section 4.1) of this standard), the per cent by dues class distribution is determined.

8.10.2 Volume Scaling of Sample Loads

Mass per volume ratios can be obtained by volume scaling various sample loads. Paragraph 9.4 "CSA Scaling Roundwood 0302.1-09 provides formulas used to estimate the necessary number of sample loads.

The scaling methods that can be used are fully described in the individual logs (section 4.1), logs in piles (section 4.2) and pencil bucking (section 5.1) sections of this standard.

a) Sample Load Scaling – The sample loads are selected in a random or systematic random design from the total population of loads. When volumes are determined in solid cubic metres, the material being scaled must conform to all descriptions of individual logs or piled logs. The log volumes are determined individually, then summed for a total gross volume.

b) Defect Volumes – All volume deductions are determined according to the original scaling method employed. The deductions are made from the gross volume of the load to obtain a net volume.

c) Mass-volume Ratio – The ratio used for converting mass into volume is obtained by dividing the total mass of the sample loads by the total sum of their volumes.

$$MV = \frac{St}{Vn}$$

Where MV = Mass volume ratio to five significant digits
St = Total mass of sample units
Vn = Total volume of sample units

The ratio is expressed as tonnes per cubic metres or kilograms per cubic metre if the sample load volumes were scaled in solid cubic metres. It the sample load volumes were scaled in stacked cubic metres, the ratio is expressed as tonnes per stacked cubic metre or kilograms per stacked cubic metre.

d) Calculation of Total Net Volume – The ratio previously determined from the sample loads is used to determine the net volume of the total mass of the population of loads. This is done by dividing the ratio into the total mass.

$$NV = \frac{M}{MV}$$

Where NV = Net Volume
M = Total mass of loads (kg or tonnes)
MV = Mass-Volume ratio (kg or tonnes/m^3)

If the mass-volume ratio is being obtained using solid cubic metres, the net volume will be expressed as solid cubic metres.

Example 1: Cubic Metre Conversion Factor

Given:

Total mass of loads – 1,498,000 kg

	Volume	Mass
Sample Unit 1 –	48.426 m^3	39,903 kg
Sample Unit 2 –	64.791 m^3	55,461 kg
Sample Unit 3 –	53.040 m^3	34,688 kg
Sample Unit 4 –	58.450 m^3	44,033 kg
	224.707 m^3	174,085 kg

Calculation

$$\text{Ratio} = \frac{174{,}085 \text{ kg}}{224.707 \text{ m}^3}$$

$$= 774.72 \text{ kg/m}^3$$

$$\text{Therefore net volume} = \frac{1{,}498{,}000 \text{ kg}}{774.72 \text{ kg/m}^3}$$

$$\text{net volume} = 1{,}933.602 \text{ m}^3$$

Example 2: Stacked Wood Conversion Factor

Given:

Total mass of Loads – 2,063,000 kg

	Volume	Mass
Sample Unit 1 –	96.24 m^3 (stacked)	60,342 kg
Sample Unit 2 –	87.92 m^3 (stacked)	61,720 kg
Sample Unit 3 –	82.57 m^3 (stacked)	48,221 kg
Sample Unit 4 –	79.63 m^3 (stacked)	53,034 kg
	346.36 m^3 (stacked)	223,317 kg

Calculation

$$\text{Ratio} = \frac{223{,}317 \text{ kg}}{346.36 \text{ m}^3 \text{ (stacked)}}$$

$$= 644.75 \text{ kg/m}^3 \text{ (stacked)}$$

$$\text{Therefore net volume} = \frac{2{,}063{,}000 \text{ kg}}{644.75 \text{ kg/ m}^3 \text{ (stacked)}}$$

Net Volume = 3199.69 m^3 (stacked)

e) Species Composition – When a species composition or breakdown of the loads is desired, it is done on the basis of its volume. A species volume percentage can be determined from the sample loads and applied to the whole population. When scaling the sample loads to determine the mass volume ratio, the species' volumes are recorded separately. After sampling of a particular population is completed, the total volume of each species and its sample is determined. The following formula will obtain the species volume percentage for a particular population.

$$Ps = \frac{Vs}{V} \times 100$$

Where Ps = Species Volume percentage
Vs = Individual species net volume
V = Total net volume of all species in sample unit

8.10.2.1 Determination of Dues Class Distribution for Mass to Volume Scaling

Dues class distribution, expressed as a percentage, is dependent upon the technique used to determine the solid volume of the load. The methods for determining the volume class distribution (section 2.3.3) is described in detail in the logs in piles, individual logs or pencil bucking section of this standard.

Once the weights of all the loads are converted to solid volume, based on the conversion determined from the sample loads, the per cent of each volume class will be applied to the total net volume.

9. TREE LENGTH ENDORSEMENT

This section describes the methods used in measuring the boles of trees to a specified top diameter after they have been felled and generally, but not necessarily, limbed. It also provides for the determination of the solid volume of individual tree lengths and aggregate of tree lengths in piles.

Pile heights must not exceed 2.5 m.

This method of determining volume is not to be used to scale tree length timber on trucks.

9.1 Stack Identification

The stack will be marked as in section 2.3.1 of this standard.

9.2 Measurement Method

9.2.1 Diameter Measurement

Unless otherwise stated in the scaling plan, diameters shall be measured inside bark to the specified tolerance level for the tree length method being used and in accordance with the techniques outlined in section 4.1 of this standard.

The diameter of a butt end shall be the shortest measurement through the geometric centre of the butt end surface (Fig. 40), disregarding abnormal depressions or protuberances. This diameter measurement shall be along a plane that is perpendicular to the longitudinal axis of the tree length.

In the case of butt swell in a tree, the diameter of the butt is to be measured in line with the normal taper of the log (figure 4, section 4.1.1.1).

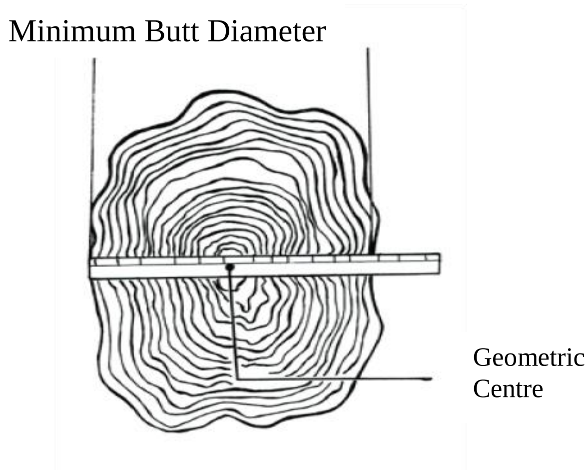


Figure 40 Measurement of the Diameter of a Butt End Tree Length Log

9.2.2 Width Measurement (tree length)

There are two methods for determining the width measurement of a pile. The methods will dictate which tables are used for calculation volume. The methods are:

1. Tree Length – the trees in these piles are full trees that may have been topped to a minimum top utilization size but have not been cut to hauling lengths.

2. Cut to Haul – These are trees that have been cut, typically in half for hauling purposes. The average top size in the pile will need to be determined to facilitate use of the correct cut to haul table.

Tree lengths for all methods of tree length scaling shall be measured in metres to the nearest 0.2 m using techniques outlined in section 3.2 of this standard.

In order to estimate the width of the pile (the average tree length in the pile), three width measurements must be taken at locations evenly spaced along the face of the pile so as to divide the pile into thirds (Figure 41). The width measurement is to be the average width for that section of the pile. For example: pile width 18.644 = 6.21 m apart.

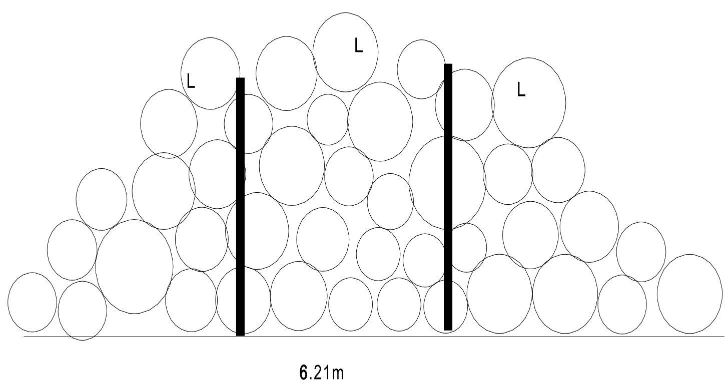


Figure 41 Example of Width Measurement Placings

The location on the pile chosen for measurement of pile width must be marked with an **L**.

9.2.2.1 Tree Length Pile Width Estimation

When estimating pile width the scaler must estimate the average width for the section of the pile. At this location the scaler must estimate all tree lengths in that section to the minimum top diameter, not necessarily the top tree length (Figure 42).

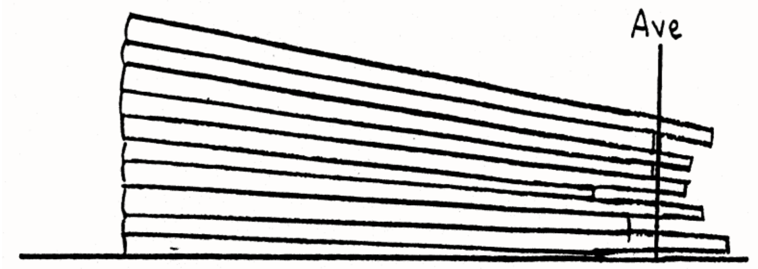


Figure 42 Example of Estimating Pile Width

The place on the face where the average width is measured must be clearly marked on the pile by the scaler. As well, when it is safe to do so, the scaler must mark the place where the pile widths were measured on the top end of the tree. This is to ensure a check scaler is able to identify the places where width measurements were taken.

9.2.2.2 Cut to Haul Pile Width Estimation

On the top of the pile, the average top size for that section of the pile will be determined by painting a block that extends from the bottom to the top of the pile, 0.5 metres on either side of the tree that received the "L" marking. For each tree that is >50% within the block, the diameter will be recorded and measured to the nearest 1 cm.

In some cases the above method is not practical because of factors such as snow pack, piling methods or other factors that cause a difficulty in measuring all the tops within the marked area If this is the case the scaler or licensee must contact the scaling unit prior to scaling the pile of timber for approval to use an alternate method of estimating the diameter of the bolts on the top side of the pile.

Figure 43 Cut to Haul Pile Width Estimation

The average top size for the pile will be determined by averaging all the diameter measurements taken in each section at the top of the pile.

9.2.3 Length (face length)

Maximum face length is 30 m.

9.3 Methods for the Determination of Gross Volume

To enable the scaling of tree lengths, all tree lengths shall be piled with their butt ends forming an accessible, common face. All methods described require either the measurement of the butt end diameters of all tree lengths or a sample of tree lengths to determine the observed or the estimated diameter class frequency distribution of the population. The distribution obtained is used with a volume table provided by the Forest Service to estimate the solid wood volume and dues class percents of the tree length timber. It is the scaler's responsibility to ensure they are using the current version of the tree length tables.

Species must be identified when scaling timber in tree length form. Because of differences in form between species the appropriate table or tables must be used based on average tree length (pile width), species and standards for minimum top diameter harvested.

Tree length

If the width measurements were determined as per section 9.2.2.1, the appropriate tree length table is determined through application of species and average width measurement. The volume is determined by locating the appropriate minimum butt diameter and reading off the resulting volumes.

For softwood species, the volumes in the tree length tables are reported as total volume, percent S1a or S1b, percent S2, and percenct S3.

For hardwood species, the volumes in the tree length tables are reported as total volume, percent H1 and percent H2.

Cut to haul

If the width measurements were determined as per section 9.2.2.2, the appropriate cut to haul table is determined through application of species, average width measurement and average top size. The volume is determined by finding the appropriate minimum butt diameter and reading off the resulting volumes.

For softwood species, the volumes in the cut to haul tables are reported as total volume, percent S1a or S1b, percent S2, percent S3.

For hardwood species, the volumes in the tree length tables are reported as total volume, percent H1 and percent H2.

9.3.1 Total Population Measurement

All diameters in the face of the pile will be measured to the nearest 2 cm using the diameter methods outlined in section 9.2.1 of this standard.

The total gross volume of the pile is determined by multiplying the number of tree lengths in each diameter class by the corresponding tree length volume for that diameter class obtained from the applicable tree length volume table and summing the total volumes for all classes.

Figure 44 Total Population Method

9.3.1.1 Determination of Dues Class Distribution for Total Population Method

The volume tables also contain the dues class proportions for the regulated dues classes. The volume of each dues class is determined by multiplying the total volume determined for each minimum diameter class times the percentage of each dues class as given in the appropriate tree length table. The total of each dues class is obtained by adding all the volumes for each dues class.

9.3.2 Total Tree Count and Sample Measurement

The number of tree lengths in the pile shall be obtained by a total count. Diameter distribution shall be determined from a sample of diameter measurements taken from 20% of the total number of tree lengths.

9.3.2.1 Sampling 20% of the Pile by Measuring Every 5th Tree

This method may be used to measure 20% of the butts in a pile by counting the pieces and measuring every 5th butt. It is the scaler's responsibility to ensure that the butts chosen for every 5th tree are representative of the pile. Butts that are counted should be marked. The butt chosen for the sample should be identified with an S or numbered.

The total gross volume of the sample is determined by multiplying the number of tree lengths in each diameter class by the corresponding tree length volume for that diameter class. The diameter class volumes are obtained from the applicable tree length volume table(s) and summed for the total volumes of all diameter classes.

The total gross volume for the pile is determined by multiplying the total gross volume of the sample by five if the sample is based on **exactly** 20% of the total tree count. If the sample is based on more, or less than 20%, then the following calculation must be used:

$$\text{Multiplier} = \frac{\text{Total number of trees in the pile}}{\text{Number of trees in the sample}}$$

$$= \frac{\text{968 trees in pile}}{\text{194 sample trees}} = 4.99 = 5.0$$

Multiplier is rounded to 1 decimal place
Multiply the volume of the sample (and defect volume, if applicable) by 5.0

Figure 45 Total Tree Count and Sample Measurement

9.3.2.2 Determination of Dues Class Distribution for Total Tree Count Method

The dues class distribution of the entire pile is based on the sample diameters. The volume of each dues class is determined for the sample diameters by multiplying the total volume of each minimum diameter class times the percentage of each dues class as given in the appropriate tree length table. The total of each dues class of the sample diameters is obtained by adding all the volumes for each dues class. The total pile dues class distribution is obtained by multiplying the total sample volume of each dues class by 5 or the multiplier.

9.4 Measurement of Pile Face

The measurement of pile face uses the area of the face of the pile and **a volume to face area ratio** to determine the gross volume.

When the area of the face of the pile is to be used, the length of the pile and the average pile height will be determined using the same techniques as outlined in section 7, the stacked wood section of this standard. The face area of the pile face is obtained by multiplying the average height of the pile by the length of the pile.

The gross volume shall be obtained by multiplying the face area by the **volume to face area ratio**. The volume is recorded to the nearest .001 m^3. The ratio of pile volume to surface area shall be obtained by sampling a part of the population.

The face area ratio shall be obtained by sampling 20% of the face area and is calculated as follows:

Ave. pile height	=	1.50 m
Pile length	=	19.20 m
Face area	=	28.80 m^2
Area x 20%	=	28.80 m^2 x .2 = 5.76 or 6 m^2

Note: If the resulting calculation determines that a portion of a square be measured, the scaler will round this number to the nearest whole number.

The 20% of the face area to be sampled shall be identified by painting evenly spaced one-meter squares across the face area of the pile so as to equally represent the diameter distribution of the pile.

Figure 46 **Sample Area Marked on Pile of Timber**

All diameters where the face is more than halfway into the sample area are considered to be part of the sample.

All diameters in the samples will be measured to the nearest 1 cm using the diameter methods outlined in section 9.2.1 of this standard.

The total gross volume of samples is determined by multiplying the number of sample trees in each diameter class by the corresponding tree length volume for that diameter class obtained from the applicable tree length volume table, and summing the total volumes of all diameter classes.

The total gross volume for the pile is determined by multiplying the total gross volume of the sample by five if the sample is based on exactly 20% of the area. If the sample is based on more, or less, than 20% then the following calculation must be used:

$$\text{Multiplier} = \frac{\text{Total face are in the pile } (m^2)}{\text{Total number of } m^2 \text{ samples}}$$

$$= \frac{28.80\ m^2}{6\ m^2 \text{ samples}} = 4.8$$

Multiply the face area by 4.8.
Multiplier is rounded to one decimal place.

9.4.1 Determination of Dues Class Distribution for Measurement of Pile Face.

The total of each dues class is based on the sample of the face area. The dues class distribution of all diameters in the 1m x 1m sample areas is determined by multiplying the total volume of each diameter class times the per cent of each dues class as given in the appropriate tree length table. The total sample volume for each dues class is obtained by adding all the sample volumes for each dues class. The dues class distribution for the pile is obtained by multiplying the total sample volume for each volume class by the multiplier.

9.4.2 Calculation of Defect Volume

The amount of any of the allowable defects will be based on the butt end of the log. For softwood species, all defect diameters will be measured as if the defect were a **circle** and calculated as a **cone**. For hardwood species, all defect diameters will be measured as if the defect were a **circle** and calculated as a **cylinder**.

Defect volumes are multiplied by five or by the multiplier, depending on the tree length scaling method utilized.

When classifying timber scaled as S1ad or S1bd dues classes based on rot appearing on the face of the pile, the scaler must measure the defective pieces based on the whole face of the pile and not based on the sample trees or sample squares. The volumes of S1ad and/or S1bd are then deducted from the S1a and S1b volumes respectively to determine the final S1a and S1b volumes.

Note: When excessive advanced decay is present and appears to extend further into the tree than the allowed length, it may be to the licensee's benefit to have the timber scaled in shortwood form allowing all deductions to be identified. If this is not possible, the licensee may contact the check scaler to review of the application of length for defects for the particular area or pile.

9.4.2.1 Hardwood Tree Lengths

In the absence of indications to the contrary, defect length will be estimated, based on the relationship between the defect diameter and the recorded butt diameter of the log.

The following formula is used to determine the per cent of butt face area covered by a defect:

$$\% \text{ defect area} = \frac{\text{diameter of defect in cm}^2}{\text{minimum butt diameter in cm}^2} \times 100$$

Example: 34 cm diameter tA with 16 cm of butt rot

$$\% \text{ defect area} = \frac{16 \text{ cm}^2}{} \times 100 = 47\%$$

$34\ cm^2$

47% of the 34 cm tA butt face is covered by defect.

The per cent defect area is applied to the following table to determine the length value to be used in the cylinder formula when determining the defect volume.

	Where Rot Measures	Length of Rot (Hardwood)
25%	(< 37.5) or ¼ of the recorded butt diameter	2.0 m
50%	(≥ 37.5 and < 62.5) or ½ of the recorded butt diameter	2.6 m
75%	(≥ 62.5 and < 87.5) or ¾ of the recorded butt diameter	3.0 m
100%	(< 87.5) or the total recorded butt diameter	3.4 m

In the above example, 47% is in the class ≥ 37.5 and < 62.5, so the defect length is 2.6 m.

The cylinder formula is used to determine the defect volume, with the length of the defect extracted from the above table.

$$\text{Cylinder} = \frac{0.7854 \text{ x } D^2}{10000} \text{ x } L = m^3$$

D = diameter of the defect
L = length of the defect

9.4.2.2 Softwood Logs

For softwood logs the normal butt rot rules apply – the cone formula is used with the length calculated as five time the defect diameter.

$$\text{Cone} = \frac{0.7854 \text{ x } D^2}{30000} \text{ x } L = m^3$$

D = diameter of the defect
L = length of the defect

9.5 Cull Tables

At the writing of this standard, no cull tables have been developed for specific operations or for the province. As more operations begin to use the tree length method of scaling their timber, it may become desirable for a specific operation to develop unique cull tables through sampling. Additionally, the Ministry of Environment will be developing provincial cull tables, over time, as data is collected.

9.6 Calculation of Net Volume

Total gross volume for the pile minus total defect volume for the pile equals total net volume for the pile of timber.

9.7 Sampling for Unique Tree Length Coefficients

Should a specific operation feel that the tree length volume tables and subsequent volume class distribution percentages are not accurate for the wood profile being harvested, tables can be developed that will be unique to the operation.

Development of these tables will be conducted through an ongoing sampling procedure of physically bucking or pencil bucking the tree lengths into appropriate lengths as per the tolerance level, scaling each bolt using the methods outlined in the individual log section of this standard, and recording the data in a manner which will identify the volume of each tree. The subsequent volume tables and volume class distributions will be developed using programs provided by Forest Service.

Development of tree length tables by a licensee unique to an operation must be approved in a scaling plan.

10. SCALING PLANS

FRMR, requires that all Forest Management Agreement or Term Supply Licence holders must complete a scaling plan. Forest product permit holders may be required to complete a scaling plan according to terms of the licence to harvest.

Scaling plans are documents authorizing the measurement of Crown timber. These plans are developed annually by the licence holder to outline the scaling practices and reporting mechanisms to be used.

Scaling plans will be in effect for the fiscal year April 1 – March 31 unless an extension is authorized in writing by an officer. A new plan must be completed for the following year. It is desirable that all plans are submitted to the approving office in sufficient time for the hauling of timber to be continuous.

Although most of the information required in all scaling plans is the same, the level of detail required in some cases may be substantially less. A two page scaling plan, App Q, which contains all the information that is required under FRMA and FRMR may be all that is required to be completed and approved prior to hauling of timber in certain situations.

The issuing officer may require that a licence holder complete a more detailed scaling plan if the method of scaling or the cumulative annual volume is sufficient to warrant a more detailed plan.

If the licence holder is scaling his/her timber in a manner which will require sample scaling then a more detailed plan will be required.

10.1 Scaling Plan Content

Scaling plans must address the following information:

1. Method of scale
    - The method of scaling the timber at the entrance to the processing facility, timber storage area, or in the bush will be outlined, i.e. Stacked, Mass, Tree Length.
2. Allowable deductions
    - This section outlines the allowable deductions respecting quality and form.
3. Scaling sites
    - This section will identify where the scaling will occur, for example at the entrance the processing facility, the staging area or at the entrance to a storage area.
4. Volume estimate (Production estimate Fig 47)
    - This is an estimate of the volume of forest products to be harvested.
5. Sampling procedures (if applicable)
    - This section will include the following information:
        a) Objectives – as outlined in section 11.3.1 of this standard;
        b) Sampling intensity – as outlined in Section 11.3.4 of this standard;
        c) Initial coefficients
            - if the licensee has been scaling for the previous year, initial conversion numbers and per cent of dues class distribution will be available. These numbers may be used for the start of the new sampling year;

- should a licensee not have a previous sampling year from which to obtain the numbers, the licensee may propose alternative initial coefficients.

d) Methodology
  - this section will describe the methods in which the sampling will be carried out;
  - how sample loads will be chosen;
  - how sample loads will be identified;
  - at what tolerance level the timber will be scaled;
  - method for determination of dues class distribution.

e) Stratification requirements (production estimate)
  - the various types of wood or stratum which will be harvested and/or accepted by the licensee. This may include, but is not limited to, green, fire killed, insect damaged, staged, various length wood and other licence holders' wood. For identification purposes, a number will be issued to each stratum and a brief description will be given;
  - the volume and number of truck loads in each stratum to be scaled within the time frame of the scaling plan approval;
  - the geographic location of each stratum (harvest area) if applicable;
  - initial sampling intensity;
  - desired number of sample loads per stratum;
  - top size, minimum diameter as per utilization requirements.

f) The scaling plan may include the requirement to submit a payment schedule.

g) Schedule of weight scale certification, if applicable.

Production Estimate

Location of Processing facility: Prince Albert

Stratum (Population)	Description	Estimated Volume	Estimated # of Loads	% Intensity	1 Load in Every	Estimated # of Samples	Top Size	Scaling Site	Initial Coeff	Initial Species %	Intitial Dues Class %
1102	Hardwood Pulp TL Staged	50000	1111	0.50%	200	5.6	8	A1 Pulpmill	842	100% tA	H1 60% H2 40%
1103	Hardwood Pulp TL Green	45000	1000	0.50%	200	5	8	A1 Pulpmill	958	85% tA/15%bPo	H1 60% H2 40%
1104	Permit Purchase Softwood	4000	89	5%	20	4.5	10	A1 Pulpmill	813	100%wS	S1a 100%

<u>Placement of volume from other licence holders</u>

Company XYZ. Stratum 1103 = 25,000 m^3 of HW pulp

Permit # ABC Joes Timber stratum 1104 150 m^3 of SW

Figure 47 Example of Production Estimate

The licensee has the sole responsibility for reliable production estimates. Production estimates may change from time to time. If authorities other than the licensee are included in a stratum, the volume and harvest authority must be identified as well.

6. Sampling results as applied to dues and fees calculations
   - this section describes how and when the results of the sampling program will be applied to the calculation of dues and forest management fees;
   - it may also outline the schedule for payment of dues and fees.
7. Reporting requirements
   - outlines the requirement for submissions of all scale data to the chief scaler;
   - outlines the time allotted for the submission of this data;

10.2 Wood Flow Reporting

Wood Flow reports include the following information:

- Volume of forest products harvested, received at mill sites, or delivered to other locations by licence holder and harvest location (to the block level).
- Volume of forest products received from other licence holders, including harvest authority and harvest locations (to the block level).
- Volume of forest products received from private lands stating the land owner's name and land location.
- Volume of residual forest products sold or transferred to other locations, from the bush or the mill site, including destination.
- Volume of residual forest products received from other licence holders by licence holder and source location.
- Volume of residual forest products received from private lands stating the source name and location.
- Volume of forest products sold or traded to other companies including destination.
- Estimated volume of forest products in the bush by operating area.
- Additional information as requested by the Ministry of Environment from time to time.

10.3 Map of Processing Facility or Storage Facility

License holders that are scaling their timber at the entrance to their processing or storage facility are required to provide a map showing the location of their sampling areas and the exact location at the entrance of their facility where the truck will be scaled.

10.4 Amendment of Scaling Plan

A written amendment is required if a licensee wishes to make any changes to an approved scaling plan, including any adjustments to volumes covered by the plan. The approval of this amendment must be obtained prior to the movement of timber covered under the amendment, and prior to any of the amendments coming into force.

11. SAMPLE SCALING

11.1 Why Sample

Sample scaling is the application of an established scaling procedure to a representative portion of the total population to obtain accurate conversion factors in which to convert the total population into solid cubic metres.

The principle of sample scaling is that a carefully measured sample will yield accurate information about the total population of timber with similar characteristics. Careful measurement is essential. A small error made on a sample quickly magnifies itself when applied to the total population.

The reliability of factors determined during sample scaling are dependent on:

- a well designed scaling and sampling plan;
- the accuracy with which sample trees are measured;
- monitoring the sampling plan progress;
- revising the plan as necessary;
- careful calculation and reporting of data.

11.2 Who Samples

The requirement to sample scale to determine coefficients is outlined in section 45 of FRMR:

- those whose timber is scaled using mass or stack scale technique;
- those who harvest more than 30,000 m^3 annually and have it scaled using the tree length technique;
- those intending to determine what proportion of softwood timber volume harvested has a diameter, with the bark removed:
  (i) greater than 15 centimetres;
  (ii) greater than 10 centimetres and less than or equal to 15 centimetres; and
  (iii) less than or equal to 10 centimetres;
  those intending to determine what proportion of hardwood timber volume harvested has a diameter, with the bark removed:
  (i) greater than 10 centimetres; and
  (ii) less than or equal to 10 centimetres**".**
- those whose timber is scaled using any other technique that require coefficients to determine timber volume.

The scaling plan will describe in detail the method in which to determine the coefficients, and may include, but are not limited to, the following:

a) weight to volume using logs in piles technique;
b) weight to volume using individual logs technique;
c) stacked to solid using individual logs technique;
d) stacked to solid using logs in piles technique;
e) sampling for tree length coefficients.

The above methods for determining coefficients and the dues class distribution are described in detail in the appropriate sections of this standard.

11.3 Setting up the Sampling Plan

The sampling plan is designed to ensure that the timber profile population is clearly defined, that the sampling objectives and the data needs are accurately stated, and that sampling is undertaken to meet the objectives and precision requirements.

11.3.1 Sampling Objectives

The primary objective of sampling is to determine the volume of timber extracted from Crown forests for:

- the determination of cut control;
- the determination of applicable Crown dues and fees.

Sampling may also be necessary for licensees scaling for the determination of tree profile, for accurate determination of cut control and application Crown dues and fees.

11.3.2 Precision Requirements

The design of the sample scale shall meet:

> A minimum sampling error of 2.5% or less, using a confidence interval of 95% for the population being sampled.

This means we must sample enough of the population to ensure there is a 95% probability the total volume we estimate for the population will be within ± 2.5% of the actual volume.

After a licence holder has been sampling for a period of time, it will become evident through the variance of the sample coefficients whether the sampling intensity is adequate or not. Depending on the findings, the chief scaler may adjust the sampling intensity accordingly to ensure that sampling is within the precision requirements.

11.3.3 Stratification

Stratification is the grouping of components of the population on the basis of similarity of one or more characteristics.
For example:

- species;
- condition;
  - green;
  - fire killed;
  - insect/disease;
- season;
- staged (amount of time between harvest and delivery);
- forest management unit;
- harvesting contract area.

Stratification may serve to reduce sampling costs by reducing sample size, and provide more meaningful answers about the population. The keys to effective stratification are a meaningful and reasonable production forecast and experience. Experience is gained mostly through monitoring sampling results.

11.3.4 Sampling Frequency

The sampling frequency sets the rate of sampling in each stratum required to meet the sampling objectives. Only those loads selected as samples are physically scaled. All sampling must be fully random, that is, all loads have an equal opportunity of being selected.

For each stratum, a sampling frequency of 0.5% will be used as a guide for determining the number of loads to be physically scaled. The chief scaler can modify this intensity as needed to obtain an accurate and statistically valid sampling of the stratum.

11.4 Monitoring of Sampling

The monitoring of the sampling plan is key to the accuracy of the results obtained. Sampling will be monitored throughout the operating year and valuable experience can be gained through the maintenance of past years sampling results. Monitoring of the sampling plan will include:

- periodic check scales by Ministry of Environment check scalers;
- periodic review of sampling intensities and adjustment as required;
- maintenance of past sample scaling results for determination of future sampling intensities;
- adjustment and/or addition of the stratification as required;
- periodic review of production estimates to ensure that objectives will be met;
- adjustment of dues class distribution percentages as required.

11.5 Initial Coefficients and Reconciliation

If the licence holder has been sampling for a number of years, the initial coefficient(s) for each subsequent sampling year will be as determined from the previous year's sampling. Should a licence holder not have sampled previously they may propose initial coefficients and dues class distribution percentages for approval in their scaling plan. These may be adjusted accordingly as the licence holder obtains more data about the timber that is being harvested.

For all licence holders, the initial coefficients are the starting coefficients in which to convert the timber into solid cubic metres. At the end of the term of the scaling/sampling plan, the final coefficients(s) for the operating year will be determined. The volume of wood harvested and the amount of Crown dues and fees paid will be adjusted according to the new coefficient. This final coefficient(s) will be the starting coefficient(s) for the following year operation.

Unless otherwise stated in the scaling plan, the licensee is responsible for conducting and submitting the reconcile to the chief scaler by June 30th following the fiscal year end.

APPENDICES

Appendix A Glossary

The following definitions apply in this standard.

Acceptance limits of error means the limits of error that apply to a device when the performance of the device is tested.

Accuracy means the degree of agreement with an accepted reference value of individual measurements, tests or observations, made under prescribed conditions, or of estimates computed from them, and refers to the success of estimating the true value of a quantity.

Advanced Decay means the late stage of decay in which the decomposition is readily recognizable as the wood becomes punky, soft, stringy, pitted or crumbly.

Bark means all the tissues, including the cambrium, taken collectively and forming the exterior covering the xylem of a tree.

Bias means the consistent or systematic error that will be of the same amount in all individuals of a set of measurements made under similar circumstances.

Bole means a tree stem once it has grown to substantial thickness – generally, capable of yielding saw timber, veneer logs, large poles or pulpwood; seedlings, saplings, and thinner poles have stems not boles.

Bolt means any short log specially cut to length.

Branch Whorl means a more or less circular arrangement of branches around a point on the stem of a tree.

Butt End means the end of a tree length that was originally connected to the stump.

Butt Log means the lowest log from a bole.

Butt Rot means any decay or rot developing in, and sometimes characteristically confined to, the base or lower stem of a tree.

Butt Swell means that part of a log outside its normal taper and extending from where the normal taper ends and the flare begins to the large end of the log. It is usually manifest only in butt logs due to the self-buttressing growth of the tree near its base.

Caliper means an instrument for determining tree and log diameters by measurement of their rectangular projection on a straight graduated rule via two arms at right angles to (and one of them sliding along) the rule itself.

Catface means a defect on the surface of a tree or log resulting from a wound where healing has not reestablished the normal cross section.

Charred Wood means wood that has been converted to charcoal as a result of incomplete combustion.

Check means a lengthwise separation of the wood in a log or piece of timber, which usually extends across the rings of annual growth, commonly resulting from stresses set up in the wood during seasoning.

Chief Scaler means an officer of the ministry designated by the minister.

Church Door Fire Scar means a defect on the surface of a butt log caused by a ground fire, resulting in a tapered piece of sound wood missing from the butt end of the log.

Crook means an abrupt bend or curvature in the length of a log.

Crown Marking means marking the cut end of each log or tree that is on the top of the pile, clearly identifying the logs that make up that parcel of timber.

Dead Side means a misshapen side of a log caused by the lack of growth of wood because of the death or removal of the inner bark, or phloem, along the side of the living tree.

Decay means the decomposition of wood substance caused by the action of wood-destroying fungi, resulting in softening, loss of strength and mass, and often in change of texture and colour.

Defect means any of the following imperfections occurring in and affecting the utility of logs; advanced decay, charred wood, and missing wood.

Diameter, small end means the average diameter, inside bark, at the upper end of the butt or tree length.

Diameter Tape means a tape measure specially graduated so that the diameter may be read directly when the tape is placed round a tree stem, bole, or piece of roundwood.

Face (of a pile) means one of the surfaces of a pile of logs showing only the cut ends of the logs.

Fire Scar means a healing or healed-over injury, caused or aggravated by woody fire, on a woody plant.

Firm Red Heart means a form of incipient decay characterized by a reddish colour produced in the heartwood, which does not render the wood unfit for the majority of uses. Firm red heart contains none of the white pockets that characterize the more advanced stage of decay (not to be confused with natural red heartwood).

Foreign Material means any material extraneous to roundwood such as earth, ice, snow and branch, any of which add mass to the load.

Fuelwood means roundwood, whole or split, produced for burning.

Gross Mass means the mass of a load before any deduction for moisture content and, when present, bark, defect, and foreign material.

Gross Oven-dry Mass of Wood means the gross mass of wood, and defect less their moisture content.

Gross Volume means total volume including defects.

Heart Rot means any rot characteristically confined to the heartwood. It generally originates in the living tree.

Heart Shake means a shake that originates at the pith of a log and extends across the annual rings.

Heartwood means the inner core of a woody stem wholly composed of nonliving cells and usually differentiates from the outer enveloping layer (sapwood) by its darker colour. It is usually more decay-resistant than sapwood.

Hole means any opening in a log, other than check, shake or split. It may extend partially or entirely through a log and be from any cause;

Bird Holes means holes and damage caused by woodpeckers and other species of birds;

Borer Holes means missing wood caused by wood-boring insects or worms;

Insect Holes means missing wood caused by insects or insect larvae.

In-service limits of error means the limits of error that apply to a device when the performance of the device is tested at any time other than a time referred to in the definition of "acceptance limits of error"

Incipient Decay means the early stage of decay in which the decomposition has not proceeded far enough to soften or otherwise change the hardness of the wood perceptibly. It is usually accompanied by a slight discoloration of the wood (see "firm red heart" under "decay").

Intermediate Decay means a more advanced stage of decay than incipient decay characterized by a change in colour of the wood and some slight decomposition and loss of strength which, however, do not render the wood unfit for general purposes.

Known Weight - is a device, such as a concrete block which is used for the testing of the sections within the weighing platform. The weight of the known weight must be sufficient enough to sufficiently stress the sections of the weighing platform so as to achieve an accurate section test according to Measurement Canada Standards.

Licensee means a person mentioned in clause 1-1(1)(a) of the Forest Products Scaling Chapter.

Log means any section of the bole, or of the thicker branches, of a felled tree, after trimming and cross-cutting.

Log Rule means a table showing the estimated or calculated volume of wood that is contained in logs of given length, form, and end diameter inside bark.

Mass means the property of a body that is a measure of its inertia, that is commonly taken as a measure of the amount of material it contains, and causes it to have weight in a gravitational field.

Measuring means to find out the extent size, quantity, capacity, etc. of something by some standard.

Minimum Butt Diameter means the smallest diameter, inside bark, that can be measured through the geometric centre of the large end of a log with visible butt swell.

Missing Wood means wood that is absent from a log or part of a log that otherwise would usually be regarded as naturally complete. It may be caused by advanced decay, fire, or the operation of a machine or tool.

Moisture Content means the mass of water in wood expressed as a percentage of its total mass.

Net Oven-dry Mass means the oven-dry mass of the sound wood after deduction of moisture, bark and defect from the original gross mass of the load.

Net Volume means the volume remaining after all deductions from defects from gross volume have been made; in stacked measure, deductions include voids.

Normal Taper means the regular decrease in diameter of a log from its large to small end; this includes that taper found on a butt log.

Oven-dry means a condition in which the wood has ceased to loose moisture after being subjected to a temperature of 103 ± 2°C in a ventilated oven, for purposes of determining moisture content.

Parcel means any quantity of grouped timber.

Peeled means that all or most of the bark has been removed.

Pile means for scaling purposes, an orderly arrangement of logs or bolts less than or equal to 5.1 m in length.

Pipe means a hole, the product of decay, running through the centre of a log.

Pith means the small cylinder of primary tissue of a tree stem around which the annual rings form.

Pocket Rot means, in wood, any rot localized in small areas, generally forming rounded or lens-shaped cavities.

Precision means the closeness of agreement among a set of measurements made under prescribed conditions, and refers to the clustering of sample values about their own average.

Primary Forest Products means any of the commercially valuable raw material, consisting essentially of xylem, obtained from the stem or limbs of a felled or cut tree, including but not confined to roundwood and woodchips.

Punky means a soft, weak, often spongy wood condition caused by decay.

Random Sampling – *simple random sampling* requires that there be an equal chance of selecting all possible combinations of the N sampling units from the population. The selection of each sampling unit must be free from deliberate choice, and must be completely independent of the selection of all other units.

Reject means a log that has been rejected from a scale of logs. However, it will be of value for a use other than that originally intended.

Relative Density means the ratio of the oven-dry mass of a sample to the mass of a volume of water (at 40°C) equal to the volume of the sample at some specified moisture content.

Ring Rot means any rot localized mainly in the early wood of the annual ring, giving a concentric pattern of decayed wood in cross section.

Rough means that some or none of the bark has been removed.

Rounding means the process of approximating to a number by omitting certain of the end digits, replacing by zeros if necessary and adjusting the digit retained so that the resulting approximation is as near as possible to the original number. If the last digit is increased by unity the number is said to be rounded up; if decreased by unity it is rounded down. When both are under consideration the process is said to be one of rounding off.

Roundwood 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 the section (for fuel wood).

Sample means some component parts selected from a population, or measurements to be included in the sample.

Sample Size means the number of items, specimens, observations, or measurements to be included in the sample.

Sample Tree means an individual tree that has been included in a sample for the purpose of measurement.

Sap Rot means any rot characteristically confined to the sapwood.

Scale (noun) means the measured or estimated quantity, expressed as the volume, or area, or length, or mass, or number of products obtained from trees and measured or estimated after they are felled.

Scale (verb) means to measure or estimate the quantity, expressed as the volume, or area, or length, or mass, or number of products obtained from trees after they are felled.

Scaler means a person mentioned in clause 1-1(1)(b) of the Forest Product Scaling Chapter. This person is qualified to scale primary forest products and is licensed or appointed by a government agency.

Scales means an instrument or machines for determining mass or for weighing.

Scale Stick means a graduate stick for measuring the end diameters of logs or felled trees inside bark. Of many types, it usually has a shaped handle on one if its ends, a tine at the other, and a log rule reproduced on its length; it also means a graduated stick for measuring the external dimensions of stacked wood.

Secondary Wood Products means any of the commercially valuable material, consisting essentially of xylem, manufactured from primary wood products.

Shake means a separation along the grain of a log or tree and occurring between or across the annual rings but not extending from one surface to another;

Ring Shake means a shake that partially or completely encircles the pith.

SI Units means only the base, supplementary, and derived units of measure included within the International System of Units (SI) (See CSA Standard CAN3-z234.2-76).

Significant Digit means any digit that is necessary to define the specific quantity or value.

Sound Wood means wood free from defect.

Split means cleft completely and lengthwise along the grain of a log.

Stack means, for scaling purposes, an orderly arrangement of logs or bolts less than or equal to 5.1m in length.

Stacked Cubic Metre [symbol m^3 (stacked)] 1 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 axes approximately parallel.
Note: this definition is taken from s.335 of the Government of Canada's *Weights and Measures Regulations*.

Stacked Cubic Metre Peeled [symbol m^3 (stacked) peeled] means 1 Stacked Cubic Metre of peeled roundwood.

Stacked Scaling means the act or process of measuring or estimating the total amount of wood, bark and airspace contained in a stack of roundwood, where the bolt length is less than or equal to 5.1 m as determined by its external dimensions.

Staged means any wood which has remained in a staging area for a period of greater than four months from May 1 to October 31 or a period of greater than six months in any calendar year.

Stem means the principal axis of a plant, from which buds and shoots develop.

Stratum (Strata) means the grouping of components of a population on the basis of similarity of one or more characteristics.

Sweep means a gradual curve in the length of a log, as distinct from an abrupt bend or curvature.

Systematic Sampling – the sampling units are spaced at fixed intervals throughout the population. The initial sampling unit can be randomly chosen out of the entire population of units, or it may be randomly selected from the first interval in the population. In either case, once the first unit is chosen, all following units will be selected at regular intervals.

Tangent – a line meeting a curved line or surface at a point and having same direction there, this touching it but not intersecting it.

Tare means the mass of the unloaded vehicle or container.

Testing Apparatus - is the heaviest, shortest wheel-base vehicle available to conduct a section test, but does not exceed the scale's sectional capacity. The weight of the apparatus should be at least 25% of the scale capacity. Cars and pickup trucks are too light.

Tier means one of a set of layers or rows arranged one above another of roundwood cut to similar lengths, piled in a regular manner with their longitudinal axes approximately parallel, placed on a truck or railway car.

Tolerance means the total range of variation permitted for a required size.

Void means an unnecessary airspace in a stack of roundwood, large enough to accommodate the average size of log or bolt in the stack.

Weigh means to measure a definite quantity on or as if on a scale.

Weighing Machine means any device for measuring mass, possessing moving parts that may influence the accuracy of the instrument.

Weigh Scale is defined as any device or equipment or accessories attached to or used in conjunction with the device which is used for the weighing of trucks and/or trailers or parts thereof.

Weight means the force with which a body is attracted toward the earth or a celestial body by gravitation and which is equal to the product of the mass by the local gravitational acceleration.

Wood means the hard fibrous substance basically xylem that makes up the greater part of the stems and branches of trees or shrubs, beneath the bark.

Xylem means the complex tissue in the vascular system of higher plants that consists of vessels, tracheids, or both usually together with wood fibres and parenchyma cells. It functions chiefly in conduction but also in support and storage, and typically constitutes the woody element (as of a plant system).

Appendix B Maximum Allowable Rot by Log Size

Log Diameter (cm)	Max Allowable %Rot (area)	Maximum Diameter	Log Diameter	Max Allowable % Rot (area)	Maximum Diameter
10	0	0.0	55	30	30.1
11	0	0.0	56	30	30.7
12	0	0.0	57	30	31.2
13	0	0.0	58	30	31.8
14	0	0.0	59	30	32.3
15	0	0.0	60	30	32.9
16	0	0.0	61	30	33.4
17	0	0.0	62	30	34.0
18	0	0.0	63	30	34.5
19	10	6.0	64	30	35.1
20	15	7.6	65	30	35.6
21	15	8.1	66	30	36.1
22	20	9.3	67	30	36.7
23	20	10.2	68	30	37.2
24	20	11.3	69	30	37.8
25	25	12.3	70	30	38.3
26	25	13.3	71	30	38.9
27	30	14.8	72	30	39.4
28	30	15.3	73	30	40.0
29	30	15.9	74	30	40.5
30	30	16.4	75	30	41.1
31	30	17.0	76	30	41.6
32	30	17.5	77	30	42.2
33	30	18.1	78	30	42.7
34	30	18.6	79	30	43.3
35	30	19.2	80	30	43.8
36	30	19.7	81	30	44.4
37	30	20.3	82	30	44.9
38	30	20.8	83	30	45.5
39	30	21.4	84	30	46.0
40	30	21.9	85	30	46.6
41	30	22.5	86	30	47.1
42	30	23.0	87	30	47.7
43	30	23.6	88	30	48.2
44	30	24.1	89	30	48.7
45	30	24.6	90	30	49.3
46	30	25.2	91	30	49.8
47	30	25.7	92	30	50.4
48	30	26.3	93	30	50.9
49	30	26.8	94	30	51.5
50	30	27.4	95	30	52.0
51	30	27.9	96	30	52.6
52	30	28.5	97	30	53.1
53	30	29.0	98	30	53.7
54	30	29.6	99	30	54.2

Appendix C Commercial Tree Species Identification

Of the commercial tree species in Canada as shown in Appendix D of this standard, the common names and botanical names for each species and group of species are shown. Of these species, thirteen occur naturally in Saskatchewan; appropriate names, symbols, and identifying features are:

1.1 Coniferous Species

i) White Spruce (WS)

Bark – thin, scaly, light grayish brown; second layer salmon pink surface; new inner bark silvery white.

Wood – light, soft, resilient, straight-grained; pale white with little contrast between sapwood and heartwood;

– staining only indicative of incipient decay.

ii) Black Spruce (BS)

Bark – thin, scaly, dark grayish-brown; second layer olive-green.

Wood – moderately light; soft (but harder than white spruce), relatively strong, resilient, straight grained; nearly white, with little contrast between sapwood and heartwood;

– usually slower growing than white spruce, with growth rings frequently very close together and an obvious distinction between spring wood and summer wood;

– staining may be present in butt logs, but usually only indicative of incipient decay.

iii) Jack Pine (JP)

Bark – thin, reddish brown to grey on young stems, becoming thicker, dark brown, flaky, and somewhat corky in appearance on older stems; layering is obvious in all, but the thinnest bark; on older stems, the bark becomes furrowed into irregular layered, corky, thick plates.

Wood – moderately hard and heavy, not strong, heartwood light brown, sapwood nearly white with slight yellowish tinge when compared with white spruce;

– heartwood frequently stained, but sound.

iv) Lodgepole Pine (LP)

The only known range in Saskatchewan is in the Cypress Hills; seldom encountered during scaling.

Bark – thin, orangey-brown to grey, finely scale.

Wood – light and soft to moderately hard and heavy, sometimes spiral-grained, often prominently dimpled in the flat grain surface;

– heartwood light yellow to yellowish-brown, sapwood nearly white.

v) Balsam Fir (BF)

Bark – smooth, grayish, dotted with raised resin blisters when young;
– with age becoming broken into irregular brownish scales.

Wood – light, soft, weak, somewhat brittle; white, with no contrast between heartwood and sapwood.
– very susceptible to decay, even in young stems.

vi) Tamarack (Eastern Larch) (TL)

Bark – thin, very finely scaled, grey when young; becomes reddish brown and scaly with age;
– inner bark reddish purple.

Wood – moderately hard and heavy, somewhat oily; heartwood yellowish-brown to chocolate, sapwood whitish;
– decay resistant, frequently spiral-grained.

1.2 Deciduous Species

i) Aspen (Trembling Aspen, White Poplar) (TA)

Bark – smooth with a waxy appearance, pale green to almost white;
– with age becoming grey and furrowed into long flat ridges.

Wood – moderately light, soft, relatively low in strength;
– heartwood grayish white, not clearly defined, sapwood nearly white; diffuse porous;
– quite susceptible to decay, even in young stems, and particularly in trees from poorer growing sites;
– growth rings frequently indistinct.

ii) Black Poplar (Balsam Poplar) (BPO)

Bark – on young trees smooth, greenish-brown, turning dark grayish and becoming furrowed into flat topped rough ridges separated by irregular V-shaped crevices;
– similar to aspen only on very young stems.

Wood – light, soft, low in strength, heartwood grayish-brown, sometimes tinged with red;
– sapwood nearly white; diffuse porous;
– heartwood frequently darkly stained but sound;
– growth rings frequently indistinct.

iii) White Birch (Paper Birch) (WB)

Bark – thin, smooth, reddish-brown on young trunks, becoming creamy-white, peels easily into large sheets to expose a reddish-orange inner bark which after exposure, gradually turns black with age.

Wood – moderately heavy, hard, strong, not durable when in contact with soil; pale brown with nearly white sapwood; diffuse porous;
– growth rings frequently indistinguishable.

iv) Green Ash (GA)
Occurs naturally only in the Cumberland House Lowlands; seldom encountered during scaling.

Bark – greyish-brown often tinged with red, becoming broken into firm narrow, irregular, slightly raised ridges running into one another and giving a somewhat diamond-shaped pattern.
Wood – hard, heavy, moderately strong, coarse grained; light brown, with nearly white sapwood; ring porous.

v) Manitoba Maple (MM)
Occurs naturally most abundantly in the Cumberland Lowlands, but also somewhat sporadically along streams elsewhere in the south-eastern portion of the Provincial Forest; seldom encountered during scaling.

Bark – light grey, smooth, becoming furrowed into narrow firm ridges, darkening with age.
Wood – moderately light, soft, low in strength, close grained; nearly white; diffuse porous.

vi) White Elm (American Elm) (WE)
Occurs naturally only in the Cumberland Lowlands; presently seldom encountered during scaling, although commercial use of this species may increase. Due to Dutch Elm disease, transport of this species is limited. Check with the Provincial DED Administrator before transporting this species.

Bark – dark greyish-brown with broad deep, intersecting ridges, or often scaly; outer bark when broken across shows layers of a whitish-buff color alternating with thicker dark layers;
– with weathering, whitish and dark areas are exposed, making the trunk somewhat mottled and ash-grey.
Wood – heartwood pale yellowish-brown, sapwood nearly white; ring porous.

vii) Bur Oak (BO)
Occurs only along the Qu'Appelle River system, well outside the Provincial Forest; seldom if ever encountered during scaling.

Bark – rough becoming deeply furrowed into scaly darkish ridges.
Wood – pale brown, nearly white sapwood; ring porous.

<u>In addition</u>, tree species which are not native to Saskatchewan, but which can be expected to become commercially important in the future, are: Scots Pine and European Larch; bark and wood identifying features will be included in this Standard when necessary.

Appendix D Names for Commercial Tree Species Grown in Canada

Commercial Tree Species – these species are grown in sufficient quantities in Canada and have such properties as to make them of commercial value, that is, for building construction, industrial use, re-manufacturing and use by home craftsmen both in Canada and abroad. Their inclusion in Table D was judged appropriate by reference not only to Native Trees of Canada but the publication Canadian Forestry Statistics 1973, the third edition of Canadian Woods Their Properties and Uses, and reports of provincial representatives on the CSA Committee on Scaling of Primary Forest Products.

> - from the Appendix of Scaling Roundwood, National Standard of Canada – CAN3-0302.1-09

COMMON NAME	BOTANICAL NAME
2.1 Coniferous Species	
Pine	*Pinus L*
Eastern White Pine	*Pinus strobus L.*
Western White Pine	*Pinus monticola Dougl.*
Whitebark Pine	*Pinus albicaulis Engelm*
Ponderosa Pine	*Pinus ponderosa Laws.*
Pitch Pine	*Pinus rigida Mill.*
Red Pine	*Pinus resinosa Ait*
Jack Pine	*Pinus banksiana Lamb.*
Lodgepole Pine	*Pinus contorta Dougl.*
Scots Pine	*Pinus sylvestris L.*
Austrian Pine	*Pinus nigra Arnold*
Mugho Pine	*Pinus mugo Turra var. mughus Zenari*
Larch	
Tamarack	*Larix Laricina (DuRoi) K. Koch*
Western Larch	*Larix occidentalis Nutt*
European Larch	*Larix decidua Mill.*
Spruce	*Picea A. Dietr.*
White Spruce	*Picea glauca (Moench) Voss*
Engelmann Spruce	*Picea engelmannii Parry*
Sitka Spruce	*Picea sitchensis (Bong.) Carr.*
Red Spruce	*Picea rubens Sarg.*
Black Spruce	*Picea mariana (Mill.) B.S.P.*
Norway Spruce	*Picea abies (L.) Karst*
Hemlock	*Tsuga (Endl.) Carr*
Eastern Hemlock	*Tsuga Canadensis (L.) Carr*

Western Hemlock	*Tsuga Heterophylla (Raf.) Sarg*
Mountain Hemlock	*Tsuga Mertensiana (Bong.) Carr.*
Douglas Fir	*Pseudotsuga menziessi (Mirb.) Franco*
Fir	*Abies Mill.*
Balsam Fir	*Abies balsamea (L.) Mill.*
Alpine Fir	*Abies lasiocarpa (Hook.) Nutt.*
Amabilis Fir	*Abies amabilis (Dougl.) Forbes*
Grand Fir	*Abies grandis (Dougl.) Lindl*
Arbor-vitae	*Thuja L.*
Eastern White Cedar	*Thuja occidentalis L.*
Western Red Cedar	*Thuja plicata Donn.*
Yellow Cedar	*Chamaecyparis nootkatensis (D. Don) Spach*
Eastern Red Cedar	*Juniperus virginiana L.*
Western Yew	*Taxus brevifolia Nutt.*
Other coniferous species	

2.2 Deciduous Species

Black Willow	*Salix nigra Marsh.*
Poplar	*Polulus L.*
Trembling Aspen	*Populus tremuloides Michx.*
Largetooth Aspen	*Populus grandidentata Michx.*
Balsam Poplar	*Populus balsamifera L.*
Eastern Cottonwood	*Populus deltoids Bartr.*
Black Cottonwood	*Populus trichocarpa Torr. & Gray*
European White Poplar	*Populus alba L.*
Carolina Poplar	*Populus x canadensis Moench*
Butternut	*Juglans cinerea L.*
Black Walnut	*Juglans nigra L.*
Hickory	*Carya Nutt*
Shagbark Hickory	*Carya ovata (Mill.) K. Koch*
Pignut Hickory	*Carya glabra (Mill.) Sweet*
Bitternut Hickory	*Carya cordiformis (Wang.) K. Koch*
Hop-hornbeam	*Ostrya virginiana (Mill.) K. Koch*
Birch	*Betula L.*
Yellow Birch	*Betula alleghaniensis Britton*
White Birch	*Betula papyrifera Marsh.*
Alder	*Alnus B. Ehrh.*

Red Alder	*Alnus rubra Bong.*
Sitka Alder	*Alnus sinuate (Reg.) Rydb.*
Beech	*Fagus grandifolia Ehrh.*
Oak	*Quercus L.*
White Oak	*Quercus alba L.*
Bur Oak	*Quercus macrocarpa Michx.*
Swamp White Oak	*Quercus bicolor Wild.*
Chinquapin Oak	*Quercus muehlenbergii Engelm.*
Chestnut Oak	*Quercus prinus L.*
Red Oak	*Quercus rubra L.*

Black Oak	*Quercus velutina Lam.*
Pin Oak	*Quercus palustris Muenchh.*
Elm	*Ulmus L.*
White Elm	*Ulmus Americana L.*
Rock Elm	*Ulmus thomasii Sarg.*
Slippery Elm	*Ulmus rubra Muhl*
Red Mulberry	*Morus rubra L.*
Tulip-tree	*Liriodendron tulipifera L.*
Sassafras	*Sassafras albidum (Nutt.) Nees*
Sycamore	*Platanus occidentalis L.*
Black Cherry	*Prunus serotina Ehrh.*
Honey-Locust	*Gleditsia triacanthos L.*
Black Locust	*Robinia pseudoacacia L.*
Maple	*Acer L.*
Sugar Maple	*Acer saccharum Marsh.*
Black Maple	*Acer nigrum Michx. f.*
Bigleaf Maple	*Acer macrophyllum Pursh*
Silver Maple	*Acer saccharinum L.*
Red Maple	*Acer rubrum L.*
Vine Maple	*Acer circinatum Pursh*
Manitoba Maple	*Acer negundo L.*
Cascara	*Rhamnus purshiana DC.*
Basswood	*Tilia American L.*
Black Gum	*Nyssa sylvatica Marsh.*
Arbutus	*Arbutus menziesii Pursh*
Ash	*Fraxinus L.*
White Ash	*Fraxinus americana L.*
Red Ash	*Fraxinus pennsylvanica Marsh.*
Blue Ash	*Fraxinus quadrangulata Michx.*
Black Ash	*Fraxinus nigra Marsh.*
Green Ash	*Fraxinus pennsylvanica var. Subintegerrima*

Appendix E Tolerance Level Measurement Error

The selection of size class intervals implies that errors in volume estimation are acceptable to the extent caused by the actual dimension being measured falling at the boundary of the size class interval rather than at the midpoint of the interval. These errors are particularly important in the determination of the volume of an individual log; however, it is usually assumed in scaling that if a sufficient number of logs are scaled, the positive and negative errors tend to compensate each other.

The following examples illustrate the amount of error that must be acceptable for individual logs for each Tolerance level:

1) <u>Tolerance Level One</u>

Nominal log dimensions:	Average end diameter	=	20.0 cm
	Length	=	1.3 m
	Estimated Volume	=	0 0405 m^3
a) Actual log dimensions:	Average end diameter	=	19.95 cm
	Length	=	1.295 m
	Actual Volume	=	0.0405 m^3
	Per cent error	=	0.0%
b) Actual log dimensions:	Average end diameter	=	20.00 cm
	Length	=	1.295 m
	Actual Volume	=	0.0407 m^3
	Per cent error	=	0.5%
c) Actual log dimensions:	Average end diameter	=	19.95 cm
	Length	=	1.300 m
	Actual Volume	=	0.0406 m^3
	Per cent error	=	0.2%
d) Actual log dimensions:	Average end diameter	=	20.00 cm
	Length	=	1.300 m
	Actual Volume	=	0.0408 m^3
	Per cent error	=	0.7%

2) <u>Tolerance Level Two</u>

Nominal log dimensions:	Average end diameter	=	20.0 cm
	Length	=	2.5 m
	Estimated Volume	=	0.0732 m^3

a)	Actual log dimensions:	Average end diameter	=	19.5 cm
		Length	=	2.45 m
		Actual Volume	=	0.0732 m³
		Per cent error	=	0.0%
b)	Actual log dimensions:	Average end diameter	=	20.00 cm
		Length	=	2.45 m
		Actual Volume	=	0.0770 m³
		Per cent error	=	5.2%
c)	Actual log dimensions:	Average end diameter	=	19.5 cm
		Length	=	2.5 m
		Actual Volume	=	0.0747 m³
		Per cent error	=	2.0%
d)	Actual log dimensions:	Average end diameter	=	20.00 cm
		Length	=	2.5 m
		Actual Volume	=	0.0785 m³
		Per cent error	=	7.2%

3) <u>Tolerance Level Three</u>

Nominal log dimensions:	Average end diameter	=	20 cm
	Length	=	5 m
	Estimated volume	=	0.157m³

a)	Actual log dimensions:	Average end diameter	=	20 cm
		Length	=	5.0 m
		Actual Volume	=	0.157 m³
		Per cent error	=	0.0%
b)	Actual log dimensions:	Average end diameter	=	21.00 cm
		Length	=	5.0 m
		Actual Volume	=	0.173 m³
		Per cent error	=	10.2%
c)	Actual log dimensions:	Average end diameter	=	20.0 cm
		Length	=	5.1 m
		Actual Volume	=	0.160 m³
		Per cent error	=	2.0%
d)	Actual log dimensions:	Average end diameter	=	21.00 cm
		Length	=	5.1 m
		Actual Volume	=	0.177 m³
		Per cent error	=	12.5%

Appendix F Volume Comparisons

To Actual Volumes (m^3) for Specific Log Diameters and Log Lengths

D (cm)	Length			D (cm)	Length		
	2.4	2.5	2.6		4.8	4.9	5.0
10.0	0.019	0.020	0.020	10.0	0.038	0.038	0.039
		0.020				0.038	
10.5	0.021	0.020	0.022	10.5	0.042	0.043	0.044
	0.021	0.020	0.022		0.042	0.042	0.043
11.0	0.023	0.024	0.025	11.0	0.046	0.047	0.048
		0.024				0.047	
20.0	0.075	0.078	0.082	20.0	0.151	0.154	0.157
		0.079				0.154	
20.5	0.079	0.082	0.086	20.0	0.158	0.162	0.165
	0.079	0.083	0.086		0.158	0.162	0.165
21.0	0.083	0.086	0.090	21.0	0.166	0.170	0.173
		0.087				0.170	
30.0	0.170	0.177	0.184	30.0	0.339	0.346	0.353
		0.177				0.346	
30.5	0.176	0.183	0.190	30.5	0.350	0.358	0.365
	0.176	0.183	0.190		0.351	0.358	0.365
31.0	0.181	0.188	0.196	31.0	0.362	0.370	0.377
		0.189				0.370	
40.0	0.302	0.314	0.327	40.0	0.603	0.616	0.628
		0.314				0.616	
40.5	0.310	0.322	0.335	40.5	0.618	0.631	0.628
	0.309	0.322	0.335		0.618	0.631	
41.0	0.317	0.330	0.343	41.0	0.634	0.647	0.660
		0.330				0.647	
50.0	0.471	0.491	0.511	50.0	0.942	0.962	0.982
		0.491				0.962	
50.5	0.481	0.501	0.521	50.5	0.962	0.982	1.002
	0.481	0.501	0.521		0.962	0.982	1.001
51.0	0.490	0.510	0.531	51.0	0.981	1.001	1.021
		0.510				1.001	

Interpolated Volume (m^3)
Actual Volume (m^3)

Appendix G Relative Densities for Thirteen Species Native to Saskatchewan

Pine , jack	.42
Pine, lodgepole	.41
Spruce, black	.41
Spruce, white	.36
Tamarack	.48
Ash, green	.49
Aspen, trembling	.37
Birch, white	.51
Elm, white	.52
Maple, Manitoba	.42
Oak, bur	.60
Poplar, balsam	.37

*Average relative densities per species.

Source: Dobie J. Wright, D.M.
Western Forest Products Laboratory, 1975

Note: Multiply relative density by 1000 to convert to kilograms per cubic metre.

Appendix H Specifications for Metric Scaling Sticks

Materials

1. Rule:
   a. Select straight grained hardwood – oak, ash, maple, and hickory preferred.
   b. At no time may the grain cross from one side of the stick to the other side.
   c. Loose knots or knots larger than 5 mm will not be accepted
   d. Finish shall be high quality and clear, such that it will not wear off readily or become opaque.

2. Face Plates and Tine:
   a. Steel or duralumin at least 1mm thick, 25mm wide and rigidly attached to the rule.

Markings

1. Stack Stick:
   a. 10 cm calibrations – every 10 cm from the inside of the tine calibrate a solid line on the front side and both edges in red.
   b. On the front side only, directly above the calibration line, place the appropriate numeral in metres and tenths of metres.

      Example 20 cm from the tine label 0.2

2. 2 cm calibrations:
   a. Beginning at 0.11 m (i.e. 0.11 mm from the inside of the tine), and every 2 cm thereafter, calibrate in black the solid line, only on the back side of the rule; that is, a solid line is calibrated at every odd numbered centimetre for the full calibrated length of the rule.
   b. On the back side only, midway between the calibrated black lines, place the appropriate numerals; at every 10 cm, the distance from the inside of the tine to the midway point between the calibration lines is stated in metres and tenths of metres, in red; all other numerals are black and only the last digit is shown. For example, at 1.64 in from the tine, only “4” is shown on the rule.
   c. All numerals shall be 10 mm high, horizontal, and right side up with the stick in a vertical position, tine down.
   d. The uncalibrated portion of the stick should state “metres”.

3. Cube Stick;
   a. Both sides of the cube stick shall be identical except that from one side, the numerals depicting diameter classes shall be right side up with the non-calibrated portion of the stick held horizontally in the right hand, and the other side with the non-calibrated portion of the stick held horizontally in the left hand.

b. The following information shall be recorded on the stick:
   1. 2 cm diameter classes on both edges of the stick;
   2. 1 cm diameter classes on both sides of the stick;
   3. 0.01 m^3 (stacked) designations on both sides of the stick.

4. The 2 cm calibration lines shall start 3 cm from the inside of the tine and be placed every 2 cm thereafter for the full calibrated length of the stick. These lines should be black, heavy and be marked on both sides and both edges of the stick. The numerals depicting each diameter class shall be a 4 mm high, black and midway between the calibration lines along both edges only, of the stick.

5. The 1 cm calibration lines shall be midway between the 2 cm lines. These lines shall be black, fine, and marked only on both sides of the stick. The numerals depicting each diameter class shall be 4 mm high, black on both sides only, along the lower edge with the stick held in the appropriate hand. The 0.01 m^3 (stacked) designations shall be 4 mm high, red and placed between the 1 cm calibration lines along both sides, along the upper edge with the stick held in the appropriate hand. These numerals shall be horizontal, right side up, with the stick in a vertical position, tine down.

6. On the un-calibrated portion of the stick, parallel to the longitudinal axis, is in line with the pertinent information mark:

   2 cm
   0.01 m – (Stacked for L = 2.4m)
   1 cm

   In numerals and letters 4 mm high, in addition to, midway on both sides of the uncalibrated portion of the stick, mark:

   m^3 (stacked) ROUGH

   In letters 10 mm high.

   Dimensions

Stacked Stick:	Width	=	35 + mm
	Thickness	=	10 + mm
	Length	=	to be specified by the purchaser
Cube Stick:	Width	=	30 + mm
	Thickness	=	8 + mm
	Length	=	to be specified by the purchaser

Appendix I Determination of Relative Density

A useful method for determination of relative density by water displacement

Equipment required

1. A beam scale with a minimum capacity of 10 kg. The bottom plate of the balance shall be holed, so as to give access to a small chain, which can be attached to the scale platform.
2. A wire mesh basket, sufficiently weighed and which can contain up to 5 averaged-sized wood disks.
3. A sharp knife to remove the bark off sample disks.
4. A chainsaw with accessories in order to cut sample disks from logs.
5. A vessel containing water.

Procedure

1. Determine the mass of the basket in air, then in water. The difference is mass between the two weights equals the volume of the basket.
2. Cut sample disks on a number of logs selected at random on the sample loads. The first disk shall be cut at the butt of sample log number 1, the second from the butt of number 2 and the third at 40 cm from the butt of sample log number 3, etc. Disks shall be 3 cm thick.
3. Debark the wood disks.
4. Weigh wood disks in basket in air, then weigh wood and basket immersed in water. The difference equals volume of basket of wood. Deduct from this figure the volume of the water basket. The remainder is the volume of the wood.
5. Place wood disks in oven and dry at 103 $\pm 2^{o}$ C until no further loss in mass is noticeable (the oven dry mass).
6. The density (D) is found by:

$$D = \frac{\text{Oven-dry Mass}}{\text{Volume}}$$

7. The relative density is then the ratios of D to the density of water at 4^{o} C

From the “appendix of Scaling Roundwood” National Standard of Canada – Canada 3-0302.1-M77

Appendix J 1 (One) cm Volume Tables

Tolerance Level Two

(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
0.1	0.05	0.001	0.004	0.009	0.016	0.025	0.035	0.048	0.063	0.080	0.098
0.1	0.10	0.002	0.008	0.018	0.031	0.049	0.071	0.096	0.126	0.159	0.196
0.2	0.15	0.003	0.012	0.027	0.047	0.074	0.106	0.144	0.188	0.239	0.295
0.2	0.20	0.004	0.016	0.035	0.063	0.098	0.141	0.192	0.251	0.318	0.393
0.3	0.25	0.005	0.020	0.044	0.079	0.123	0.177	0.241	0.314	0.398	0.491
0.3	0.30	0.006	0.024	0.053	0.094	0.147	0.212	0.289	0.377	0.477	0.001
0.4	0.35	0.007	0.027	0.062	0.110	0.172	0.247	0.337	0.440	0.001	0.001
0.4	0.40	0.008	0.031	0.071	0.126	0.196	0.283	0.385	0.001	0.001	0.001
0.5	0.45	0.009	0.035	0.080	0.141	0.221	0.318	0.433	0.001	0.001	0.001
0.5	0.50	0.010	0.039	0.088	0.157	0.245	0.353	0.481	0.001	0.001	0.001
0.6	0.55	0.011	0.043	0.097	0.173	0.270	0.389	0.001	0.001	0.001	0.001
0.6	0.60	0.012	0.047	0.106	0.188	0.295	0.424	0.001	0.001	0.001	0.001
0.7	0.65	0.013	0.051	0.115	0.204	0.319	0.459	0.001	0.001	0.001	0.001
0.7	0.70	0.014	0.055	0.124	0.220	0.344	0.495	0.001	0.001	0.001	0.001
0.8	0.75	0.015	0.059	0.133	0.236	0.368	0.001	0.001	0.001	0.001	0.001
0.8	0.80	0.016	0.063	0.141	0.251	0.393	0.001	0.001	0.001	0.001	0.002
0.9	0.85	0.017	0.067	0.150	0.267	0.417	0.001	0.001	0.001	0.001	0.002
0.9	0.90	0.018	0.071	0.159	0.283	0.442	0.001	0.001	0.001	0.001	0.002
1.0	0.95	0.019	0.075	0.168	0.298	0.466	0.001	0.001	0.001	0.002	0.002
1.0	1.00	0.020	0.079	0.177	0.314	0.491	0.001	0.001	0.001	0.002	0.002
1.1	1.05	0.021	0.082	0.186	0.330	0.001	0.001	0.001	0.001	0.002	0.002
1.1	1.10	0.022	0.086	0.194	0.346	0.001	0.001	0.001	0.001	0.002	0.002
1.2	1.15	0.023	0.090	0.203	0.361	0.001	0.001	0.001	0.001	0.002	0.002
1.2	1.20	0.024	0.094	0.212	0.377	0.001	0.001	0.001	0.002	0.002	0.002
1.3	1.25	0.025	0.098	0.221	0.393	0.001	0.001	0.001	0.002	0.002	0.002
1.3	1.30	0.026	0.102	0.230	0.408	0.001	0.001	0.001	0.002	0.002	0.003
1.4	1.35	0.027	0.106	0.239	0.424	0.001	0.001	0.001	0.002	0.002	0.003
1.4	1.40	0.027	0.110	0.247	0.440	0.001	0.001	0.001	0.002	0.002	0.003
1.5	1.45	0.028	0.114	0.256	0.456	0.001	0.001	0.001	0.002	0.002	0.003
1.5	1.50	0.029	0.118	0.265	0.471	0.001	0.001	0.001	0.002	0.002	0.003
1.6	1.55	0.030	0.122	0.274	0.487	0.001	0.001	0.001	0.002	0.002	0.003
1.6	1.60	0.031	0.126	0.283	0.001	0.001	0.001	0.002	0.002	0.003	0.003
1.7	1.65	0.032	0.130	0.292	0.001	0.001	0.001	0.002	0.002	0.003	0.003
1.7	1.70	0.033	0.134	0.300	0.001	0.001	0.001	0.002	0.002	0.003	0.003
1.8	1.75	0.034	0.137	0.309	0.001	0.001	0.001	0.002	0.002	0.003	0.003
1.8	1.80	0.035	0.141	0.318	0.001	0.001	0.001	0.002	0.002	0.003	0.004
1.9	1.85	0.036	0.145	0.327	0.001	0.001	0.001	0.002	0.002	0.003	0.004
1.9	1.90	0.037	0.149	0.336	0.001	0.001	0.001	0.002	0.002	0.003	0.004
2.0	1.95	0.038	0.153	0.345	0.001	0.001	0.001	0.002	0.002	0.003	0.004

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
2.0	**2.00**	0.039	0.157	0.353	0.001	0.001	0.001	0.002	0.003	0.003	0.004
2.1	**2.05**	0.040	0.161	0.362	0.001	0.001	0.001	0.002	0.003	0.003	0.004
2.1	**2.10**	0.041	0.165	0.371	0.001	0.001	0.001	0.002	0.003	0.003	0.004
2.2	**2.15**	0.042	0.169	0.380	0.001	0.001	0.002	0.002	0.003	0.003	0.004
2.2	**2.20**	0.043	0.173	0.389	0.001	0.001	0.002	0.002	0.003	0.003	0.004
2.3	**2.25**	0.044	0.177	0.398	0.001	0.001	0.002	0.002	0.003	0.004	0.004
2.3	**2.30**	0.045	0.181	0.406	0.001	0.001	0.002	0.002	0.003	0.004	0.005
2.4	**2.35**	0.046	0.185	0.415	0.001	0.001	0.002	0.002	0.003	0.004	0.005
2.4	**2.40**	0.047	0.188	0.424	0.001	0.001	0.002	0.002	0.003	0.004	0.005
2.5	**2.45**	0.048	0.192	0.433	0.001	0.001	0.002	0.002	0.003	0.004	0.005
2.5	**2.50**	0.049	0.196	0.442	0.001	0.001	0.002	0.002	0.003	0.004	0.005
2.6	**2.55**	0.050	0.200	0.451	0.001	0.001	0.002	0.002	0.003	0.004	0.005
2.6	**2.60**	0.051	0.204	0.459	0.001	0.001	0.002	0.003	0.003	0.004	0.005
2.7	**2.65**	0.052	0.208	0.468	0.001	0.001	0.002	0.003	0.003	0.004	0.005
2.7	**2.70**	0.053	0.212	0.477	0.001	0.001	0.002	0.003	0.003	0.004	0.005
2.8	**2.75**	0.054	0.216	0.486	0.001	0.001	0.002	0.003	0.003	0.004	0.005
2.8	**2.80**	0.055	0.220	0.495	0.001	0.001	0.002	0.003	0.004	0.004	0.005
2.9	**2.85**	0.056	0.224	0.001	0.001	0.001	0.002	0.003	0.004	0.005	0.006
2.9	**2.90**	0.057	0.228	0.001	0.001	0.001	0.002	0.003	0.004	0.005	0.006
3.0	**2.95**	0.058	0.232	0.001	0.001	0.001	0.002	0.003	0.004	0.005	0.006
3.0	**3.00**	0.059	0.236	0.001	0.001	0.001	0.002	0.003	0.004	0.005	0.006
3.1	**3.05**	0.060	0.240	0.001	0.001	0.001	0.002	0.003	0.004	0.005	0.006
3.1	**3.10**	0.061	0.243	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.006
3.2	**3.15**	0.062	0.247	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.006
3.2	**3.20**	0.063	0.251	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.006
3.3	**3.25**	0.064	0.255	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.006
3.3	**3.30**	0.065	0.259	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.006
3.4	**3.35**	0.066	0.263	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.007
3.4	**3.40**	0.067	0.267	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.007
3.5	**3.45**	0.068	0.271	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.007
3.5	**3.50**	0.069	0.275	0.001	0.001	0.002	0.002	0.003	0.004	0.006	0.007
3.6	**3.55**	0.070	0.279	0.001	0.001	0.002	0.003	0.003	0.004	0.006	0.007
3.6	**3.60**	0.071	0.283	0.001	0.001	0.002	0.003	0.003	0.005	0.006	0.007
3.7	**3.65**	0.072	0.287	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.007
3.7	**3.70**	0.073	0.291	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.007
3.8	**3.75**	0.074	0.295	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.007
3.8	**3.80**	0.075	0.298	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.007
3.9	**3.85**	0.076	0.302	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.008
3.9	**3.90**	0.077	0.306	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.008

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
4.0	**3.95**	0.078	0.310	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.008
4.0	**4.00**	0.079	0.314	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.008
4.1	**4.05**	0.080	0.318	0.001	0.001	0.002	0.003	0.004	0.005	0.006	0.008
4.1	**4.10**	0.081	0.322	0.001	0.001	0.002	0.003	0.004	0.005	0.007	0.008
4.2	**4.15**	0.081	0.326	0.001	0.001	0.002	0.003	0.004	0.005	0.007	0.008
4.2	**4.20**	0.082	0.330	0.001	0.001	0.002	0.003	0.004	0.005	0.007	0.008
4.3	**4.25**	0.083	0.334	0.001	0.001	0.002	0.003	0.004	0.005	0.007	0.008
4.3	**4.30**	0.084	0.338	0.001	0.001	0.002	0.003	0.004	0.005	0.007	0.008
4.4	**4.35**	0.085	0.342	0.001	0.001	0.002	0.003	0.004	0.005	0.007	0.009
4.4	**4.40**	0.086	0.346	0.001	0.001	0.002	0.003	0.004	0.006	0.007	0.009
4.5	**4.45**	0.087	0.350	0.001	0.001	0.002	0.003	0.004	0.006	0.007	0.009
4.5	**4.50**	0.088	0.353	0.001	0.001	0.002	0.003	0.004	0.006	0.007	0.009
4.6	**4.55**	0.089	0.357	0.001	0.001	0.002	0.003	0.004	0.006	0.007	0.009
4.6	**4.60**	0.090	0.361	0.001	0.001	0.002	0.003	0.004	0.006	0.007	0.009
4.7	**4.65**	0.091	0.365	0.001	0.001	0.002	0.003	0.004	0.006	0.007	0.009
4.7	**4.70**	0.092	0.369	0.001	0.001	0.002	0.003	0.005	0.006	0.007	0.009
4.8	**4.75**	0.093	0.373	0.001	0.001	0.002	0.003	0.005	0.006	0.008	0.009
4.8	**4.80**	0.094	0.377	0.001	0.002	0.002	0.003	0.005	0.006	0.008	0.009
4.9	**4.85**	0.095	0.381	0.001	0.002	0.002	0.003	0.005	0.006	0.008	0.010
4.9	**4.90**	0.096	0.385	0.001	0.002	0.002	0.003	0.005	0.006	0.008	0.010
5.0	**4.95**	0.097	0.389	0.001	0.002	0.002	0.003	0.005	0.006	0.008	0.010
5.0	**5.00**	0.098	0.393	0.001	0.002	0.002	0.004	0.005	0.006	0.008	0.010
5.1	**5.05**	0.099	0.397	0.001	0.002	0.002	0.004	0.005	0.006	0.008	0.010
5.1	**5.10**	0.100	0.401	0.001	0.002	0.003	0.004	0.005	0.006	0.008	0.010

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
0.1	0.05	0.119	0.141	0.166	0.192	0.221	0.251	0.284	0.318	0.354	0.393
0.1	0.10	0.238	0.283	0.332	0.385	0.442	0.001	0.001	0.001	0.001	0.001
0.2	0.15	0.356	0.424	0.498	0.000	0.001	0.001	0.001	0.001	0.001	0.001
0.2	0.20	0.475	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
0.3	0.25	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
0.3	0.30	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
0.4	0.35	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.003
0.4	0.40	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.003
0.5	0.45	0.001	0.001	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.004
0.5	0.50	0.001	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004
0.6	0.55	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004
0.6	0.60	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004	0.005
0.7	0.65	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004	0.005	0.005
0.7	0.70	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.004	0.005	0.005
0.8	0.75	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.005	0.006
0.8	0.80	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.006
0.9	0.85	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.007
0.9	0.90	0.002	0.003	0.003	0.003	0.004	0.005	0.005	0.006	0.006	0.007
1.0	0.95	0.002	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.007	0.007
1.0	1.00	0.002	0.003	0.003	0.004	0.004	0.005	0.006	0.006	0.007	0.008
1.1	1.05	0.002	0.003	0.003	0.004	0.005	0.005	0.006	0.007	0.007	0.008
1.1	1.10	0.003	0.003	0.004	0.004	0.005	0.006	0.006	0.007	0.008	0.009
1.2	1.15	0.003	0.003	0.004	0.004	0.005	0.006	0.007	0.007	0.008	0.009
1.2	1.20	0.003	0.003	0.004	0.005	0.005	0.006	0.007	0.008	0.009	0.009
1.3	1.25	0.003	0.004	0.004	0.005	0.006	0.006	0.007	0.008	0.009	0.010
1.3	1.30	0.003	0.004	0.004	0.005	0.006	0.007	0.007	0.008	0.009	0.010
1.4	1.35	0.003	0.004	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.011
1.4	1.40	0.003	0.004	0.005	0.005	0.006	0.007	0.008	0.009	0.010	0.011
1.5	1.45	0.003	0.004	0.005	0.006	0.006	0.007	0.008	0.009	0.010	0.011
1.5	1.50	0.004	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.012
1.6	1.55	0.004	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.012
1.6	1.60	0.004	0.005	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.013
1.7	1.65	0.004	0.005	0.005	0.006	0.007	0.008	0.009	0.010	0.012	0.013
1.7	1.70	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.012	0.013
1.8	1.75	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.012	0.014
1.8	1.80	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.013	0.014
1.9	1.85	0.004	0.005	0.006	0.007	0.008	0.009	0.010	0.012	0.013	0.015
1.9	1.90	0.005	0.005	0.006	0.007	0.008	0.010	0.011	0.012	0.013	0.015
2.0	1.95	0.005	0.006	0.006	0.008	0.009	0.010	0.011	0.012	0.014	0.015

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
2.0	**2.00**	0.005	0.006	0.007	0.008	0.009	0.010	0.011	0.013	0.014	0.016
2.1	**2.05**	0.005	0.006	0.007	0.008	0.009	0.010	0.012	0.013	0.015	0.016
2.1	**2.10**	0.005	0.006	0.007	0.008	0.009	0.011	0.012	0.013	0.015	0.016
2.2	**2.15**	0.005	0.006	0.007	0.008	0.009	0.011	0.012	0.014	0.015	0.017
2.2	**2.20**	0.005	0.006	0.007	0.008	0.010	0.011	0.012	0.014	0.016	0.017
2.3	**2.25**	0.005	0.006	0.007	0.009	0.010	0.011	0.013	0.014	0.016	0.018
2.3	**2.30**	0.005	0.007	0.008	0.009	0.010	0.012	0.013	0.015	0.016	0.018
2.4	**2.35**	0.006	0.007	0.008	0.009	0.010	0.012	0.013	0.015	0.017	0.018
2.4	**2.40**	0.006	0.007	0.008	0.009	0.011	0.012	0.014	0.015	0.017	0.019
2.5	**2.45**	0.006	0.007	0.008	0.009	0.011	0.012	0.014	0.016	0.017	0.019
2.5	**2.50**	0.006	0.007	0.008	0.010	0.011	0.013	0.014	0.016	0.018	0.020
2.6	**2.55**	0.006	0.007	0.008	0.010	0.011	0.013	0.014	0.016	0.018	0.020
2.6	**2.60**	0.006	0.007	0.009	0.010	0.011	0.013	0.015	0.017	0.018	0.020
2.7	**2.65**	0.006	0.007	0.009	0.010	0.012	0.013	0.015	0.017	0.019	0.021
2.7	**2.70**	0.006	0.008	0.009	0.010	0.012	0.014	0.015	0.017	0.019	0.021
2.8	**2.75**	0.007	0.008	0.009	0.011	0.012	0.014	0.016	0.017	0.019	0.022
2.8	**2.80**	0.007	0.008	0.009	0.011	0.012	0.014	0.016	0.018	0.020	0.022
2.9	**2.85**	0.007	0.008	0.009	0.011	0.013	0.014	0.016	0.018	0.020	0.022
2.9	**2.90**	0.007	0.008	0.010	0.011	0.013	0.015	0.016	0.018	0.021	0.023
3.0	**2.95**	0.007	0.008	0.010	0.011	0.013	0.015	0.017	0.019	0.021	0.023
3.0	**3.00**	0.007	0.008	0.010	0.012	0.013	0.015	0.017	0.019	0.021	0.024
3.1	**3.05**	0.007	0.009	0.010	0.012	0.013	0.015	0.017	0.019	0.022	0.024
3.1	**3.10**	0.007	0.009	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024
3.2	**3.15**	0.007	0.009	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.025
3.2	**3.20**	0.008	0.009	0.011	0.012	0.014	0.016	0.018	0.020	0.023	0.025
3.3	**3.25**	0.008	0.009	0.011	0.013	0.014	0.016	0.018	0.021	0.023	0.026
3.3	**3.30**	0.008	0.009	0.011	0.013	0.015	0.017	0.019	0.021	0.023	0.026
3.4	**3.35**	0.008	0.009	0.011	0.013	0.015	0.017	0.019	0.021	0.024	0.026
3.4	**3.40**	0.008	0.010	0.011	0.013	0.015	0.017	0.019	0.022	0.024	0.027
3.5	**3.45**	0.008	0.010	0.011	0.013	0.015	0.017	0.020	0.022	0.024	0.027
3.5	**3.50**	0.008	0.010	0.012	0.013	0.015	0.018	0.020	0.022	0.025	0.027
3.6	**3.55**	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.023	0.025	0.028
3.6	**3.60**	0.009	0.010	0.012	0.014	0.016	0.018	0.020	0.023	0.026	0.028
3.7	**3.65**	0.009	0.010	0.012	0.014	0.016	0.018	0.021	0.023	0.026	0.029
3.7	**3.70**	0.009	0.010	0.012	0.014	0.016	0.019	0.021	0.024	0.026	0.029
3.8	**3.75**	0.009	0.011	0.012	0.014	0.017	0.019	0.021	0.024	0.027	0.029
3.8	**3.80**	0.009	0.011	0.013	0.015	0.017	0.019	0.022	0.024	0.027	0.030
3.9	**3.85**	0.009	0.011	0.013	0.015	0.017	0.019	0.022	0.024	0.027	0.030
3.9	**3.90**	0.009	0.011	0.013	0.015	0.017	0.020	0.022	0.025	0.028	0.031

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
4.0	**3.95**	0.009	0.011	0.013	0.015	0.017	0.020	0.022	0.025	0.028	0.031
4.0	**4.00**	0.010	0.011	0.013	0.015	0.018	0.020	0.023	0.025	0.028	0.031
4.1	**4.05**	0.010	0.011	0.013	0.016	0.018	0.020	0.023	0.026	0.029	0.032
4.1	**4.10**	0.010	0.012	0.014	0.016	0.018	0.021	0.023	0.026	0.029	0.032
4.2	**4.15**	0.010	0.012	0.014	0.016	0.018	0.021	0.024	0.026	0.029	0.033
4.2	**4.20**	0.010	0.012	0.014	0.016	0.019	0.021	0.024	0.027	0.030	0.033
4.3	**4.25**	0.010	0.012	0.014	0.016	0.019	0.021	0.024	0.027	0.030	0.033
4.3	**4.30**	0.010	0.012	0.014	0.017	0.019	0.022	0.024	0.027	0.030	0.034
4.4	**4.35**	0.010	0.012	0.014	0.017	0.019	0.022	0.025	0.028	0.031	0.034
4.4	**4.40**	0.010	0.012	0.015	0.017	0.019	0.022	0.025	0.028	0.031	0.035
4.5	**4.45**	0.011	0.013	0.015	0.017	0.020	0.022	0.025	0.028	0.032	0.035
4.5	**4.50**	0.011	0.013	0.015	0.017	0.020	0.023	0.026	0.029	0.032	0.035
4.6	**4.55**	0.011	0.013	0.015	0.018	0.020	0.023	0.026	0.029	0.032	0.036
4.6	**4.60**	0.011	0.013	0.015	0.018	0.020	0.023	0.026	0.029	0.033	0.036
4.7	**4.65**	0.011	0.013	0.015	0.018	0.021	0.023	0.026	0.030	0.033	0.037
4.7	**4.70**	0.011	0.013	0.016	0.018	0.021	0.024	0.027	0.030	0.033	0.037
4.8	**4.75**	0.011	0.013	0.016	0.018	0.021	0.024	0.027	0.030	0.034	0.037
4.8	**4.80**	0.011	0.014	0.016	0.018	0.021	0.024	0.027	0.031	0.034	0.038
4.9	**4.85**	0.012	0.014	0.016	0.019	0.021	0.024	0.028	0.031	0.034	0.038
4.9	**4.90**	0.012	0.014	0.016	0.019	0.022	0.025	0.028	0.031	0.035	0.038
5.0	**4.95**	0.012	0.014	0.016	0.019	0.022	0.025	0.028	0.031	0.035	0.039
5.0	**5.00**	0.012	0.014	0.017	0.019	0.022	0.025	0.028	0.032	0.035	0.039
5.1	**5.05**	0.012	0.014	0.017	0.019	0.022	0.025	0.029	0.032	0.036	0.040
5.1	**5.10**	0.012	0.014	0.017	0.020	0.023	0.026	0.029	0.032	0.036	0.040

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15
0.1	0.05	0.433	0.475	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
0.1	0.10	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
0.2	0.15	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
0.2	0.20	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.004
0.3	0.25	0.002	0.002	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004
0.3	0.30	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.005
0.4	0.35	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.005	0.006	0.006
0.4	0.40	0.003	0.004	0.004	0.005	0.005	0.005	0.006	0.006	0.007	0.007
0.5	0.45	0.004	0.004	0.005	0.005	0.006	0.006	0.006	0.007	0.007	0.008
0.5	0.50	0.004	0.005	0.005	0.006	0.006	0.007	0.007	0.008	0.008	0.009
0.6	0.55	0.005	0.005	0.006	0.006	0.007	0.007	0.008	0.008	0.009	0.010
0.6	0.60	0.005	0.006	0.006	0.007	0.007	0.008	0.009	0.009	0.010	0.011
0.7	0.65	0.006	0.006	0.007	0.007	0.008	0.009	0.009	0.010	0.011	0.011
0.7	0.70	0.006	0.007	0.007	0.008	0.009	0.009	0.010	0.011	0.012	0.012
0.8	0.75	0.006	0.007	0.008	0.008	0.009	0.010	0.011	0.012	0.012	0.013
0.8	0.80	0.007	0.008	0.008	0.009	0.010	0.011	0.011	0.012	0.013	0.014
0.9	0.85	0.007	0.008	0.009	0.010	0.010	0.011	0.012	0.013	0.014	0.015
0.9	0.90	0.008	0.009	0.009	0.010	0.011	0.012	0.013	0.014	0.015	0.016
1.0	0.95	0.008	0.009	0.010	0.011	0.012	0.013	0.014	0.015	0.016	0.017
1.0	1.00	0.009	0.010	0.010	0.011	0.012	0.013	0.014	0.015	0.017	0.018
1.1	1.05	0.009	0.010	0.011	0.012	0.013	0.014	0.015	0.016	0.017	0.019
1.1	1.10	0.010	0.010	0.011	0.012	0.013	0.015	0.016	0.017	0.018	0.019
1.2	1.15	0.010	0.011	0.012	0.013	0.014	0.015	0.016	0.018	0.019	0.020
1.2	1.20	0.010	0.011	0.012	0.014	0.015	0.016	0.017	0.018	0.020	0.021
1.3	1.25	0.011	0.012	0.013	0.014	0.015	0.017	0.018	0.019	0.021	0.022
1.3	1.30	0.011	0.012	0.014	0.015	0.016	0.017	0.019	0.020	0.021	0.023
1.4	1.35	0.012	0.013	0.014	0.015	0.017	0.018	0.019	0.021	0.022	0.024
1.4	1.40	0.012	0.013	0.015	0.016	0.017	0.019	0.020	0.022	0.023	0.025
1.5	1.45	0.013	0.014	0.015	0.016	0.018	0.019	0.021	0.022	0.024	0.026
1.5	1.50	0.013	0.014	0.016	0.017	0.018	0.020	0.021	0.023	0.025	0.027
1.6	1.55	0.013	0.015	0.016	0.018	0.019	0.021	0.022	0.024	0.026	0.027
1.6	1.60	0.014	0.015	0.017	0.018	0.020	0.021	0.023	0.025	0.026	0.028
1.7	1.65	0.014	0.016	0.017	0.019	0.020	0.022	0.024	0.025	0.027	0.029
1.7	1.70	0.015	0.016	0.018	0.019	0.021	0.023	0.024	0.026	0.028	0.030
1.8	1.75	0.015	0.017	0.018	0.020	0.021	0.023	0.025	0.027	0.029	0.031
1.8	1.80	0.016	0.017	0.019	0.020	0.022	0.024	0.026	0.028	0.030	0.032
1.9	1.85	0.016	0.018	0.019	0.021	0.023	0.025	0.026	0.028	0.031	0.033
1.9	1.90	0.016	0.018	0.020	0.021	0.023	0.025	0.027	0.029	0.031	0.034
2.0	1.95	0.017	0.019	0.020	0.022	0.024	0.026	0.028	0.030	0.032	0.034

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15
2.0	**2.00**	0.017	0.019	0.021	0.023	0.025	0.027	0.029	0.031	0.033	0.035
2.1	**2.05**	0.018	0.019	0.021	0.023	0.025	0.027	0.029	0.032	0.034	0.036
2.1	**2.10**	0.018	0.020	0.022	0.024	0.026	0.028	0.030	0.032	0.035	0.037
2.2	**2.15**	0.019	0.020	0.022	0.024	0.026	0.029	0.031	0.033	0.036	0.038
2.2	**2.20**	0.019	0.021	0.023	0.025	0.027	0.029	0.031	0.034	0.036	0.039
2.3	**2.25**	0.019	0.021	0.023	0.025	0.028	0.030	0.032	0.035	0.037	0.040
2.3	**2.30**	0.020	0.022	0.024	0.026	0.028	0.031	0.033	0.035	0.038	0.041
2.4	**2.35**	0.020	0.022	0.024	0.027	0.029	0.031	0.034	0.036	0.039	0.042
2.4	**2.40**	0.021	0.023	0.025	0.027	0.029	0.032	0.034	0.037	0.040	0.042
2.5	**2.45**	0.021	0.023	0.025	0.028	0.030	0.033	0.035	0.038	0.040	0.043
2.5	**2.50**	0.022	0.024	0.026	0.028	0.031	0.033	0.036	0.038	0.041	0.044
2.6	**2.55**	0.022	0.024	0.026	0.029	0.031	0.034	0.037	0.039	0.042	0.045
2.6	**2.60**	0.023	0.025	0.027	0.029	0.032	0.035	0.037	0.040	0.043	0.046
2.7	**2.65**	0.023	0.025	0.028	0.030	0.033	0.035	0.038	0.041	0.044	0.047
2.7	**2.70**	0.023	0.026	0.028	0.031	0.033	0.036	0.039	0.042	0.045	0.048
2.8	**2.75**	0.024	0.026	0.029	0.031	0.034	0.037	0.039	0.042	0.045	0.049
2.8	**2.80**	0.024	0.027	0.029	0.032	0.034	0.037	0.040	0.043	0.046	0.049
2.9	**2.85**	0.025	0.027	0.030	0.032	0.035	0.038	0.041	0.044	0.047	0.050
2.9	**2.90**	0.025	0.028	0.030	0.033	0.036	0.038	0.042	0.045	0.048	0.051
3.0	**2.95**	0.026	0.028	0.031	0.033	0.036	0.039	0.042	0.045	0.049	0.052
3.0	**3.00**	0.026	0.029	0.031	0.034	0.037	0.040	0.043	0.046	0.050	0.053
3.1	**3.05**	0.026	0.029	0.032	0.034	0.037	0.040	0.044	0.047	0.050	0.054
3.1	**3.10**	0.027	0.029	0.032	0.035	0.038	0.041	0.044	0.048	0.051	0.055
3.2	**3.15**	0.027	0.030	0.033	0.036	0.039	0.042	0.045	0.048	0.052	0.056
3.2	**3.20**	0.028	0.030	0.033	0.036	0.039	0.042	0.046	0.049	0.053	0.057
3.3	**3.25**	0.028	0.031	0.034	0.037	0.040	0.043	0.047	0.050	0.054	0.057
3.3	**3.30**	0.029	0.031	0.034	0.037	0.040	0.044	0.047	0.051	0.054	0.058
3.4	**3.35**	0.029	0.032	0.035	0.038	0.041	0.044	0.048	0.052	0.055	0.059
3.4	**3.40**	0.029	0.032	0.035	0.038	0.042	0.045	0.049	0.052	0.056	0.060
3.5	**3.45**	0.030	0.033	0.036	0.039	0.042	0.046	0.049	0.053	0.057	0.061
3.5	**3.50**	0.030	0.033	0.036	0.040	0.043	0.046	0.050	0.054	0.058	0.062
3.6	**3.55**	0.031	0.034	0.037	0.040	0.044	0.047	0.051	0.055	0.059	0.063
3.6	**3.60**	0.031	0.034	0.037	0.041	0.044	0.048	0.052	0.055	0.059	0.064
3.7	**3.65**	0.032	0.035	0.038	0.041	0.045	0.048	0.052	0.056	0.060	0.065
3.7	**3.70**	0.032	0.035	0.038	0.042	0.045	0.049	0.053	0.057	0.061	0.065
3.8	**3.75**	0.032	0.036	0.039	0.042	0.046	0.050	0.054	0.058	0.062	0.066
3.8	**3.80**	0.033	0.036	0.039	0.043	0.047	0.050	0.054	0.058	0.063	0.067
3.9	**3.85**	0.033	0.037	0.040	0.044	0.047	0.051	0.055	0.059	0.064	0.068
3.9	**3.90**	0.034	0.037	0.041	0.044	0.048	0.052	0.056	0.060	0.064	0.069

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		10.5	11	11.5	12	12.5	13	13.5	14	14.5	15
Length Class	**Midpoints**										
4.0	**3.95**	0.034	0.038	0.041	0.045	0.048	0.052	0.057	0.061	0.065	0.070
4.0	**4.00**	0.035	0.038	0.042	0.045	0.049	0.053	0.057	0.062	0.066	0.071
4.1	**4.05**	0.035	0.038	0.042	0.046	0.050	0.054	0.058	0.062	0.067	0.072
4.1	**4.10**	0.036	0.039	0.043	0.046	0.050	0.054	0.059	0.063	0.068	0.072
4.2	**4.15**	0.036	0.039	0.043	0.047	0.051	0.055	0.059	0.064	0.069	0.073
4.2	**4.20**	0.036	0.040	0.044	0.048	0.052	0.056	0.060	0.065	0.069	0.074
4.3	**4.25**	0.037	0.040	0.044	0.048	0.052	0.056	0.061	0.065	0.070	0.075
4.3	**4.30**	0.037	0.041	0.045	0.049	0.053	0.057	0.062	0.066	0.071	0.076
4.4	**4.35**	0.038	0.041	0.045	0.049	0.053	0.058	0.062	0.067	0.072	0.077
4.4	**4.40**	0.038	0.042	0.046	0.050	0.054	0.058	0.063	0.068	0.073	0.078
4.5	**4.45**	0.039	0.042	0.046	0.050	0.055	0.059	0.064	0.069	0.073	0.079
4.5	**4.50**	0.039	0.043	0.047	0.051	0.055	0.060	0.064	0.069	0.074	0.080
4.6	**4.55**	0.039	0.043	0.047	0.051	0.056	0.060	0.065	0.070	0.075	0.080
4.6	**4.60**	0.040	0.044	0.048	0.052	0.056	0.061	0.066	0.071	0.076	0.081
4.7	**4.65**	0.040	0.044	0.048	0.053	0.057	0.062	0.067	0.072	0.077	0.082
4.7	**4.70**	0.041	0.045	0.049	0.053	0.058	0.062	0.067	0.072	0.078	0.083
4.8	**4.75**	0.041	0.045	0.049	0.054	0.058	0.063	0.068	0.073	0.078	0.084
4.8	**4.80**	0.042	0.046	0.050	0.054	0.059	0.064	0.069	0.074	0.079	0.085
4.9	**4.85**	0.042	0.046	0.050	0.055	0.060	0.064	0.069	0.075	0.080	0.086
4.9	**4.90**	0.042	0.047	0.051	0.055	0.060	0.065	0.070	0.075	0.081	0.087
5.0	**4.95**	0.043	0.047	0.051	0.056	0.061	0.066	0.071	0.076	0.082	0.087
5.0	**5.00**	0.043	0.048	0.052	0.057	0.061	0.066	0.072	0.077	0.083	0.088
5.1	**5.05**	0.044	0.048	0.052	0.057	0.062	0.067	0.072	0.078	0.083	0.089
5.1	**5.10**	0.044	0.048	0.053	0.058	0.063	0.068	0.073	0.079	0.084	0.090

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20
0.1	**0.05**	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
0.1	**0.10**	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.003	0.003	0.003
0.2	**0.15**	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.005
0.2	**0.20**	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.006	0.006	0.006
0.3	**0.25**	0.005	0.005	0.005	0.006	0.006	0.007	0.006	0.007	0.007	0.008
0.3	**0.30**	0.006	0.006	0.006	0.007	0.007	0.008	0.007	0.009	0.009	0.009
0.4	**0.35**	0.007	0.007	0.007	0.008	0.008	0.009	0.009	0.010	0.010	0.011
0.4	**0.40**	0.008	0.008	0.009	0.009	0.010	0.011	0.010	0.011	0.012	0.013
0.5	**0.45**	0.008	0.009	0.010	0.010	0.011	0.012	0.011	0.013	0.013	0.014
0.5	**0.50**	0.009	0.010	0.011	0.011	0.012	0.013	0.012	0.014	0.015	0.016
0.6	**0.55**	0.010	0.011	0.012	0.012	0.013	0.015	0.014	0.016	0.016	0.017
0.6	**0.60**	0.011	0.012	0.013	0.014	0.014	0.016	0.015	0.017	0.018	0.019
0.7	**0.65**	0.012	0.013	0.014	0.015	0.016	0.017	0.016	0.018	0.019	0.020
0.7	**0.70**	0.013	0.014	0.015	0.016	0.017	0.019	0.017	0.020	0.021	0.022
0.8	**0.75**	0.014	0.015	0.016	0.017	0.018	0.020	0.019	0.021	0.022	0.024
0.8	**0.80**	0.015	0.016	0.017	0.018	0.019	0.022	0.020	0.023	0.024	0.025
0.9	**0.85**	0.016	0.017	0.018	0.019	0.020	0.023	0.021	0.024	0.025	0.027
0.9	**0.90**	0.017	0.018	0.019	0.020	0.022	0.024	0.022	0.026	0.027	0.028
1.0	**0.95**	0.018	0.019	0.020	0.022	0.023	0.026	0.024	0.027	0.028	0.030
1.0	**1.00**	0.019	0.020	0.021	0.023	0.024	0.027	0.025	0.028	0.030	0.031
1.1	**1.05**	0.020	0.021	0.022	0.024	0.025	0.028	0.026	0.030	0.031	0.033
1.1	**1.10**	0.021	0.022	0.024	0.025	0.026	0.030	0.027	0.031	0.033	0.035
1.2	**1.15**	0.022	0.023	0.025	0.026	0.028	0.031	0.029	0.033	0.034	0.036
1.2	**1.20**	0.023	0.024	0.026	0.027	0.029	0.032	0.030	0.034	0.036	0.038
1.3	**1.25**	0.024	0.025	0.027	0.028	0.030	0.034	0.031	0.035	0.037	0.039
1.3	**1.30**	0.025	0.026	0.028	0.030	0.031	0.035	0.032	0.037	0.039	0.041
1.4	**1.35**	0.025	0.027	0.029	0.031	0.032	0.036	0.034	0.038	0.040	0.042
1.4	**1.40**	0.026	0.028	0.030	0.032	0.034	0.038	0.035	0.040	0.042	0.044
1.5	**1.45**	0.027	0.029	0.031	0.033	0.035	0.039	0.036	0.041	0.043	0.046
1.5	**1.50**	0.028	0.030	0.032	0.034	0.036	0.040	0.037	0.043	0.045	0.047
1.6	**1.55**	0.029	0.031	0.033	0.035	0.037	0.042	0.039	0.044	0.046	0.049
1.6	**1.60**	0.030	0.032	0.034	0.036	0.038	0.043	0.040	0.045	0.048	0.050
1.7	**1.65**	0.031	0.033	0.035	0.037	0.040	0.044	0.041	0.047	0.049	0.052
1.7	**1.70**	0.032	0.034	0.036	0.039	0.041	0.046	0.042	0.048	0.051	0.053
1.8	**1.75**	0.033	0.035	0.037	0.040	0.042	0.047	0.044	0.050	0.052	0.055
1.8	**1.80**	0.034	0.036	0.038	0.041	0.043	0.048	0.045	0.051	0.054	0.057
1.9	**1.85**	0.035	0.037	0.040	0.042	0.044	0.050	0.046	0.052	0.055	0.058
1.9	**1.90**	0.036	0.038	0.041	0.043	0.046	0.051	0.047	0.054	0.057	0.060
2.0	**1.95**	0.037	0.039	0.042	0.044	0.047	0.052	0.049	0.055	0.058	0.061

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20
2.0	**2.00**	0.038	0.040	0.043	0.045	0.048	0.051	0.054	0.057	0.060	0.063
2.1	**2.05**	0.039	0.041	0.044	0.047	0.049	0.052	0.055	0.058	0.061	0.064
2.1	**2.10**	0.040	0.042	0.045	0.048	0.051	0.053	0.056	0.060	0.063	0.066
2.2	**2.15**	0.041	0.043	0.046	0.049	0.052	0.055	0.058	0.061	0.064	0.068
2.2	**2.20**	0.042	0.044	0.047	0.050	0.053	0.056	0.059	0.062	0.066	0.069
2.3	**2.25**	0.042	0.045	0.048	0.051	0.054	0.057	0.060	0.064	0.067	0.071
2.3	**2.30**	0.043	0.046	0.049	0.052	0.055	0.059	0.062	0.065	0.069	0.072
2.4	**2.35**	0.044	0.047	0.050	0.053	0.057	0.060	0.063	0.067	0.070	0.074
2.4	**2.40**	0.045	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.072	0.075
2.5	**2.45**	0.046	0.049	0.052	0.056	0.059	0.062	0.066	0.069	0.073	0.077
2.5	**2.50**	0.047	0.050	0.053	0.057	0.060	0.064	0.067	0.071	0.075	0.079
2.6	**2.55**	0.048	0.051	0.055	0.058	0.061	0.065	0.069	0.072	0.076	0.080
2.6	**2.60**	0.049	0.052	0.056	0.059	0.063	0.066	0.070	0.074	0.078	0.082
2.7	**2.65**	0.050	0.053	0.057	0.060	0.064	0.067	0.071	0.075	0.079	0.083
2.7	**2.70**	0.051	0.054	0.058	0.061	0.065	0.069	0.073	0.077	0.081	0.085
2.8	**2.75**	0.052	0.055	0.059	0.062	0.066	0.070	0.074	0.078	0.082	0.086
2.8	**2.80**	0.053	0.056	0.060	0.064	0.067	0.071	0.075	0.079	0.084	0.088
2.9	**2.85**	0.054	0.057	0.061	0.065	0.069	0.073	0.077	0.081	0.085	0.090
2.9	**2.90**	0.055	0.058	0.062	0.066	0.070	0.074	0.078	0.082	0.087	0.091
3.0	**2.95**	0.056	0.059	0.063	0.067	0.071	0.075	0.079	0.084	0.088	0.093
3.0	**3.00**	0.057	0.060	0.064	0.068	0.072	0.076	0.081	0.085	0.090	0.094
3.1	**3.05**	0.058	0.061	0.065	0.069	0.073	0.078	0.082	0.086	0.091	0.096
3.1	**3.10**	0.058	0.062	0.066	0.070	0.075	0.079	0.083	0.088	0.093	0.097
3.2	**3.15**	0.059	0.063	0.067	0.071	0.076	0.080	0.085	0.089	0.094	0.099
3.2	**3.20**	0.060	0.064	0.068	0.073	0.077	0.081	0.086	0.091	0.096	0.101
3.3	**3.25**	0.061	0.065	0.069	0.074	0.078	0.083	0.087	0.092	0.097	0.102
3.3	**3.30**	0.062	0.066	0.071	0.075	0.079	0.084	0.089	0.094	0.099	0.104
3.4	**3.35**	0.063	0.067	0.072	0.076	0.081	0.085	0.090	0.095	0.100	0.105
3.4	**3.40**	0.064	0.068	0.073	0.077	0.082	0.087	0.091	0.096	0.102	0.107
3.5	**3.45**	0.065	0.069	0.074	0.078	0.083	0.088	0.093	0.098	0.103	0.108
3.5	**3.50**	0.066	0.070	0.075	0.079	0.084	0.089	0.094	0.099	0.105	0.110
3.6	**3.55**	0.067	0.071	0.076	0.081	0.085	0.090	0.095	0.101	0.106	0.112
3.6	**3.60**	0.068	0.072	0.077	0.082	0.087	0.092	0.097	0.102	0.108	0.113
3.7	**3.65**	0.069	0.073	0.078	0.083	0.088	0.093	0.098	0.103	0.109	0.115
3.7	**3.70**	0.070	0.074	0.079	0.084	0.089	0.094	0.099	0.105	0.110	0.116
3.8	**3.75**	0.071	0.075	0.080	0.085	0.090	0.095	0.101	0.106	0.112	0.118
3.8	**3.80**	0.072	0.076	0.081	0.086	0.091	0.097	0.102	0.108	0.113	0.119
3.9	**3.85**	0.073	0.077	0.082	0.087	0.093	0.098	0.103	0.109	0.115	0.121
3.9	**3.90**	0.074	0.078	0.083	0.089	0.094	0.099	0.105	0.111	0.116	0.123

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		15.5	16	16.5	17	17.5	18	18.5	19	19.5	20
Length											
Class Midpoints											
4.0	**3.95**	0.075	0.079	0.084	0.090	0.095	0.101	0.106	0.112	0.118	0.124
4.0	**4.00**	0.075	0.080	0.086	0.091	0.096	0.102	0.108	0.113	0.119	0.126
4.1	**4.05**	0.076	0.081	0.087	0.092	0.097	0.103	0.109	0.115	0.121	0.127
4.1	**4.10**	0.077	0.082	0.088	0.093	0.099	0.104	0.110	0.116	0.122	0.129
4.2	**4.15**	0.078	0.083	0.089	0.094	0.100	0.106	0.112	0.118	0.124	0.130
4.2	**4.20**	0.079	0.084	0.090	0.095	0.101	0.107	0.113	0.119	0.125	0.132
4.3	**4.25**	0.080	0.085	0.091	0.096	0.102	0.108	0.114	0.120	0.127	0.134
4.3	**4.30**	0.081	0.086	0.092	0.098	0.103	0.109	0.116	0.122	0.128	0.135
4.4	**4.35**	0.082	0.087	0.093	0.099	0.105	0.111	0.117	0.123	0.130	0.137
4.4	**4.40**	0.083	0.088	0.094	0.100	0.106	0.112	0.118	0.125	0.131	0.138
4.5	**4.45**	0.084	0.089	0.095	0.101	0.107	0.113	0.120	0.126	0.133	0.140
4.5	**4.50**	0.085	0.090	0.096	0.102	0.108	0.115	0.121	0.128	0.134	0.141
4.6	**4.55**	0.086	0.091	0.097	0.103	0.109	0.116	0.122	0.129	0.136	0.143
4.6	**4.60**	0.087	0.092	0.098	0.104	0.111	0.117	0.124	0.130	0.137	0.145
4.7	**4.65**	0.088	0.093	0.099	0.106	0.112	0.118	0.125	0.132	0.139	0.146
4.7	**4.70**	0.089	0.094	0.100	0.107	0.113	0.120	0.126	0.133	0.140	0.148
4.8	**4.75**	0.090	0.096	0.102	0.108	0.114	0.121	0.128	0.135	0.142	0.149
4.8	**4.80**	0.091	0.097	0.103	0.109	0.115	0.122	0.129	0.136	0.143	0.151
4.9	**4.85**	0.092	0.098	0.104	0.110	0.117	0.123	0.130	0.138	0.145	0.152
4.9	**4.90**	0.092	0.099	0.105	0.111	0.118	0.125	0.132	0.139	0.146	0.154
5.0	**4.95**	0.093	0.100	0.106	0.112	0.119	0.126	0.133	0.140	0.148	0.156
5.0	**5.00**	0.094	0.101	0.107	0.113	0.120	0.127	0.134	0.142	0.149	0.157
5.1	**5.05**	0.095	0.102	0.108	0.115	0.121	0.129	0.136	0.143	0.151	0.159
5.1	**5.10**	0.096	0.103	0.109	0.116	0.123	0.130	0.137	0.145	0.152	0.160

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25
0.1	**0.05**	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
0.1	**0.10**	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005
0.2	**0.15**	0.005	0.005	0.005	0.006	0.006	0.006	0.007	0.007	0.007	0.007
0.2	**0.20**	0.007	0.007	0.007	0.008	0.008	0.008	0.009	0.009	0.009	0.010
0.3	**0.25**	0.008	0.009	0.009	0.010	0.010	0.010	0.011	0.011	0.012	0.012
0.3	**0.30**	0.010	0.010	0.011	0.011	0.012	0.012	0.013	0.014	0.014	0.015
0.4	**0.35**	0.012	0.012	0.013	0.013	0.014	0.015	0.015	0.016	0.017	0.017
0.4	**0.40**	0.013	0.014	0.015	0.015	0.016	0.017	0.017	0.018	0.019	0.020
0.5	**0.45**	0.015	0.016	0.016	0.017	0.018	0.019	0.020	0.020	0.021	0.022
0.5	**0.50**	0.017	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025
0.6	**0.55**	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027
0.6	**0.60**	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029
0.7	**0.65**	0.021	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.031	0.032
0.7	**0.70**	0.023	0.024	0.025	0.027	0.028	0.029	0.030	0.032	0.033	0.034
0.8	**0.75**	0.025	0.026	0.027	0.029	0.030	0.031	0.033	0.034	0.035	0.037
0.8	**0.80**	0.026	0.028	0.029	0.030	0.032	0.033	0.035	0.036	0.038	0.039
0.9	**0.85**	0.028	0.029	0.031	0.032	0.034	0.035	0.037	0.038	0.040	0.042
0.9	**0.90**	0.030	0.031	0.033	0.034	0.036	0.037	0.039	0.041	0.042	0.044
1.0	**0.95**	0.031	0.033	0.034	0.036	0.038	0.039	0.041	0.043	0.045	0.047
1.0	**1.00**	0.033	0.035	0.036	0.038	0.040	0.042	0.043	0.045	0.047	0.049
1.1	**1.05**	0.035	0.036	0.038	0.040	0.042	0.044	0.046	0.048	0.050	0.052
1.1	**1.10**	0.036	0.038	0.040	0.042	0.044	0.046	0.048	0.050	0.052	0.054
1.2	**1.15**	0.038	0.040	0.042	0.044	0.046	0.048	0.050	0.052	0.054	0.056
1.2	**1.20**	0.040	0.042	0.044	0.046	0.048	0.050	0.052	0.054	0.057	0.059
1.3	**1.25**	0.041	0.043	0.045	0.048	0.050	0.052	0.054	0.057	0.059	0.061
1.3	**1.30**	0.043	0.045	0.047	0.049	0.052	0.054	0.056	0.059	0.061	0.064
1.4	**1.35**	0.045	0.047	0.049	0.051	0.054	0.056	0.059	0.061	0.064	0.066
1.4	**1.40**	0.046	0.048	0.051	0.053	0.056	0.058	0.061	0.063	0.066	0.069
1.5	**1.45**	0.048	0.050	0.053	0.055	0.058	0.060	0.063	0.066	0.068	0.071
1.5	**1.50**	0.050	0.052	0.054	0.057	0.060	0.062	0.065	0.068	0.071	0.074
1.6	**1.55**	0.051	0.054	0.056	0.059	0.062	0.064	0.067	0.070	0.073	0.076
1.6	**1.60**	0.053	0.055	0.058	0.061	0.064	0.066	0.069	0.072	0.075	0.079
1.7	**1.65**	0.054	0.057	0.060	0.063	0.066	0.069	0.072	0.075	0.078	0.081
1.7	**1.70**	0.056	0.059	0.062	0.065	0.068	0.071	0.074	0.077	0.080	0.083
1.8	**1.75**	0.058	0.061	0.064	0.067	0.070	0.073	0.076	0.079	0.083	0.086
1.8	**1.80**	0.059	0.062	0.065	0.068	0.072	0.075	0.078	0.081	0.085	0.088
1.9	**1.85**	0.061	0.064	0.067	0.070	0.074	0.077	0.080	0.084	0.087	0.091
1.9	**1.90**	0.063	0.066	0.069	0.072	0.076	0.079	0.082	0.086	0.090	0.093
2.0	**1.95**	0.064	0.068	0.071	0.074	0.078	0.081	0.085	0.088	0.092	0.096

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class Midpoints		20.5	21	21.5	22	22.5	23	23.5	24	24.5	25
2.0	**2.00**	0.066	0.069	0.073	0.076	0.080	0.083	0.087	0.090	0.094	0.098
2.1	**2.05**	0.068	0.071	0.074	0.078	0.082	0.085	0.089	0.093	0.097	0.101
2.1	**2.10**	0.069	0.073	0.076	0.080	0.083	0.087	0.091	0.095	0.099	0.103
2.2	**2.15**	0.071	0.074	0.078	0.082	0.085	0.089	0.093	0.097	0.101	0.106
2.2	**2.20**	0.073	0.076	0.080	0.084	0.087	0.091	0.095	0.100	0.104	0.108
2.3	**2.25**	0.074	0.078	0.082	0.086	0.089	0.093	0.098	0.102	0.106	0.110
2.3	**2.30**	0.076	0.080	0.084	0.087	0.091	0.096	0.100	0.104	0.108	0.113
2.4	**2.35**	0.078	0.081	0.085	0.089	0.093	0.098	0.102	0.106	0.111	0.115
2.4	**2.40**	0.079	0.083	0.087	0.091	0.095	0.100	0.104	0.109	0.113	0.118
2.5	**2.45**	0.081	0.085	0.089	0.093	0.097	0.102	0.106	0.111	0.116	0.120
2.5	**2.50**	0.083	0.087	0.091	0.095	0.099	0.104	0.108	0.113	0.118	0.123
2.6	**2.55**	0.084	0.088	0.093	0.097	0.101	0.106	0.111	0.115	0.120	0.125
2.6	**2.60**	0.086	0.090	0.094	0.099	0.103	0.108	0.113	0.118	0.123	0.128
2.7	**2.65**	0.087	0.092	0.096	0.101	0.105	0.110	0.115	0.120	0.125	0.130
2.7	**2.70**	0.089	0.094	0.098	0.103	0.107	0.112	0.117	0.122	0.127	0.133
2.8	**2.75**	0.091	0.095	0.100	0.105	0.109	0.114	0.119	0.124	0.130	0.135
2.8	**2.80**	0.092	0.097	0.102	0.106	0.111	0.116	0.121	0.127	0.132	0.137
2.9	**2.85**	0.094	0.099	0.103	0.108	0.113	0.118	0.124	0.129	0.134	0.140
2.9	**2.90**	0.096	0.100	0.105	0.110	0.115	0.120	0.126	0.131	0.137	0.142
3.0	**2.95**	0.097	0.102	0.107	0.112	0.117	0.123	0.128	0.133	0.139	0.145
3.0	**3.00**	0.099	0.104	0.109	0.114	0.119	0.125	0.130	0.136	0.141	0.147
3.1	**3.05**	0.101	0.106	0.111	0.116	0.121	0.127	0.132	0.138	0.144	0.150
3.1	**3.10**	0.102	0.107	0.113	0.118	0.123	0.129	0.134	0.140	0.146	0.152
3.2	**3.15**	0.104	0.109	0.114	0.120	0.125	0.131	0.137	0.143	0.149	0.155
3.2	**3.20**	0.106	0.111	0.116	0.122	0.127	0.133	0.139	0.145	0.151	0.157
3.3	**3.25**	0.107	0.113	0.118	0.124	0.129	0.135	0.141	0.147	0.153	0.160
3.3	**3.30**	0.109	0.114	0.120	0.125	0.131	0.137	0.143	0.149	0.156	0.162
3.4	**3.35**	0.111	0.116	0.122	0.127	0.133	0.139	0.145	0.152	0.158	0.164
3.4	**3.40**	0.112	0.118	0.123	0.129	0.135	0.141	0.147	0.154	0.160	0.167
3.5	**3.45**	0.114	0.119	0.125	0.131	0.137	0.143	0.150	0.156	0.163	0.169
3.5	**3.50**	0.116	0.121	0.127	0.133	0.139	0.145	0.152	0.158	0.165	0.172
3.6	**3.55**	0.117	0.123	0.129	0.135	0.141	0.147	0.154	0.161	0.167	0.174
3.6	**3.60**	0.119	0.125	0.131	0.137	0.143	0.150	0.156	0.163	0.170	0.177
3.7	**3.65**	0.120	0.126	0.133	0.139	0.145	0.152	0.158	0.165	0.172	0.179
3.7	**3.70**	0.122	0.128	0.134	0.141	0.147	0.154	0.160	0.167	0.174	0.182
3.8	**3.75**	0.124	0.130	0.136	0.143	0.149	0.156	0.163	0.170	0.177	0.184
3.8	**3.80**	0.125	0.132	0.138	0.144	0.151	0.158	0.165	0.172	0.179	0.187
3.9	**3.85**	0.127	0.133	0.140	0.146	0.153	0.160	0.167	0.174	0.182	0.189
3.9	**3.90**	0.129	0.135	0.142	0.148	0.155	0.162	0.169	0.176	0.184	0.191

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25
4.0	**3.95**	0.130	0.137	0.143	0.150	0.157	0.164	0.171	0.179	0.186	0.194
4.0	**4.00**	0.132	0.139	0.145	0.152	0.159	0.166	0.173	0.181	0.189	0.196
4.1	**4.05**	0.134	0.140	0.147	0.154	0.161	0.168	0.176	0.183	0.191	0.199
4.1	**4.10**	0.135	0.142	0.149	0.156	0.163	0.170	0.178	0.185	0.193	0.201
4.2	**4.15**	0.137	0.144	0.151	0.158	0.165	0.172	0.180	0.188	0.196	0.204
4.2	**4.20**	0.139	0.145	0.152	0.160	0.167	0.175	0.182	0.190	0.198	0.206
4.3	**4.25**	0.140	0.147	0.154	0.162	0.169	0.177	0.184	0.192	0.200	0.209
4.3	**4.30**	0.142	0.149	0.156	0.163	0.171	0.179	0.187	0.195	0.203	0.211
4.4	**4.35**	0.144	0.151	0.158	0.165	0.173	0.181	0.189	0.197	0.205	0.214
4.4	**4.40**	0.145	0.152	0.160	0.167	0.175	0.183	0.191	0.199	0.207	0.216
4.5	**4.45**	0.147	0.154	0.162	0.169	0.177	0.185	0.193	0.201	0.210	0.218
4.5	**4.50**	0.149	0.156	0.163	0.171	0.179	0.187	0.195	0.204	0.212	0.221
4.6	**4.55**	0.150	0.158	0.165	0.173	0.181	0.189	0.197	0.206	0.215	0.223
4.6	**4.60**	0.152	0.159	0.167	0.175	0.183	0.191	0.200	0.208	0.217	0.226
4.7	**4.65**	0.153	0.161	0.169	0.177	0.185	0.193	0.202	0.210	0.219	0.228
4.7	**4.70**	0.155	0.163	0.171	0.179	0.187	0.195	0.204	0.213	0.222	0.231
4.8	**4.75**	0.157	0.165	0.172	0.181	0.189	0.197	0.206	0.215	0.224	0.233
4.8	**4.80**	0.158	0.166	0.174	0.182	0.191	0.199	0.208	0.217	0.226	0.236
4.9	**4.85**	0.160	0.168	0.176	0.184	0.193	0.202	0.210	0.219	0.229	0.238
4.9	**4.90**	0.162	0.170	0.178	0.186	0.195	0.204	0.213	0.222	0.231	0.241
5.0	**4.95**	0.163	0.171	0.180	0.188	0.197	0.206	0.215	0.224	0.233	0.243
5.0	**5.00**	0.165	0.173	0.182	0.190	0.199	0.208	0.217	0.226	0.236	0.245
5.1	**5.05**	0.167	0.175	0.183	0.192	0.201	0.210	0.219	0.228	0.238	0.248
5.1	**5.10**	0.168	0.177	0.185	0.194	0.203	0.212	0.221	0.231	0.240	0.250

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	25.5	26	26.5	27	27.5	28	28.5	29	29.5	30
0.1	**0.05**	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004
0.1	**0.10**	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.007
0.2	**0.15**	0.008	0.008	0.008	0.009	0.009	0.009	0.010	0.010	0.010	0.011
0.2	**0.20**	0.010	0.011	0.011	0.011	0.012	0.012	0.013	0.013	0.014	0.014
0.3	**0.25**	0.013	0.013	0.014	0.014	0.015	0.015	0.016	0.017	0.017	0.018
0.3	**0.30**	0.015	0.016	0.017	0.017	0.018	0.018	0.019	0.020	0.021	0.021
0.4	**0.35**	0.018	0.019	0.019	0.020	0.021	0.022	0.022	0.023	0.024	0.025
0.4	**0.40**	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.026	0.027	0.028
0.5	**0.45**	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032
0.5	**0.50**	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035
0.6	**0.55**	0.028	0.029	0.030	0.031	0.033	0.034	0.035	0.036	0.038	0.039
0.6	**0.60**	0.031	0.032	0.033	0.034	0.036	0.037	0.038	0.040	0.041	0.042
0.7	**0.65**	0.033	0.035	0.036	0.037	0.039	0.040	0.041	0.043	0.044	0.046
0.7	**0.70**	0.036	0.037	0.039	0.040	0.042	0.043	0.045	0.046	0.048	0.049
0.8	**0.75**	0.038	0.040	0.041	0.043	0.045	0.046	0.048	0.050	0.051	0.053
0.8	**0.80**	0.041	0.042	0.044	0.046	0.048	0.049	0.051	0.053	0.055	0.057
0.9	**0.85**	0.043	0.045	0.047	0.049	0.050	0.052	0.054	0.056	0.058	0.060
0.9	**0.90**	0.046	0.048	0.050	0.052	0.053	0.055	0.057	0.059	0.062	0.064
1.0	**0.95**	0.049	0.050	0.052	0.054	0.056	0.058	0.061	0.063	0.065	0.067
1.0	**1.00**	0.051	0.053	0.055	0.057	0.059	0.062	0.064	0.066	0.068	0.071
1.1	**1.05**	0.054	0.056	0.058	0.060	0.062	0.065	0.067	0.069	0.072	0.074
1.1	**1.10**	0.056	0.058	0.061	0.063	0.065	0.068	0.070	0.073	0.075	0.078
1.2	**1.15**	0.059	0.061	0.063	0.066	0.068	0.071	0.073	0.076	0.079	0.081
1.2	**1.20**	0.061	0.064	0.066	0.069	0.071	0.074	0.077	0.079	0.082	0.085
1.3	**1.25**	0.064	0.066	0.069	0.072	0.074	0.077	0.080	0.083	0.085	0.088
1.3	**1.30**	0.066	0.069	0.072	0.074	0.077	0.080	0.083	0.086	0.089	0.092
1.4	**1.35**	0.069	0.072	0.074	0.077	0.080	0.083	0.086	0.089	0.092	0.095
1.4	**1.40**	0.071	0.074	0.077	0.080	0.083	0.086	0.089	0.092	0.096	0.099
1.5	**1.45**	0.074	0.077	0.080	0.083	0.086	0.089	0.093	0.096	0.099	0.102
1.5	**1.50**	0.077	0.080	0.083	0.086	0.089	0.092	0.096	0.099	0.103	0.106
1.6	**1.55**	0.079	0.082	0.085	0.089	0.092	0.095	0.099	0.102	0.106	0.110
1.6	**1.60**	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.106	0.109	0.113
1.7	**1.65**	0.084	0.088	0.091	0.094	0.098	0.102	0.105	0.109	0.113	0.117
1.7	**1.70**	0.087	0.090	0.094	0.097	0.101	0.105	0.108	0.112	0.116	0.120
1.8	**1.75**	0.089	0.093	0.097	0.100	0.104	0.108	0.112	0.116	0.120	0.124
1.8	**1.80**	0.092	0.096	0.099	0.103	0.107	0.111	0.115	0.119	0.123	0.127
1.9	**1.85**	0.094	0.098	0.102	0.106	0.110	0.114	0.118	0.122	0.126	0.131
1.9	**1.90**	0.097	0.101	0.105	0.109	0.113	0.117	0.121	0.125	0.130	0.134
2.0	**1.95**	0.100	0.104	0.108	0.112	0.116	0.120	0.124	0.129	0.133	0.138

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

		Diameter (cm)									
		25.5	**26**	**26.5**	**27**	**27.5**	**28**	**28.5**	**29**	**29.5**	**30**
Length Class Midpoints											
2.0	**2.00**	0.102	0.106	0.110	0.115	0.119	0.123	0.128	0.132	0.137	0.141
2.1	**2.05**	0.105	0.109	0.113	0.117	0.122	0.126	0.131	0.135	0.140	0.145
2.1	**2.10**	0.107	0.111	0.116	0.120	0.125	0.129	0.134	0.139	0.144	0.148
2.2	**2.15**	0.110	0.114	0.119	0.123	0.128	0.132	0.137	0.142	0.147	0.152
2.2	**2.20**	0.112	0.117	0.121	0.126	0.131	0.135	0.140	0.145	0.150	0.156
2.3	**2.25**	0.115	0.119	0.124	0.129	0.134	0.139	0.144	0.149	0.154	0.159
2.3	**2.30**	0.117	0.122	0.127	0.132	0.137	0.142	0.147	0.152	0.157	0.163
2.4	**2.35**	0.120	0.125	0.130	0.135	0.140	0.145	0.150	0.155	0.161	0.166
2.4	**2.40**	0.123	0.127	0.132	0.137	0.143	0.148	0.153	0.159	0.164	0.170
2.5	**2.45**	0.125	0.130	0.135	0.140	0.146	0.151	0.156	0.162	0.167	0.173
2.5	**2.50**	0.128	0.133	0.138	0.143	0.148	0.154	0.159	0.165	0.171	0.177
2.6	**2.55**	0.130	0.135	0.141	0.146	0.151	0.157	0.163	0.168	0.174	0.180
2.6	**2.60**	0.133	0.138	0.143	0.149	0.154	0.160	0.166	0.172	0.178	0.184
2.7	**2.65**	0.135	0.141	0.146	0.152	0.157	0.163	0.169	0.175	0.181	0.187
2.7	**2.70**	0.138	0.143	0.149	0.155	0.160	0.166	0.172	0.178	0.185	0.191
2.8	**2.75**	0.140	0.146	0.152	0.157	0.163	0.169	0.175	0.182	0.188	0.194
2.8	**2.80**	0.143	0.149	0.154	0.160	0.166	0.172	0.179	0.185	0.191	0.198
2.9	**2.85**	0.146	0.151	0.157	0.163	0.169	0.175	0.182	0.188	0.195	0.201
2.9	**2.90**	0.148	0.154	0.160	0.166	0.172	0.179	0.185	0.192	0.198	0.205
3.0	**2.95**	0.151	0.157	0.163	0.169	0.175	0.182	0.188	0.195	0.202	0.209
3.0	**3.00**	0.153	0.159	0.165	0.172	0.178	0.185	0.191	0.198	0.205	0.212
3.1	**3.05**	0.156	0.162	0.168	0.175	0.181	0.188	0.195	0.201	0.208	0.216
3.1	**3.10**	0.158	0.165	0.171	0.177	0.184	0.191	0.198	0.205	0.212	0.219
3.2	**3.15**	0.161	0.167	0.174	0.180	0.187	0.194	0.201	0.208	0.215	0.223
3.2	**3.20**	0.163	0.170	0.176	0.183	0.190	0.197	0.204	0.211	0.219	0.226
3.3	**3.25**	0.166	0.173	0.179	0.186	0.193	0.200	0.207	0.215	0.222	0.230
3.3	**3.30**	0.169	0.175	0.182	0.189	0.196	0.203	0.211	0.218	0.226	0.233
3.4	**3.35**	0.171	0.178	0.185	0.192	0.199	0.206	0.214	0.221	0.229	0.237
3.4	**3.40**	0.174	0.181	0.188	0.195	0.202	0.209	0.217	0.225	0.232	0.240
3.5	**3.45**	0.176	0.183	0.190	0.198	0.205	0.212	0.220	0.228	0.236	0.244
3.5	**3.50**	0.179	0.186	0.193	0.200	0.208	0.216	0.223	0.231	0.239	0.247
3.6	**3.55**	0.181	0.188	0.196	0.203	0.211	0.219	0.226	0.234	0.243	0.251
3.6	**3.60**	0.184	0.191	0.199	0.206	0.214	0.222	0.230	0.238	0.246	0.254
3.7	**3.65**	0.186	0.194	0.201	0.209	0.217	0.225	0.233	0.241	0.249	0.258
3.7	**3.70**	0.189	0.196	0.204	0.212	0.220	0.228	0.236	0.244	0.253	0.262
3.8	**3.75**	0.192	0.199	0.207	0.215	0.223	0.231	0.239	0.248	0.256	0.265
3.8	**3.80**	0.194	0.202	0.210	0.218	0.226	0.234	0.242	0.251	0.260	0.269
3.9	**3.85**	0.197	0.204	0.212	0.220	0.229	0.237	0.246	0.254	0.263	0.272
3.9	**3.90**	0.199	0.207	0.215	0.223	0.232	0.240	0.249	0.258	0.267	0.276

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		25.5	26	26.5	27	27.5	28	28.5	29	29.5	30
Length											
Class	**Midpoints**										
4.0	**3.95**	0.202	0.210	0.218	0.226	0.235	0.243	0.252	0.261	0.270	0.279
4.0	**4.00**	0.204	0.212	0.221	0.229	0.238	0.246	0.255	0.264	0.273	0.283
4.1	**4.05**	0.207	0.215	0.223	0.232	0.241	0.249	0.258	0.268	0.277	0.286
4.1	**4.10**	0.209	0.218	0.226	0.235	0.244	0.252	0.262	0.271	0.280	0.290
4.2	**4.15**	0.212	0.220	0.229	0.238	0.246	0.256	0.265	0.274	0.284	0.293
4.2	**4.20**	0.214	0.223	0.232	0.240	0.249	0.259	0.268	0.277	0.287	0.297
4.3	**4.25**	0.217	0.226	0.234	0.243	0.252	0.262	0.271	0.281	0.290	0.300
4.3	**4.30**	0.220	0.228	0.237	0.246	0.255	0.265	0.274	0.284	0.294	0.304
4.4	**4.35**	0.222	0.231	0.240	0.249	0.258	0.268	0.278	0.287	0.297	0.307
4.4	**4.40**	0.225	0.234	0.243	0.252	0.261	0.271	0.281	0.291	0.301	0.311
4.5	**4.45**	0.227	0.236	0.245	0.255	0.264	0.274	0.284	0.294	0.304	0.315
4.5	**4.50**	0.230	0.239	0.248	0.258	0.267	0.277	0.287	0.297	0.308	0.318
4.6	**4.55**	0.232	0.242	0.251	0.261	0.270	0.280	0.290	0.301	0.311	0.322
4.6	**4.60**	0.235	0.244	0.254	0.263	0.273	0.283	0.293	0.304	0.314	0.325
4.7	**4.65**	0.237	0.247	0.256	0.266	0.276	0.286	0.297	0.307	0.318	0.329
4.7	**4.70**	0.240	0.250	0.259	0.269	0.279	0.289	0.300	0.310	0.321	0.332
4.8	**4.75**	0.243	0.252	0.262	0.272	0.282	0.292	0.303	0.314	0.325	0.336
4.8	**4.80**	0.245	0.255	0.265	0.275	0.285	0.296	0.306	0.317	0.328	0.339
4.9	**4.85**	0.248	0.258	0.268	0.278	0.288	0.299	0.309	0.320	0.331	0.343
4.9	**4.90**	0.250	0.260	0.270	0.281	0.291	0.302	0.313	0.324	0.335	0.346
5.0	**4.95**	0.253	0.263	0.273	0.283	0.294	0.305	0.316	0.327	0.338	0.350
5.0	**5.00**	0.255	0.265	0.276	0.286	0.297	0.308	0.319	0.330	0.342	0.353
5.1	**5.05**	0.258	0.268	0.279	0.289	0.300	0.311	0.322	0.334	0.345	0.357
5.1	**5.10**	0.260	0.271	0.281	0.292	0.303	0.314	0.325	0.337	0.349	0.360

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	30.5	31	31.5	32	32.5	33	33.5	34	34.5	35
0.1	**0.05**	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005
0.1	**0.10**	0.007	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.010
0.2	**0.15**	0.011	0.011	0.012	0.012	0.012	0.013	0.013	0.014	0.014	0.014
0.2	**0.20**	0.015	0.015	0.016	0.016	0.017	0.017	0.018	0.018	0.019	0.019
0.3	**0.25**	0.018	0.019	0.019	0.020	0.021	0.021	0.022	0.023	0.023	0.024
0.3	**0.30**	0.022	0.023	0.023	0.024	0.025	0.026	0.026	0.027	0.028	0.029
0.4	**0.35**	0.026	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034
0.4	**0.40**	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038
0.5	**0.45**	0.033	0.034	0.035	0.036	0.037	0.038	0.040	0.041	0.042	0.043
0.5	**0.50**	0.037	0.038	0.039	0.040	0.041	0.043	0.044	0.045	0.047	0.048
0.6	**0.55**	0.040	0.042	0.043	0.044	0.046	0.047	0.048	0.050	0.051	0.053
0.6	**0.60**	0.044	0.045	0.047	0.048	0.050	0.051	0.053	0.054	0.056	0.058
0.7	**0.65**	0.047	0.049	0.051	0.052	0.054	0.056	0.057	0.059	0.061	0.063
0.7	**0.70**	0.051	0.053	0.055	0.056	0.058	0.060	0.062	0.064	0.065	0.067
0.8	**0.75**	0.055	0.057	0.058	0.060	0.062	0.064	0.066	0.068	0.070	0.072
0.8	**0.80**	0.058	0.060	0.062	0.064	0.066	0.068	0.071	0.073	0.075	0.077
0.9	**0.85**	0.062	0.064	0.066	0.068	0.071	0.073	0.075	0.077	0.079	0.082
0.9	**0.90**	0.066	0.068	0.070	0.072	0.075	0.077	0.079	0.082	0.084	0.087
1.0	**0.95**	0.069	0.072	0.074	0.076	0.079	0.081	0.084	0.086	0.089	0.091
1.0	**1.00**	0.073	0.075	0.078	0.080	0.083	0.086	0.088	0.091	0.093	0.096
1.1	**1.05**	0.077	0.079	0.082	0.084	0.087	0.090	0.093	0.095	0.098	0.101
1.1	**1.10**	0.080	0.083	0.086	0.088	0.091	0.094	0.097	0.100	0.103	0.106
1.2	**1.15**	0.084	0.087	0.090	0.092	0.095	0.098	0.101	0.104	0.108	0.111
1.2	**1.20**	0.088	0.091	0.094	0.097	0.100	0.103	0.106	0.109	0.112	0.115
1.3	**1.25**	0.091	0.094	0.097	0.101	0.104	0.107	0.110	0.113	0.117	0.120
1.3	**1.30**	0.095	0.098	0.101	0.105	0.108	0.111	0.115	0.118	0.122	0.125
1.4	**1.35**	0.099	0.102	0.105	0.109	0.112	0.115	0.119	0.123	0.126	0.130
1.4	**1.40**	0.102	0.106	0.109	0.113	0.116	0.120	0.123	0.127	0.131	0.135
1.5	**1.45**	0.106	0.109	0.113	0.117	0.120	0.124	0.128	0.132	0.136	0.140
1.5	**1.50**	0.110	0.113	0.117	0.121	0.124	0.128	0.132	0.136	0.140	0.144
1.6	**1.55**	0.113	0.117	0.121	0.125	0.129	0.133	0.137	0.141	0.145	0.149
1.6	**1.60**	0.117	0.121	0.125	0.129	0.133	0.137	0.141	0.145	0.150	0.154
1.7	**1.65**	0.121	0.125	0.129	0.133	0.137	0.141	0.145	0.150	0.154	0.159
1.7	**1.70**	0.124	0.128	0.132	0.137	0.141	0.145	0.150	0.154	0.159	0.164
1.8	**1.75**	0.128	0.132	0.136	0.141	0.145	0.150	0.154	0.159	0.164	0.168
1.8	**1.80**	0.132	0.136	0.140	0.145	0.149	0.154	0.159	0.163	0.168	0.173
1.9	**1.85**	0.135	0.140	0.144	0.149	0.153	0.158	0.163	0.168	0.173	0.178
1.9	**1.90**	0.139	0.143	0.148	0.153	0.158	0.163	0.167	0.173	0.178	0.183
2.0	**1.95**	0.142	0.147	0.152	0.157	0.162	0.167	0.172	0.177	0.182	0.188

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	30.5	31	31.5	32	32.5	33	33.5	34	34.5	35
2.0	2.00	0.146	0.151	0.156	0.161	0.166	0.171	0.176	0.182	0.187	0.192
2.1	2.05	0.150	0.155	0.160	0.165	0.170	0.175	0.181	0.186	0.192	0.197
2.1	2.10	0.153	0.159	0.164	0.169	0.174	0.180	0.185	0.191	0.196	0.202
2.2	2.15	0.157	0.162	0.168	0.173	0.178	0.184	0.190	0.195	0.201	0.207
2.2	2.20	0.161	0.166	0.171	0.177	0.183	0.188	0.194	0.200	0.206	0.212
2.3	2.25	0.164	0.170	0.175	0.181	0.187	0.192	0.198	0.204	0.210	0.216
2.3	2.30	0.168	0.174	0.179	0.185	0.191	0.197	0.203	0.209	0.215	0.221
2.4	2.35	0.172	0.177	0.183	0.189	0.195	0.201	0.207	0.213	0.220	0.226
2.4	2.40	0.175	0.181	0.187	0.193	0.199	0.205	0.212	0.218	0.224	0.231
2.5	2.45	0.179	0.185	0.191	0.197	0.203	0.210	0.216	0.222	0.229	0.236
2.5	2.50	0.183	0.189	0.195	0.201	0.207	0.214	0.220	0.227	0.234	0.241
2.6	2.55	0.186	0.192	0.199	0.205	0.212	0.218	0.225	0.232	0.238	0.245
2.6	2.60	0.190	0.196	0.203	0.209	0.216	0.222	0.229	0.236	0.243	0.250
2.7	2.65	0.194	0.200	0.207	0.213	0.220	0.227	0.234	0.241	0.248	0.255
2.7	2.70	0.197	0.204	0.210	0.217	0.224	0.231	0.238	0.245	0.252	0.260
2.8	2.75	0.201	0.208	0.214	0.221	0.228	0.235	0.242	0.250	0.257	0.265
2.8	2.80	0.205	0.211	0.218	0.225	0.232	0.239	0.247	0.254	0.262	0.269
2.9	2.85	0.208	0.215	0.222	0.229	0.236	0.244	0.251	0.259	0.266	0.274
2.9	2.90	0.212	0.219	0.226	0.233	0.241	0.248	0.256	0.263	0.271	0.279
3.0	2.95	0.216	0.223	0.230	0.237	0.245	0.252	0.260	0.268	0.276	0.284
3.0	3.00	0.219	0.226	0.234	0.241	0.249	0.257	0.264	0.272	0.280	0.289
3.1	3.05	0.223	0.230	0.238	0.245	0.253	0.261	0.269	0.277	0.285	0.293
3.1	3.10	0.226	0.234	0.242	0.249	0.257	0.265	0.273	0.281	0.290	0.298
3.2	3.15	0.230	0.238	0.245	0.253	0.261	0.269	0.278	0.286	0.294	0.303
3.2	3.20	0.234	0.242	0.249	0.257	0.265	0.274	0.282	0.291	0.299	0.308
3.3	3.25	0.237	0.245	0.253	0.261	0.270	0.278	0.286	0.295	0.304	0.313
3.3	3.30	0.241	0.249	0.257	0.265	0.274	0.282	0.291	0.300	0.308	0.317
3.4	3.35	0.245	0.253	0.261	0.269	0.278	0.287	0.295	0.304	0.313	0.322
3.4	3.40	0.248	0.257	0.265	0.273	0.282	0.291	0.300	0.309	0.318	0.327
3.5	3.45	0.252	0.260	0.269	0.277	0.286	0.295	0.304	0.313	0.323	0.332
3.5	3.50	0.256	0.264	0.273	0.281	0.290	0.299	0.308	0.318	0.327	0.337
3.6	3.55	0.259	0.268	0.277	0.286	0.295	0.304	0.313	0.322	0.332	0.342
3.6	3.60	0.263	0.272	0.281	0.290	0.299	0.308	0.317	0.327	0.337	0.346
3.7	3.65	0.267	0.275	0.284	0.294	0.303	0.312	0.322	0.331	0.341	0.351
3.7	3.70	0.270	0.279	0.288	0.298	0.307	0.316	0.326	0.336	0.346	0.356
3.8	3.75	0.274	0.283	0.292	0.302	0.311	0.321	0.331	0.340	0.351	0.361
3.8	3.80	0.278	0.287	0.296	0.306	0.315	0.325	0.335	0.345	0.355	0.366
3.9	3.85	0.281	0.291	0.300	0.310	0.319	0.329	0.339	0.350	0.360	0.370
3.9	3.90	0.285	0.294	0.304	0.314	0.324	0.334	0.344	0.354	0.365	0.375

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	30.5	31	31.5	32	32.5	33	33.5	34	34.5	35
4.0	3.95	0.289	0.298	0.308	0.318	0.328	0.338	0.348	0.359	0.369	0.380
4.0	4.00	0.292	0.302	0.312	0.322	0.332	0.342	0.353	0.363	0.374	0.385
4.1	4.05	0.296	0.306	0.316	0.326	0.336	0.346	0.357	0.368	0.379	0.390
4.1	4.10	0.300	0.309	0.320	0.330	0.340	0.351	0.361	0.372	0.383	0.394
4.2	4.15	0.303	0.313	0.323	0.334	0.344	0.355	0.366	0.377	0.388	0.399
4.2	4.20	0.307	0.317	0.327	0.338	0.348	0.359	0.370	0.381	0.393	0.404
4.3	4.25	0.311	0.321	0.331	0.342	0.353	0.364	0.375	0.386	0.397	0.409
4.3	4.30	0.314	0.325	0.335	0.346	0.357	0.368	0.379	0.390	0.402	0.414
4.4	4.35	0.318	0.328	0.339	0.350	0.361	0.372	0.383	0.395	0.407	0.419
4.4	4.40	0.321	0.332	0.343	0.354	0.365	0.376	0.388	0.399	0.411	0.423
4.5	4.45	0.325	0.336	0.347	0.358	0.369	0.381	0.392	0.404	0.416	0.428
4.5	4.50	0.329	0.340	0.351	0.362	0.373	0.385	0.397	0.409	0.421	0.433
4.6	4.55	0.332	0.343	0.355	0.366	0.377	0.389	0.401	0.413	0.425	0.438
4.6	4.60	0.336	0.347	0.358	0.370	0.382	0.393	0.405	0.418	0.430	0.443
4.7	4.65	0.340	0.351	0.362	0.374	0.386	0.398	0.410	0.422	0.435	0.447
4.7	4.70	0.343	0.355	0.366	0.378	0.390	0.402	0.414	0.427	0.439	0.452
4.8	4.75	0.347	0.359	0.370	0.382	0.394	0.406	0.419	0.431	0.444	0.457
4.8	4.80	0.351	0.362	0.374	0.386	0.398	0.411	0.423	0.436	0.449	0.462
4.9	4.85	0.354	0.366	0.378	0.390	0.402	0.415	0.427	0.440	0.453	0.467
4.9	4.90	0.358	0.370	0.382	0.394	0.406	0.419	0.432	0.445	0.458	0.471
5.0	4.95	0.362	0.374	0.386	0.398	0.411	0.423	0.436	0.449	0.463	0.476
5.0	5.00	0.365	0.377	0.390	0.402	0.415	0.428	0.441	0.454	0.467	0.481
5.1	5.05	0.369	0.381	0.394	0.406	0.419	0.432	0.445	0.459	0.472	0.486
5.1	5.10	0.373	0.385	0.397	0.410	0.423	0.436	0.450	0.463	0.477	0.491

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
0.1	**0.05**	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006
0.1	**0.10**	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.013
0.2	**0.15**	0.015	0.015	0.016	0.016	0.017	0.017	0.017	0.018	0.018	0.019
0.2	**0.20**	0.020	0.020	0.021	0.022	0.022	0.023	0.023	0.024	0.025	0.025
0.3	**0.25**	0.025	0.025	0.026	0.027	0.028	0.028	0.029	0.030	0.031	0.031
0.3	**0.30**	0.030	0.031	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038
0.4	**0.35**	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044
0.4	**0.40**	0.040	0.041	0.042	0.043	0.044	0.045	0.047	0.048	0.049	0.050
0.5	**0.45**	0.045	0.046	0.047	0.048	0.050	0.051	0.052	0.054	0.055	0.057
0.5	**0.50**	0.049	0.051	0.052	0.054	0.055	0.057	0.058	0.060	0.061	0.063
0.6	**0.55**	0.054	0.056	0.058	0.059	0.061	0.062	0.064	0.066	0.067	0.069
0.6	**0.60**	0.059	0.061	0.063	0.065	0.066	0.068	0.070	0.072	0.074	0.075
0.7	**0.65**	0.064	0.066	0.068	0.070	0.072	0.074	0.076	0.078	0.080	0.082
0.7	**0.70**	0.069	0.071	0.073	0.075	0.077	0.079	0.081	0.084	0.086	0.088
0.8	**0.75**	0.074	0.076	0.078	0.081	0.083	0.085	0.087	0.090	0.092	0.094
0.8	**0.80**	0.079	0.081	0.084	0.086	0.088	0.091	0.093	0.096	0.098	0.101
0.9	**0.85**	0.084	0.087	0.089	0.091	0.094	0.096	0.099	0.102	0.104	0.107
0.9	**0.90**	0.089	0.092	0.094	0.097	0.099	0.102	0.105	0.108	0.110	0.113
1.0	**0.95**	0.094	0.097	0.099	0.102	0.105	0.108	0.111	0.113	0.116	0.119
1.0	**1.00**	0.099	0.102	0.105	0.108	0.110	0.113	0.116	0.119	0.123	0.126
1.1	**1.05**	0.104	0.107	0.110	0.113	0.116	0.119	0.122	0.125	0.129	0.132
1.1	**1.10**	0.109	0.112	0.115	0.118	0.121	0.125	0.128	0.131	0.135	0.138
1.2	**1.15**	0.114	0.117	0.120	0.124	0.127	0.130	0.134	0.137	0.141	0.145
1.2	**1.20**	0.119	0.122	0.126	0.129	0.133	0.136	0.140	0.143	0.147	0.151
1.3	**1.25**	0.124	0.127	0.131	0.134	0.138	0.142	0.146	0.149	0.153	0.157
1.3	**1.30**	0.129	0.132	0.136	0.140	0.144	0.147	0.151	0.155	0.159	0.163
1.4	**1.35**	0.134	0.137	0.141	0.145	0.149	0.153	0.157	0.161	0.165	0.170
1.4	**1.40**	0.139	0.143	0.146	0.151	0.155	0.159	0.163	0.167	0.172	0.176
1.5	**1.45**	0.144	0.148	0.152	0.156	0.160	0.164	0.169	0.173	0.178	0.182
1.5	**1.50**	0.148	0.153	0.157	0.161	0.166	0.170	0.175	0.179	0.184	0.188
1.6	**1.55**	0.153	0.158	0.162	0.167	0.171	0.176	0.180	0.185	0.190	0.195
1.6	**1.60**	0.158	0.163	0.167	0.172	0.177	0.181	0.186	0.191	0.196	0.201
1.7	**1.65**	0.163	0.168	0.173	0.177	0.182	0.187	0.192	0.197	0.202	0.207
1.7	**1.70**	0.168	0.173	0.178	0.183	0.188	0.193	0.198	0.203	0.208	0.214
1.8	**1.75**	0.173	0.178	0.183	0.188	0.193	0.198	0.204	0.209	0.214	0.220
1.8	**1.80**	0.178	0.183	0.188	0.194	0.199	0.204	0.210	0.215	0.221	0.226
1.9	**1.85**	0.183	0.188	0.194	0.199	0.204	0.210	0.215	0.221	0.227	0.232
1.9	**1.90**	0.188	0.193	0.199	0.204	0.210	0.215	0.221	0.227	0.233	0.239
2.0	**1.95**	0.193	0.198	0.204	0.210	0.215	0.221	0.227	0.233	0.239	0.245

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class Midpoints		35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
2.0	**2.00**	0.198	0.204	0.209	0.215	0.221	0.227	0.233	0.239	0.245	0.251
2.1	**2.05**	0.203	0.209	0.215	0.220	0.226	0.232	0.239	0.245	0.251	0.258
2.1	**2.10**	0.208	0.214	0.220	0.226	0.232	0.238	0.244	0.251	0.257	0.264
2.2	**2.15**	0.213	0.219	0.225	0.231	0.237	0.244	0.250	0.257	0.263	0.270
2.2	**2.20**	0.218	0.224	0.230	0.237	0.243	0.250	0.256	0.263	0.270	0.276
2.3	**2.25**	0.223	0.229	0.235	0.242	0.249	0.255	0.262	0.269	0.276	0.283
2.3	**2.30**	0.228	0.234	0.241	0.247	0.254	0.261	0.268	0.275	0.282	0.289
2.4	**2.35**	0.233	0.239	0.246	0.253	0.260	0.267	0.274	0.281	0.288	0.295
2.4	**2.40**	0.238	0.244	0.251	0.258	0.265	0.272	0.279	0.287	0.294	0.302
2.5	**2.45**	0.243	0.249	0.256	0.263	0.271	0.278	0.285	0.293	0.300	0.308
2.5	**2.50**	0.247	0.254	0.262	0.269	0.276	0.284	0.291	0.299	0.306	0.314
2.6	**2.55**	0.252	0.260	0.267	0.274	0.282	0.289	0.297	0.305	0.312	0.320
2.6	**2.60**	0.257	0.265	0.272	0.280	0.287	0.295	0.303	0.311	0.319	0.327
2.7	**2.65**	0.262	0.270	0.277	0.285	0.293	0.301	0.309	0.317	0.325	0.333
2.7	**2.70**	0.267	0.275	0.283	0.290	0.298	0.306	0.314	0.323	0.331	0.339
2.8	**2.75**	0.272	0.280	0.288	0.296	0.304	0.312	0.320	0.329	0.337	0.346
2.8	**2.80**	0.277	0.285	0.293	0.301	0.309	0.318	0.326	0.334	0.343	0.352
2.9	**2.85**	0.282	0.290	0.298	0.306	0.315	0.323	0.332	0.340	0.349	0.358
2.9	**2.90**	0.287	0.295	0.303	0.312	0.320	0.329	0.338	0.346	0.355	0.364
3.0	**2.95**	0.292	0.300	0.309	0.317	0.326	0.335	0.343	0.352	0.361	0.371
3.0	**3.00**	0.297	0.305	0.314	0.323	0.331	0.340	0.349	0.358	0.368	0.377
3.1	**3.05**	0.302	0.310	0.319	0.328	0.337	0.346	0.355	0.364	0.374	0.383
3.1	**3.10**	0.307	0.316	0.324	0.333	0.342	0.352	0.361	0.370	0.380	0.390
3.2	**3.15**	0.312	0.321	0.330	0.339	0.348	0.357	0.367	0.376	0.386	0.396
3.2	**3.20**	0.317	0.326	0.335	0.344	0.353	0.363	0.373	0.382	0.392	0.402
3.3	**3.25**	0.322	0.331	0.340	0.349	0.359	0.369	0.378	0.388	0.398	0.408
3.3	**3.30**	0.327	0.336	0.345	0.355	0.364	0.374	0.384	0.394	0.404	0.415
3.4	**3.35**	0.332	0.341	0.351	0.360	0.370	0.380	0.390	0.400	0.411	0.421
3.4	**3.40**	0.337	0.346	0.356	0.366	0.376	0.386	0.396	0.406	0.417	0.427
3.5	**3.45**	0.341	0.351	0.361	0.371	0.381	0.391	0.402	0.412	0.423	0.434
3.5	**3.50**	0.346	0.356	0.366	0.376	0.387	0.397	0.407	0.418	0.429	0.440
3.6	**3.55**	0.351	0.361	0.371	0.382	0.392	0.403	0.413	0.424	0.435	0.446
3.6	**3.60**	0.356	0.366	0.377	0.387	0.398	0.408	0.419	0.430	0.441	0.452
3.7	**3.65**	0.361	0.372	0.382	0.392	0.403	0.414	0.425	0.436	0.447	0.459
3.7	**3.70**	0.366	0.377	0.387	0.398	0.409	0.420	0.431	0.442	0.453	0.465
3.8	**3.75**	0.371	0.382	0.392	0.403	0.414	0.425	0.437	0.448	0.460	0.471
3.8	**3.80**	0.376	0.387	0.398	0.409	0.420	0.431	0.442	0.454	0.466	0.478
3.9	**3.85**	0.381	0.392	0.403	0.414	0.425	0.437	0.448	0.460	0.472	0.484
3.9	**3.90**	0.386	0.397	0.408	0.419	0.431	0.442	0.454	0.466	0.478	0.490

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	35.5	36	36.5	37	37.5	38	38.5	39	39.5	40
4.0	**3.95**	0.391	0.402	0.413	0.425	0.436	0.448	0.460	0.472	0.484	0.496
4.0	**4.00**	0.396	0.407	0.419	0.430	0.442	0.454	0.466	0.478	0.490	0.503
4.1	**4.05**	0.401	0.412	0.424	0.435	0.447	0.459	0.471	0.484	0.496	0.509
4.1	**4.10**	0.406	0.417	0.429	0.441	0.453	0.465	0.477	0.490	0.502	0.515
4.2	**4.15**	0.411	0.422	0.434	0.446	0.458	0.471	0.483	0.496	0.509	0.522
4.2	**4.20**	0.416	0.428	0.439	0.452	0.464	0.476	0.489	0.502	0.515	0.528
4.3	**4.25**	0.421	0.433	0.445	0.457	0.469	0.482	0.495	0.508	0.521	0.534
4.3	**4.30**	0.426	0.438	0.450	0.462	0.475	0.488	0.501	0.514	0.527	0.540
4.4	**4.35**	0.431	0.443	0.455	0.468	0.480	0.493	0.506	0.520	0.533	0.547
4.4	**4.40**	0.436	0.448	0.460	0.473	0.486	0.499	0.512	0.526	0.539	0.553
4.5	**4.45**	0.440	0.453	0.466	0.478	0.491	0.505	0.518	0.532	0.545	0.559
4.5	**4.50**	0.445	0.458	0.471	0.484	0.497	0.510	0.524	0.538	0.551	0.565
4.6	**4.55**	0.450	0.463	0.476	0.489	0.503	0.516	0.530	0.544	0.558	0.572
4.6	**4.60**	0.455	0.468	0.481	0.495	0.508	0.522	0.536	0.550	0.564	0.578
4.7	**4.65**	0.460	0.473	0.487	0.500	0.514	0.527	0.541	0.555	0.570	0.584
4.7	**4.70**	0.465	0.478	0.492	0.505	0.519	0.533	0.547	0.561	0.576	0.591
4.8	**4.75**	0.470	0.483	0.497	0.511	0.525	0.539	0.553	0.567	0.582	0.597
4.8	**4.80**	0.475	0.489	0.502	0.516	0.530	0.544	0.559	0.573	0.588	0.603
4.9	**4.85**	0.480	0.494	0.507	0.521	0.536	0.550	0.565	0.579	0.594	0.609
4.9	**4.90**	0.485	0.499	0.513	0.527	0.541	0.556	0.570	0.585	0.600	0.616
5.0	**4.95**	0.490	0.504	0.518	0.532	0.547	0.561	0.576	0.591	0.607	0.622
5.0	**5.00**	0.495	0.509	0.523	0.538	0.552	0.567	0.582	0.597	0.613	0.628
5.1	**5.05**	0.500	0.514	0.528	0.543	0.558	0.573	0.588	0.603	0.619	0.635
5.1	**5.10**	0.505	0.519	0.534	0.548	0.563	0.578	0.594	0.609	0.625	0.641

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		40.5	41	41.5	42	42.5	43	43.5	44	44.5	45
Length											
Class Midpoints											
0.1	**0.05**	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008
0.1	**0.10**	0.013	0.013	0.014	0.014	0.014	0.015	0.015	0.015	0.016	0.016
0.2	**0.15**	0.019	0.020	0.020	0.021	0.021	0.022	0.022	0.023	0.023	0.024
0.2	**0.20**	0.026	0.026	0.027	0.028	0.028	0.029	0.030	0.030	0.031	0.032
0.3	**0.25**	0.032	0.033	0.034	0.035	0.035	0.036	0.037	0.038	0.039	0.040
0.3	**0.30**	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.046	0.047	0.048
0.4	**0.35**	0.045	0.046	0.047	0.048	0.050	0.051	0.052	0.053	0.054	0.056
0.4	**0.40**	0.052	0.053	0.054	0.055	0.057	0.058	0.059	0.061	0.062	0.064
0.5	**0.45**	0.058	0.059	0.061	0.062	0.064	0.065	0.067	0.068	0.070	0.072
0.5	**0.50**	0.064	0.066	0.068	0.069	0.071	0.073	0.074	0.076	0.078	0.080
0.6	**0.55**	0.071	0.073	0.074	0.076	0.078	0.080	0.082	0.084	0.086	0.087
0.6	**0.60**	0.077	0.079	0.081	0.083	0.085	0.087	0.089	0.091	0.093	0.095
0.7	**0.65**	0.084	0.086	0.088	0.090	0.092	0.094	0.097	0.099	0.101	0.103
0.7	**0.70**	0.090	0.092	0.095	0.097	0.099	0.102	0.104	0.106	0.109	0.111
0.8	**0.75**	0.097	0.099	0.101	0.104	0.106	0.109	0.111	0.114	0.117	0.119
0.8	**0.80**	0.103	0.106	0.108	0.111	0.113	0.116	0.119	0.122	0.124	0.127
0.9	**0.85**	0.110	0.112	0.115	0.118	0.121	0.123	0.126	0.129	0.132	0.135
0.9	**0.90**	0.116	0.119	0.122	0.125	0.128	0.131	0.134	0.137	0.140	0.143
1.0	**0.95**	0.122	0.125	0.129	0.132	0.135	0.138	0.141	0.144	0.148	0.151
1.0	**1.00**	0.129	0.132	0.135	0.139	0.142	0.145	0.149	0.152	0.156	0.159
1.1	**1.05**	0.135	0.139	0.142	0.145	0.149	0.152	0.156	0.160	0.163	0.167
1.1	**1.10**	0.142	0.145	0.149	0.152	0.156	0.160	0.163	0.167	0.171	0.175
1.2	**1.15**	0.148	0.152	0.156	0.159	0.163	0.167	0.171	0.175	0.179	0.183
1.2	**1.20**	0.155	0.158	0.162	0.166	0.170	0.174	0.178	0.182	0.187	0.191
1.3	**1.25**	0.161	0.165	0.169	0.173	0.177	0.182	0.186	0.190	0.194	0.199
1.3	**1.30**	0.167	0.172	0.176	0.180	0.184	0.189	0.193	0.198	0.202	0.207
1.4	**1.35**	0.174	0.178	0.183	0.187	0.192	0.196	0.201	0.205	0.210	0.215
1.4	**1.40**	0.180	0.185	0.189	0.194	0.199	0.203	0.208	0.213	0.218	0.223
1.5	**1.45**	0.187	0.191	0.196	0.201	0.206	0.211	0.215	0.220	0.226	0.231
1.5	**1.50**	0.193	0.198	0.203	0.208	0.213	0.218	0.223	0.228	0.233	0.239
1.6	**1.55**	0.200	0.205	0.210	0.215	0.220	0.225	0.230	0.236	0.241	0.247
1.6	**1.60**	0.206	0.211	0.216	0.222	0.227	0.232	0.238	0.243	0.249	0.254
1.7	**1.65**	0.213	0.218	0.223	0.229	0.234	0.240	0.245	0.251	0.257	0.262
1.7	**1.70**	0.219	0.224	0.230	0.236	0.241	0.247	0.253	0.258	0.264	0.270
1.8	**1.75**	0.225	0.231	0.237	0.242	0.248	0.254	0.260	0.266	0.272	0.278
1.8	**1.80**	0.232	0.238	0.243	0.249	0.255	0.261	0.268	0.274	0.280	0.286
1.9	**1.85**	0.238	0.244	0.250	0.256	0.262	0.269	0.275	0.281	0.288	0.294
1.9	**1.90**	0.245	0.251	0.257	0.263	0.270	0.276	0.282	0.289	0.296	0.302
2.0	**1.95**	0.251	0.257	0.264	0.270	0.277	0.283	0.290	0.297	0.303	0.310

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45
2.0	**2.00**	0.258	0.264	0.271	0.277	0.284	0.290	0.297	0.304	0.311	0.318
2.1	**2.05**	0.264	0.271	0.277	0.284	0.291	0.298	0.305	0.312	0.319	0.326
2.1	**2.10**	0.271	0.277	0.284	0.291	0.298	0.305	0.312	0.319	0.327	0.334
2.2	**2.15**	0.277	0.284	0.291	0.298	0.305	0.312	0.320	0.327	0.334	0.342
2.2	**2.20**	0.283	0.290	0.298	0.305	0.312	0.319	0.327	0.335	0.342	0.350
2.3	**2.25**	0.290	0.297	0.304	0.312	0.319	0.327	0.334	0.342	0.350	0.358
2.3	**2.30**	0.296	0.304	0.311	0.319	0.326	0.334	0.342	0.350	0.358	0.366
2.4	**2.35**	0.303	0.310	0.318	0.326	0.333	0.341	0.349	0.357	0.365	0.374
2.4	**2.40**	0.309	0.317	0.325	0.333	0.340	0.349	0.357	0.365	0.373	0.382
2.5	**2.45**	0.316	0.323	0.331	0.339	0.348	0.356	0.364	0.373	0.381	0.390
2.5	**2.50**	0.322	0.330	0.338	0.346	0.355	0.363	0.372	0.380	0.389	0.398
2.6	**2.55**	0.329	0.337	0.345	0.353	0.362	0.370	0.379	0.388	0.397	0.406
2.6	**2.60**	0.335	0.343	0.352	0.360	0.369	0.378	0.386	0.395	0.404	0.414
2.7	**2.65**	0.341	0.350	0.358	0.367	0.376	0.385	0.394	0.403	0.412	0.421
2.7	**2.70**	0.348	0.356	0.365	0.374	0.383	0.392	0.401	0.411	0.420	0.429
2.8	**2.75**	0.354	0.363	0.372	0.381	0.390	0.399	0.409	0.418	0.428	0.437
2.8	**2.80**	0.361	0.370	0.379	0.388	0.397	0.407	0.416	0.426	0.435	0.445
2.9	**2.85**	0.367	0.376	0.386	0.395	0.404	0.414	0.424	0.433	0.443	0.453
2.9	**2.90**	0.374	0.383	0.392	0.402	0.411	0.421	0.431	0.441	0.451	0.461
3.0	**2.95**	0.380	0.389	0.399	0.409	0.418	0.428	0.438	0.449	0.459	0.469
3.0	**3.00**	0.386	0.396	0.406	0.416	0.426	0.436	0.446	0.456	0.467	0.477
3.1	**3.05**	0.393	0.403	0.413	0.423	0.433	0.443	0.453	0.464	0.474	0.485
3.1	**3.10**	0.399	0.409	0.419	0.429	0.440	0.450	0.461	0.471	0.482	0.493
3.2	**3.15**	0.406	0.416	0.426	0.436	0.447	0.457	0.468	0.479	0.490	0.501
3.2	**3.20**	0.412	0.422	0.433	0.443	0.454	0.465	0.476	0.487	0.498	0.509
3.3	**3.25**	0.419	0.429	0.440	0.450	0.461	0.472	0.483	0.494	0.505	0.517
3.3	**3.30**	0.425	0.436	0.446	0.457	0.468	0.479	0.490	0.502	0.513	0.525
3.4	**3.35**	0.432	0.442	0.453	0.464	0.475	0.486	0.498	0.509	0.521	0.533
3.4	**3.40**	0.438	0.449	0.460	0.471	0.482	0.494	0.505	0.517	0.529	0.541
3.5	**3.45**	0.444	0.455	0.467	0.478	0.489	0.501	0.513	0.525	0.537	0.549
3.5	**3.50**	0.451	0.462	0.473	0.485	0.497	0.508	0.520	0.532	0.544	0.557
3.6	**3.55**	0.457	0.469	0.480	0.492	0.504	0.516	0.528	0.540	0.552	0.565
3.6	**3.60**	0.464	0.475	0.487	0.499	0.511	0.523	0.535	0.547	0.560	0.573
3.7	**3.65**	0.470	0.482	0.494	0.506	0.518	0.530	0.542	0.555	0.568	0.581
3.7	**3.70**	0.477	0.488	0.500	0.513	0.525	0.537	0.550	0.563	0.575	0.588
3.8	**3.75**	0.483	0.495	0.507	0.520	0.532	0.545	0.557	0.570	0.583	0.596
3.8	**3.80**	0.490	0.502	0.514	0.526	0.539	0.552	0.565	0.578	0.591	0.604
3.9	**3.85**	0.496	0.508	0.521	0.533	0.546	0.559	0.572	0.585	0.599	0.612
3.9	**3.90**	0.502	0.515	0.528	0.540	0.553	0.566	0.580	0.593	0.607	0.620

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	40.5	41	41.5	42	42.5	43	43.5	44	44.5	45
4.0	**3.95**	0.509	0.522	0.534	0.547	0.560	0.574	0.587	0.601	0.614	0.628
4.0	**4.00**	0.515	0.528	0.541	0.554	0.567	0.581	0.594	0.608	0.622	0.636
4.1	**4.05**	0.522	0.535	0.548	0.561	0.575	0.588	0.602	0.616	0.630	0.644
4.1	**4.10**	0.528	0.541	0.555	0.568	0.582	0.595	0.609	0.623	0.638	0.652
4.2	**4.15**	0.535	0.548	0.561	0.575	0.589	0.603	0.617	0.631	0.645	0.660
4.2	**4.20**	0.541	0.555	0.568	0.582	0.596	0.610	0.624	0.639	0.653	0.668
4.3	**4.25**	0.548	0.561	0.575	0.589	0.603	0.617	0.632	0.646	0.661	0.676
4.3	**4.30**	0.554	0.568	0.582	0.596	0.610	0.624	0.639	0.654	0.669	0.684
4.4	**4.35**	0.560	0.574	0.588	0.603	0.617	0.632	0.646	0.661	0.677	0.692
4.4	**4.40**	0.567	0.581	0.595	0.610	0.624	0.639	0.654	0.669	0.684	0.700
4.5	**4.45**	0.573	0.588	0.602	0.617	0.631	0.646	0.661	0.677	0.692	0.708
4.5	**4.50**	0.580	0.594	0.609	0.623	0.638	0.653	0.669	0.684	0.700	0.716
4.6	**4.55**	0.586	0.601	0.615	0.630	0.645	0.661	0.676	0.692	0.708	0.724
4.6	**4.60**	0.593	0.607	0.622	0.637	0.653	0.668	0.684	0.699	0.715	0.732
4.7	**4.65**	0.599	0.614	0.629	0.644	0.660	0.675	0.691	0.707	0.723	0.740
4.7	**4.70**	0.605	0.621	0.636	0.651	0.667	0.683	0.699	0.715	0.731	0.748
4.8	**4.75**	0.612	0.627	0.643	0.658	0.674	0.690	0.706	0.722	0.739	0.755
4.8	**4.80**	0.618	0.634	0.649	0.665	0.681	0.697	0.713	0.730	0.747	0.763
4.9	**4.85**	0.625	0.640	0.656	0.672	0.688	0.704	0.721	0.737	0.754	0.771
4.9	**4.90**	0.631	0.647	0.663	0.679	0.695	0.712	0.728	0.745	0.762	0.779
5.0	**4.95**	0.638	0.654	0.670	0.686	0.702	0.719	0.736	0.753	0.770	0.787
5.0	**5.00**	0.644	0.660	0.676	0.693	0.709	0.726	0.743	0.760	0.778	0.795
5.1	**5.05**	0.651	0.667	0.683	0.700	0.716	0.733	0.751	0.768	0.785	0.803
5.1	**5.10**	0.657	0.673	0.690	0.707	0.724	0.741	0.758	0.775	0.793	0.811

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	45.5	46	46.5	47	47.5	48	48.5	48	49.5	50
0.1	**0.05**	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.010	0.010
0.1	**0.10**	0.016	0.017	0.017	0.017	0.018	0.018	0.018	0.018	0.019	0.020
0.2	**0.15**	0.024	0.025	0.025	0.026	0.027	0.027	0.028	0.027	0.029	0.029
0.2	**0.20**	0.033	0.033	0.034	0.035	0.035	0.036	0.037	0.036	0.038	0.039
0.3	**0.25**	0.041	0.042	0.042	0.043	0.044	0.045	0.046	0.045	0.048	0.049
0.3	**0.30**	0.049	0.050	0.051	0.052	0.053	0.054	0.055	0.054	0.058	0.059
0.4	**0.35**	0.057	0.058	0.059	0.061	0.062	0.063	0.065	0.063	0.067	0.069
0.4	**0.40**	0.065	0.066	0.068	0.069	0.071	0.072	0.074	0.072	0.077	0.079
0.5	**0.45**	0.073	0.075	0.076	0.078	0.080	0.081	0.083	0.081	0.087	0.088
0.5	**0.50**	0.081	0.083	0.085	0.087	0.089	0.090	0.092	0.090	0.096	0.098
0.6	**0.55**	0.089	0.091	0.093	0.095	0.097	0.100	0.102	0.100	0.106	0.108
0.6	**0.60**	0.098	0.100	0.102	0.104	0.106	0.109	0.111	0.109	0.115	0.118
0.7	**0.65**	0.106	0.108	0.110	0.113	0.115	0.118	0.120	0.118	0.125	0.128
0.7	**0.70**	0.114	0.116	0.119	0.121	0.124	0.127	0.129	0.127	0.135	0.137
0.8	**0.75**	0.122	0.125	0.127	0.130	0.133	0.136	0.139	0.136	0.144	0.147
0.8	**0.80**	0.130	0.133	0.136	0.139	0.142	0.145	0.148	0.145	0.154	0.157
0.9	**0.85**	0.138	0.141	0.144	0.147	0.151	0.154	0.157	0.154	0.164	0.167
0.9	**0.90**	0.146	0.150	0.153	0.156	0.159	0.163	0.166	0.163	0.173	0.177
1.0	**0.95**	0.154	0.158	0.161	0.165	0.168	0.172	0.176	0.172	0.183	0.187
1.0	**1.00**	0.163	0.166	0.170	0.173	0.177	0.181	0.185	0.181	0.192	0.196
1.1	**1.05**	0.171	0.175	0.178	0.182	0.186	0.190	0.194	0.190	0.202	0.206
1.1	**1.10**	0.179	0.183	0.187	0.191	0.195	0.199	0.203	0.199	0.212	0.216
1.2	**1.15**	0.187	0.191	0.195	0.200	0.204	0.208	0.212	0.208	0.221	0.226
1.2	**1.20**	0.195	0.199	0.204	0.208	0.213	0.217	0.222	0.217	0.231	0.236
1.3	**1.25**	0.203	0.208	0.212	0.217	0.222	0.226	0.231	0.226	0.241	0.245
1.3	**1.30**	0.211	0.216	0.221	0.226	0.230	0.235	0.240	0.235	0.250	0.255
1.4	**1.35**	0.220	0.224	0.229	0.234	0.239	0.244	0.249	0.244	0.260	0.265
1.4	**1.40**	0.228	0.233	0.238	0.243	0.248	0.253	0.259	0.253	0.269	0.275
1.5	**1.45**	0.236	0.241	0.246	0.252	0.257	0.262	0.268	0.262	0.279	0.285
1.5	**1.50**	0.244	0.249	0.255	0.260	0.266	0.271	0.277	0.271	0.289	0.295
1.6	**1.55**	0.252	0.258	0.263	0.269	0.275	0.280	0.286	0.280	0.298	0.304
1.6	**1.60**	0.260	0.266	0.272	0.278	0.284	0.290	0.296	0.290	0.308	0.314
1.7	**1.65**	0.268	0.274	0.280	0.286	0.292	0.299	0.305	0.299	0.318	0.324
1.7	**1.70**	0.276	0.283	0.289	0.295	0.301	0.308	0.314	0.308	0.327	0.334
1.8	**1.75**	0.285	0.291	0.297	0.304	0.310	0.317	0.323	0.317	0.337	0.344
1.8	**1.80**	0.293	0.299	0.306	0.312	0.319	0.326	0.333	0.326	0.346	0.353
1.9	**1.85**	0.301	0.307	0.314	0.321	0.328	0.335	0.342	0.335	0.356	0.363
1.9	**1.90**	0.309	0.316	0.323	0.330	0.337	0.344	0.351	0.344	0.366	0.373
2.0	**1.95**	0.317	0.324	0.331	0.338	0.346	0.353	0.360	0.353	0.375	0.383

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class Midpoints		45.5	46	46.5	47	47.5	48	48.5	48	49.5	50
2.0	**2.00**	0.325	0.332	0.340	0.347	0.354	0.362	0.369	0.362	0.385	0.393
2.1	**2.05**	0.333	0.341	0.348	0.356	0.363	0.371	0.379	0.371	0.395	0.403
2.1	**2.10**	0.341	0.349	0.357	0.364	0.372	0.380	0.388	0.380	0.404	0.412
2.2	**2.15**	0.350	0.357	0.365	0.373	0.381	0.389	0.397	0.389	0.414	0.422
2.2	**2.20**	0.358	0.366	0.374	0.382	0.390	0.398	0.406	0.398	0.423	0.432
2.3	**2.25**	0.366	0.374	0.382	0.390	0.399	0.407	0.416	0.407	0.433	0.442
2.3	**2.30**	0.374	0.382	0.391	0.399	0.408	0.416	0.425	0.416	0.443	0.452
2.4	**2.35**	0.382	0.391	0.399	0.408	0.416	0.425	0.434	0.425	0.452	0.461
2.4	**2.40**	0.390	0.399	0.408	0.416	0.425	0.434	0.443	0.434	0.462	0.471
2.5	**2.45**	0.398	0.407	0.416	0.425	0.434	0.443	0.453	0.443	0.471	0.481
2.5	**2.50**	0.406	0.415	0.425	0.434	0.443	0.452	0.462	0.452	0.481	0.491
2.6	**2.55**	0.415	0.424	0.433	0.442	0.452	0.461	0.471	0.461	0.491	0.501
2.6	**2.60**	0.423	0.432	0.442	0.451	0.461	0.470	0.480	0.470	0.500	0.511
2.7	**2.65**	0.431	0.440	0.450	0.460	0.470	0.480	0.490	0.480	0.510	0.520
2.7	**2.70**	0.439	0.449	0.459	0.468	0.478	0.489	0.499	0.489	0.520	0.530
2.8	**2.75**	0.447	0.457	0.467	0.477	0.487	0.498	0.508	0.498	0.529	0.540
2.8	**2.80**	0.455	0.465	0.476	0.486	0.496	0.507	0.517	0.507	0.539	0.550
2.9	**2.85**	0.463	0.474	0.484	0.494	0.505	0.516	0.527	0.516	0.548	0.560
2.9	**2.90**	0.472	0.482	0.492	0.503	0.514	0.525	0.536	0.525	0.558	0.569
3.0	**2.95**	0.480	0.490	0.501	0.512	0.523	0.534	0.545	0.534	0.568	0.579
3.0	**3.00**	0.488	0.499	0.509	0.520	0.532	0.543	0.554	0.543	0.577	0.589
3.1	**3.05**	0.496	0.507	0.518	0.529	0.540	0.552	0.563	0.552	0.587	0.599
3.1	**3.10**	0.504	0.515	0.526	0.538	0.549	0.561	0.573	0.561	0.597	0.609
3.2	**3.15**	0.512	0.524	0.535	0.547	0.558	0.570	0.582	0.570	0.606	0.619
3.2	**3.20**	0.520	0.532	0.543	0.555	0.567	0.579	0.591	0.579	0.616	0.628
3.3	**3.25**	0.528	0.540	0.552	0.564	0.576	0.588	0.600	0.588	0.625	0.638
3.3	**3.30**	0.537	0.548	0.560	0.573	0.585	0.597	0.610	0.597	0.635	0.648
3.4	**3.35**	0.545	0.557	0.569	0.581	0.594	0.606	0.619	0.606	0.645	0.658
3.4	**3.40**	0.553	0.565	0.577	0.590	0.602	0.615	0.628	0.615	0.654	0.668
3.5	**3.45**	0.561	0.573	0.586	0.599	0.611	0.624	0.637	0.624	0.664	0.677
3.5	**3.50**	0.569	0.582	0.594	0.607	0.620	0.633	0.647	0.633	0.674	0.687
3.6	**3.55**	0.577	0.590	0.603	0.616	0.629	0.642	0.656	0.642	0.683	0.697
3.6	**3.60**	0.585	0.598	0.611	0.625	0.638	0.651	0.665	0.651	0.693	0.707
3.7	**3.65**	0.593	0.607	0.620	0.633	0.647	0.660	0.674	0.660	0.702	0.717
3.7	**3.70**	0.602	0.615	0.628	0.642	0.656	0.670	0.684	0.670	0.712	0.726
3.8	**3.75**	0.610	0.623	0.637	0.651	0.665	0.679	0.693	0.679	0.722	0.736
3.8	**3.80**	0.618	0.632	0.645	0.659	0.673	0.688	0.702	0.688	0.731	0.746
3.9	**3.85**	0.626	0.640	0.654	0.668	0.682	0.697	0.711	0.697	0.741	0.756
3.9	**3.90**	0.634	0.648	0.662	0.677	0.691	0.706	0.721	0.706	0.751	0.766

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	45.5	46	46.5	47	47.5	48	48.5	48	49.5	50
4.0	**3.95**	0.642	0.656	0.671	0.685	0.700	0.715	0.730	0.715	0.760	0.776
4.0	**4.00**	0.650	0.665	0.679	0.694	0.709	0.724	0.739	0.724	0.770	0.785
4.1	**4.05**	0.659	0.673	0.688	0.703	0.718	0.733	0.748	0.733	0.779	0.795
4.1	**4.10**	0.667	0.681	0.696	0.711	0.727	0.742	0.757	0.742	0.789	0.805
4.2	**4.15**	0.675	0.690	0.705	0.720	0.735	0.751	0.767	0.751	0.799	0.815
4.2	**4.20**	0.683	0.698	0.713	0.729	0.744	0.760	0.776	0.760	0.808	0.825
4.3	**4.25**	0.691	0.706	0.722	0.737	0.753	0.769	0.785	0.769	0.818	0.834
4.3	**4.30**	0.699	0.715	0.730	0.746	0.762	0.778	0.794	0.778	0.828	0.844
4.4	**4.35**	0.707	0.723	0.739	0.755	0.771	0.787	0.804	0.787	0.837	0.854
4.4	**4.40**	0.715	0.731	0.747	0.763	0.780	0.796	0.813	0.796	0.847	0.864
4.5	**4.45**	0.724	0.740	0.756	0.772	0.789	0.805	0.822	0.805	0.856	0.874
4.5	**4.50**	0.732	0.748	0.764	0.781	0.797	0.814	0.831	0.814	0.866	0.884
4.6	**4.55**	0.740	0.756	0.773	0.789	0.806	0.823	0.841	0.823	0.876	0.893
4.6	**4.60**	0.748	0.764	0.781	0.798	0.815	0.832	0.850	0.832	0.885	0.903
4.7	**4.65**	0.756	0.773	0.790	0.807	0.824	0.841	0.859	0.841	0.895	0.913
4.7	**4.70**	0.764	0.781	0.798	0.815	0.833	0.850	0.868	0.850	0.904	0.923
4.8	**4.75**	0.772	0.789	0.807	0.824	0.842	0.860	0.878	0.860	0.914	0.933
4.8	**4.80**	0.780	0.798	0.815	0.833	0.851	0.869	0.887	0.869	0.924	0.942
4.9	**4.85**	0.789	0.806	0.824	0.841	0.859	0.878	0.896	0.878	0.933	0.952
4.9	**4.90**	0.797	0.814	0.832	0.850	0.868	0.887	0.905	0.887	0.943	0.962
5.0	**4.95**	0.805	0.823	0.841	0.859	0.877	0.896	0.914	0.896	0.953	0.972
5.0	**5.00**	0.813	0.831	0.849	0.867	0.886	0.905	0.924	0.905	0.962	0.982
5.1	**5.05**	0.821	0.839	0.858	0.876	0.895	0.914	0.933	0.914	0.972	0.992
5.1	**5.10**	0.829	0.848	0.866	0.885	0.904	0.923	0.942	0.923	0.981	1.001

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	50.5	51	51.5	52	52.5	53	53.5	54	54.5	55
0.1	0.05	0.010	0.010	0.010	0.011	0.011	0.011	0.011	0.011	0.012	0.012
0.1	0.10	0.020	0.020	0.021	0.021	0.022	0.022	0.022	0.023	0.023	0.024
0.2	0.15	0.030	0.031	0.031	0.032	0.032	0.033	0.034	0.034	0.035	0.036
0.2	0.20	0.040	0.041	0.042	0.042	0.043	0.044	0.045	0.046	0.047	0.048
0.3	0.25	0.050	0.051	0.052	0.053	0.054	0.055	0.056	0.057	0.058	0.059
0.3	0.30	0.060	0.061	0.062	0.064	0.065	0.066	0.067	0.069	0.070	0.071
0.4	0.35	0.070	0.071	0.073	0.074	0.076	0.077	0.079	0.080	0.082	0.083
0.4	0.40	0.080	0.082	0.083	0.085	0.087	0.088	0.090	0.092	0.093	0.095
0.5	0.45	0.090	0.092	0.094	0.096	0.097	0.099	0.101	0.103	0.105	0.107
0.5	0.50	0.100	0.102	0.104	0.106	0.108	0.110	0.112	0.115	0.117	0.119
0.6	0.55	0.110	0.112	0.115	0.117	0.119	0.121	0.124	0.126	0.128	0.131
0.6	0.60	0.120	0.123	0.125	0.127	0.130	0.132	0.135	0.137	0.140	0.143
0.7	0.65	0.130	0.133	0.135	0.138	0.141	0.143	0.146	0.149	0.152	0.154
0.7	0.70	0.140	0.143	0.146	0.149	0.152	0.154	0.157	0.160	0.163	0.166
0.8	0.75	0.150	0.153	0.156	0.159	0.162	0.165	0.169	0.172	0.175	0.178
0.8	0.80	0.160	0.163	0.167	0.170	0.173	0.176	0.180	0.183	0.187	0.190
0.9	0.85	0.170	0.174	0.177	0.181	0.184	0.188	0.191	0.195	0.198	0.202
0.9	0.90	0.180	0.184	0.187	0.191	0.195	0.199	0.202	0.206	0.210	0.214
1.0	0.95	0.190	0.194	0.198	0.202	0.206	0.210	0.214	0.218	0.222	0.226
1.0	1.00	0.200	0.204	0.208	0.212	0.216	0.221	0.225	0.229	0.233	0.238
1.1	1.05	0.210	0.214	0.219	0.223	0.227	0.232	0.236	0.240	0.245	0.249
1.1	1.10	0.220	0.225	0.229	0.234	0.238	0.243	0.247	0.252	0.257	0.261
1.2	1.15	0.230	0.235	0.240	0.244	0.249	0.254	0.259	0.263	0.268	0.273
1.2	1.20	0.240	0.245	0.250	0.255	0.260	0.265	0.270	0.275	0.280	0.285
1.3	1.25	0.250	0.255	0.260	0.265	0.271	0.276	0.281	0.286	0.292	0.297
1.3	1.30	0.260	0.266	0.271	0.276	0.281	0.287	0.292	0.298	0.303	0.309
1.4	1.35	0.270	0.276	0.281	0.287	0.292	0.298	0.303	0.309	0.315	0.321
1.4	1.40	0.280	0.286	0.292	0.297	0.303	0.309	0.315	0.321	0.327	0.333
1.5	1.45	0.290	0.296	0.302	0.308	0.314	0.320	0.326	0.332	0.338	0.344
1.5	1.50	0.300	0.306	0.312	0.319	0.325	0.331	0.337	0.344	0.350	0.356
1.6	1.55	0.310	0.317	0.323	0.329	0.336	0.342	0.348	0.355	0.362	0.368
1.6	1.60	0.320	0.327	0.333	0.340	0.346	0.353	0.360	0.366	0.373	0.380
1.7	1.65	0.330	0.337	0.344	0.350	0.357	0.364	0.371	0.378	0.385	0.392
1.7	1.70	0.341	0.347	0.354	0.361	0.368	0.375	0.382	0.389	0.397	0.404
1.8	1.75	0.351	0.357	0.365	0.372	0.379	0.386	0.393	0.401	0.408	0.416
1.8	1.80	0.361	0.368	0.375	0.382	0.390	0.397	0.405	0.412	0.420	0.428
1.9	1.85	0.371	0.378	0.385	0.393	0.400	0.408	0.416	0.424	0.432	0.440
1.9	1.90	0.381	0.388	0.396	0.404	0.411	0.419	0.427	0.435	0.443	0.451
2.0	1.95	0.391	0.398	0.406	0.414	0.422	0.430	0.438	0.447	0.455	0.463

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class Midpoints		50.5	51	51.5	52	52.5	53	53.5	54	54.5	55
2.0	**2.00**	0.401	0.409	0.417	0.425	0.433	0.441	0.450	0.458	0.467	0.475
2.1	**2.05**	0.411	0.419	0.427	0.435	0.444	0.452	0.461	0.469	0.478	0.487
2.1	**2.10**	0.421	0.429	0.437	0.446	0.455	0.463	0.472	0.481	0.490	0.499
2.2	**2.15**	0.431	0.439	0.448	0.457	0.465	0.474	0.483	0.492	0.502	0.511
2.2	**2.20**	0.441	0.449	0.458	0.467	0.476	0.485	0.495	0.504	0.513	0.523
2.3	**2.25**	0.451	0.460	0.469	0.478	0.487	0.496	0.506	0.515	0.525	0.535
2.3	**2.30**	0.461	0.470	0.479	0.488	0.498	0.507	0.517	0.527	0.537	0.546
2.4	**2.35**	0.471	0.480	0.490	0.499	0.509	0.518	0.528	0.538	0.548	0.558
2.4	**2.40**	0.481	0.490	0.500	0.510	0.520	0.529	0.540	0.550	0.560	0.570
2.5	**2.45**	0.491	0.500	0.510	0.520	0.530	0.541	0.551	0.561	0.572	0.582
2.5	**2.50**	0.501	0.511	0.521	0.531	0.541	0.552	0.562	0.573	0.583	0.594
2.6	**2.55**	0.511	0.521	0.531	0.542	0.552	0.563	0.573	0.584	0.595	0.606
2.6	**2.60**	0.521	0.531	0.542	0.552	0.563	0.574	0.584	0.595	0.607	0.618
2.7	**2.65**	0.531	0.541	0.552	0.563	0.574	0.585	0.596	0.607	0.618	0.630
2.7	**2.70**	0.541	0.552	0.562	0.573	0.584	0.596	0.607	0.618	0.630	0.641
2.8	**2.75**	0.551	0.562	0.573	0.584	0.595	0.607	0.618	0.630	0.642	0.653
2.8	**2.80**	0.561	0.572	0.583	0.595	0.606	0.618	0.629	0.641	0.653	0.665
2.9	**2.85**	0.571	0.582	0.594	0.605	0.617	0.629	0.641	0.653	0.665	0.677
2.9	**2.90**	0.581	0.592	0.604	0.616	0.628	0.640	0.652	0.664	0.677	0.689
3.0	**2.95**	0.591	0.603	0.615	0.626	0.639	0.651	0.663	0.676	0.688	0.701
3.0	**3.00**	0.601	0.613	0.625	0.637	0.649	0.662	0.674	0.687	0.700	0.713
3.1	**3.05**	0.611	0.623	0.635	0.648	0.660	0.673	0.686	0.699	0.712	0.725
3.1	**3.10**	0.621	0.633	0.646	0.658	0.671	0.684	0.697	0.710	0.723	0.737
3.2	**3.15**	0.631	0.643	0.656	0.669	0.682	0.695	0.708	0.721	0.735	0.748
3.2	**3.20**	0.641	0.654	0.667	0.680	0.693	0.706	0.719	0.733	0.747	0.760
3.3	**3.25**	0.651	0.664	0.677	0.690	0.704	0.717	0.731	0.744	0.758	0.772
3.3	**3.30**	0.661	0.674	0.687	0.701	0.714	0.728	0.742	0.756	0.770	0.784
3.4	**3.35**	0.671	0.684	0.698	0.711	0.725	0.739	0.753	0.767	0.781	0.796
3.4	**3.40**	0.681	0.695	0.708	0.722	0.736	0.750	0.764	0.779	0.793	0.808
3.5	**3.45**	0.691	0.705	0.719	0.733	0.747	0.761	0.776	0.790	0.805	0.820
3.5	**3.50**	0.701	0.715	0.729	0.743	0.758	0.772	0.787	0.802	0.816	0.832
3.6	**3.55**	0.711	0.725	0.739	0.754	0.768	0.783	0.798	0.813	0.828	0.843
3.6	**3.60**	0.721	0.735	0.750	0.765	0.779	0.794	0.809	0.824	0.840	0.855
3.7	**3.65**	0.731	0.746	0.760	0.775	0.790	0.805	0.821	0.836	0.851	0.867
3.7	**3.70**	0.741	0.756	0.771	0.786	0.801	0.816	0.832	0.847	0.863	0.879
3.8	**3.75**	0.751	0.766	0.781	0.796	0.812	0.827	0.843	0.859	0.875	0.891
3.8	**3.80**	0.761	0.776	0.792	0.807	0.823	0.838	0.854	0.870	0.886	0.903
3.9	**3.85**	0.771	0.786	0.802	0.818	0.833	0.849	0.865	0.882	0.898	0.915
3.9	**3.90**	0.781	0.797	0.812	0.828	0.844	0.860	0.877	0.893	0.910	0.927

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	50.5	51	51.5	52	52.5	53	53.5	54	54.5	55
4.0	**3.95**	0.791	0.807	0.823	0.839	0.855	0.871	0.888	0.905	0.921	0.938
4.0	**4.00**	0.801	0.817	0.833	0.849	0.866	0.882	0.899	0.916	0.933	0.950
4.1	**4.05**	0.811	0.827	0.844	0.860	0.877	0.894	0.910	0.928	0.945	0.962
4.1	**4.10**	0.821	0.838	0.854	0.871	0.888	0.905	0.922	0.939	0.956	0.974
4.2	**4.15**	0.831	0.848	0.864	0.881	0.898	0.916	0.933	0.950	0.968	0.986
4.2	**4.20**	0.841	0.858	0.875	0.892	0.909	0.927	0.944	0.962	0.980	0.998
4.3	**4.25**	0.851	0.868	0.885	0.903	0.920	0.938	0.955	0.973	0.991	1.010
4.3	**4.30**	0.861	0.878	0.896	0.913	0.931	0.949	0.967	0.985	1.003	1.022
4.4	**4.35**	0.871	0.889	0.906	0.924	0.942	0.960	0.978	0.996	1.015	1.033
4.4	**4.40**	0.881	0.899	0.917	0.934	0.952	0.971	0.989	1.008	1.026	1.045
4.5	**4.45**	0.891	0.909	0.927	0.945	0.963	0.982	1.000	1.019	1.038	1.057
4.5	**4.50**	0.901	0.919	0.937	0.956	0.974	0.993	1.012	1.031	1.050	1.069
4.6	**4.55**	0.911	0.929	0.948	0.966	0.985	1.004	1.023	1.042	1.061	1.081
4.6	**4.60**	0.921	0.940	0.958	0.977	0.996	1.015	1.034	1.054	1.073	1.093
4.7	**4.65**	0.931	0.950	0.969	0.988	1.007	1.026	1.045	1.065	1.085	1.105
4.7	**4.70**	0.941	0.960	0.979	0.998	1.017	1.037	1.057	1.076	1.096	1.117
4.8	**4.75**	0.951	0.970	0.989	1.009	1.028	1.048	1.068	1.088	1.108	1.129
4.8	**4.80**	0.961	0.981	1.000	1.019	1.039	1.059	1.079	1.099	1.120	1.140
4.9	**4.85**	0.971	0.991	1.010	1.030	1.050	1.070	1.090	1.111	1.131	1.152
4.9	**4.90**	0.981	1.001	1.021	1.041	1.061	1.081	1.102	1.122	1.143	1.164
5.0	**4.95**	0.991	1.011	1.031	1.051	1.072	1.092	1.113	1.134	1.155	1.176
5.0	**5.00**	1.001	1.021	1.042	1.062	1.082	1.103	1.124	1.145	1.166	1.188
5.1	**5.05**	1.011	1.032	1.052	1.072	1.093	1.114	1.135	1.157	1.178	1.200
5.1	**5.10**	1.022	1.042	1.062	1.083	1.104	1.125	1.146	1.168	1.190	1.212

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	55.5	56	56.5	57	57.5	58	58.5	59	59.5	60
0.1	**0.05**	0.012	0.012	0.013	0.013	0.013	0.013	0.013	0.014	0.014	0.014
0.1	**0.10**	0.024	0.025	0.025	0.026	0.026	0.026	0.027	0.027	0.028	0.028
0.2	**0.15**	0.036	0.037	0.038	0.038	0.039	0.040	0.040	0.041	0.042	0.042
0.2	**0.20**	0.048	0.049	0.050	0.051	0.052	0.053	0.054	0.055	0.056	0.057
0.3	**0.25**	0.060	0.062	0.063	0.064	0.065	0.066	0.067	0.068	0.070	0.071
0.3	**0.30**	0.073	0.074	0.075	0.077	0.078	0.079	0.081	0.082	0.083	0.085
0.4	**0.35**	0.085	0.086	0.088	0.089	0.091	0.092	0.094	0.096	0.097	0.099
0.4	**0.40**	0.097	0.099	0.100	0.102	0.104	0.106	0.108	0.109	0.111	0.113
0.5	**0.45**	0.109	0.111	0.113	0.115	0.117	0.119	0.121	0.123	0.125	0.127
0.5	**0.50**	0.121	0.123	0.125	0.128	0.130	0.132	0.134	0.137	0.139	0.141
0.6	**0.55**	0.133	0.135	0.138	0.140	0.143	0.145	0.148	0.150	0.153	0.156
0.6	**0.60**	0.145	0.148	0.150	0.153	0.156	0.159	0.161	0.164	0.167	0.170
0.7	**0.65**	0.157	0.160	0.163	0.166	0.169	0.172	0.175	0.178	0.181	0.184
0.7	**0.70**	0.169	0.172	0.176	0.179	0.182	0.185	0.188	0.191	0.195	0.198
0.8	**0.75**	0.181	0.185	0.188	0.191	0.195	0.198	0.202	0.205	0.209	0.212
0.8	**0.80**	0.194	0.197	0.201	0.204	0.208	0.211	0.215	0.219	0.222	0.226
0.9	**0.85**	0.206	0.209	0.213	0.217	0.221	0.225	0.228	0.232	0.236	0.240
0.9	**0.90**	0.218	0.222	0.226	0.230	0.234	0.238	0.242	0.246	0.250	0.254
1.0	**0.95**	0.230	0.234	0.238	0.242	0.247	0.251	0.255	0.260	0.264	0.269
1.0	**1.00**	0.242	0.246	0.251	0.255	0.260	0.264	0.269	0.273	0.278	0.283
1.1	**1.05**	0.254	0.259	0.263	0.268	0.273	0.277	0.282	0.287	0.292	0.297
1.1	**1.10**	0.266	0.271	0.276	0.281	0.286	0.291	0.296	0.301	0.306	0.311
1.2	**1.15**	0.278	0.283	0.288	0.293	0.299	0.304	0.309	0.314	0.320	0.325
1.2	**1.20**	0.290	0.296	0.301	0.306	0.312	0.317	0.323	0.328	0.334	0.339
1.3	**1.25**	0.302	0.308	0.313	0.319	0.325	0.330	0.336	0.342	0.348	0.353
1.3	**1.30**	0.314	0.320	0.326	0.332	0.338	0.343	0.349	0.355	0.361	0.368
1.4	**1.35**	0.327	0.333	0.338	0.344	0.351	0.357	0.363	0.369	0.375	0.382
1.4	**1.40**	0.339	0.345	0.351	0.357	0.364	0.370	0.376	0.383	0.389	0.396
1.5	**1.45**	0.351	0.357	0.364	0.370	0.377	0.383	0.390	0.396	0.403	0.410
1.5	**1.50**	0.363	0.369	0.376	0.383	0.390	0.396	0.403	0.410	0.417	0.424
1.6	**1.55**	0.375	0.382	0.389	0.396	0.402	0.410	0.417	0.424	0.431	0.438
1.6	**1.60**	0.387	0.394	0.401	0.408	0.415	0.423	0.430	0.437	0.445	0.452
1.7	**1.65**	0.399	0.406	0.414	0.421	0.428	0.436	0.443	0.451	0.459	0.467
1.7	**1.70**	0.411	0.419	0.426	0.434	0.441	0.449	0.457	0.465	0.473	0.481
1.8	**1.75**	0.423	0.431	0.439	0.447	0.454	0.462	0.470	0.478	0.487	0.495
1.8	**1.80**	0.435	0.443	0.451	0.459	0.467	0.476	0.484	0.492	0.500	0.509
1.9	**1.85**	0.448	0.456	0.464	0.472	0.480	0.489	0.497	0.506	0.514	0.523
1.9	**1.90**	0.460	0.468	0.476	0.485	0.493	0.502	0.511	0.519	0.528	0.537
2.0	**1.95**	0.472	0.480	0.489	0.498	0.506	0.515	0.524	0.533	0.542	0.551

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		55.5	56	56.5	57	57.5	58	58.5	59	59.5	60
Length Class Midpoints											
2.0	**2.00**	0.484	0.493	0.501	0.510	0.519	0.528	0.538	0.547	0.556	0.565
2.1	**2.05**	0.496	0.505	0.514	0.523	0.532	0.542	0.551	0.560	0.570	0.580
2.1	**2.10**	0.508	0.517	0.527	0.536	0.545	0.555	0.564	0.574	0.584	0.594
2.2	**2.15**	0.520	0.530	0.539	0.549	0.558	0.568	0.578	0.588	0.598	0.608
2.2	**2.20**	0.532	0.542	0.552	0.561	0.571	0.581	0.591	0.601	0.612	0.622
2.3	**2.25**	0.544	0.554	0.564	0.574	0.584	0.594	0.605	0.615	0.626	0.636
2.3	**2.30**	0.556	0.566	0.577	0.587	0.597	0.608	0.618	0.629	0.640	0.650
2.4	**2.35**	0.569	0.579	0.589	0.600	0.610	0.621	0.632	0.642	0.653	0.664
2.4	**2.40**	0.581	0.591	0.602	0.612	0.623	0.634	0.645	0.656	0.667	0.679
2.5	**2.45**	0.593	0.603	0.614	0.625	0.636	0.647	0.659	0.670	0.681	0.693
2.5	**2.50**	0.605	0.616	0.627	0.638	0.649	0.661	0.672	0.683	0.695	0.707
2.6	**2.55**	0.617	0.628	0.639	0.651	0.662	0.674	0.685	0.697	0.709	0.721
2.6	**2.60**	0.629	0.640	0.652	0.663	0.675	0.687	0.699	0.711	0.723	0.735
2.7	**2.65**	0.641	0.653	0.664	0.676	0.688	0.700	0.712	0.725	0.737	0.749
2.7	**2.70**	0.653	0.665	0.677	0.689	0.701	0.713	0.726	0.738	0.751	0.763
2.8	**2.75**	0.665	0.677	0.689	0.702	0.714	0.727	0.739	0.752	0.765	0.778
2.8	**2.80**	0.677	0.690	0.702	0.714	0.727	0.740	0.753	0.766	0.779	0.792
2.9	**2.85**	0.689	0.702	0.715	0.727	0.740	0.753	0.766	0.779	0.792	0.806
2.9	**2.90**	0.702	0.714	0.727	0.740	0.753	0.766	0.779	0.793	0.806	0.820
3.0	**2.95**	0.714	0.727	0.740	0.753	0.766	0.779	0.793	0.807	0.820	0.834
3.0	**3.00**	0.726	0.739	0.752	0.766	0.779	0.793	0.806	0.820	0.834	0.848
3.1	**3.05**	0.738	0.751	0.765	0.778	0.792	0.806	0.820	0.834	0.848	0.862
3.1	**3.10**	0.750	0.764	0.777	0.791	0.805	0.819	0.833	0.848	0.862	0.877
3.2	**3.15**	0.762	0.776	0.790	0.804	0.818	0.832	0.847	0.861	0.876	0.891
3.2	**3.20**	0.774	0.788	0.802	0.817	0.831	0.845	0.860	0.875	0.890	0.905
3.3	**3.25**	0.786	0.800	0.815	0.829	0.844	0.859	0.874	0.889	0.904	0.919
3.3	**3.30**	0.798	0.813	0.827	0.842	0.857	0.872	0.887	0.902	0.918	0.933
3.4	**3.35**	0.810	0.825	0.840	0.855	0.870	0.885	0.900	0.916	0.931	0.947
3.4	**3.40**	0.823	0.837	0.852	0.868	0.883	0.898	0.914	0.930	0.945	0.961
3.5	**3.45**	0.835	0.850	0.865	0.880	0.896	0.912	0.927	0.943	0.959	0.975
3.5	**3.50**	0.847	0.862	0.878	0.893	0.909	0.925	0.941	0.957	0.973	0.990
3.6	**3.55**	0.859	0.874	0.890	0.906	0.922	0.938	0.954	0.971	0.987	1.004
3.6	**3.60**	0.871	0.887	0.903	0.919	0.935	0.951	0.968	0.984	1.001	1.018
3.7	**3.65**	0.883	0.899	0.915	0.931	0.948	0.964	0.981	0.998	1.015	1.032
3.7	**3.70**	0.895	0.911	0.928	0.944	0.961	0.978	0.994	1.012	1.029	1.046
3.8	**3.75**	0.907	0.924	0.940	0.957	0.974	0.991	1.008	1.025	1.043	1.060
3.8	**3.80**	0.919	0.936	0.953	0.970	0.987	1.004	1.021	1.039	1.057	1.074
3.9	**3.85**	0.931	0.948	0.965	0.982	1.000	1.017	1.035	1.053	1.070	1.089
3.9	**3.90**	0.943	0.961	0.978	0.995	1.013	1.030	1.048	1.066	1.084	1.103

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		55.5	56	56.5	57	57.5	58	58.5	59	59.5	60
Length Class Midpoints											
4.0	**3.95**	0.956	0.973	0.990	1.008	1.026	1.044	1.062	1.080	1.098	1.117
4.0	**4.00**	0.968	0.985	1.003	1.021	1.039	1.057	1.075	1.094	1.112	1.131
4.1	**4.05**	0.980	0.998	1.015	1.033	1.052	1.070	1.089	1.107	1.126	1.145
4.1	**4.10**	0.992	1.010	1.028	1.046	1.065	1.083	1.102	1.121	1.140	1.159
4.2	**4.15**	1.004	1.022	1.040	1.059	1.078	1.096	1.115	1.135	1.154	1.173
4.2	**4.20**	1.016	1.034	1.053	1.072	1.091	1.110	1.129	1.148	1.168	1.188
4.3	**4.25**	1.028	1.047	1.066	1.084	1.104	1.123	1.142	1.162	1.182	1.202
4.3	**4.30**	1.040	1.059	1.078	1.097	1.117	1.136	1.156	1.176	1.196	1.216
4.4	**4.35**	1.052	1.071	1.091	1.110	1.130	1.149	1.169	1.189	1.210	1.230
4.4	**4.40**	1.064	1.084	1.103	1.123	1.143	1.163	1.183	1.203	1.223	1.244
4.5	**4.45**	1.077	1.096	1.116	1.136	1.156	1.176	1.196	1.217	1.237	1.258
4.5	**4.50**	1.089	1.108	1.128	1.148	1.169	1.189	1.210	1.230	1.251	1.272
4.6	**4.55**	1.101	1.121	1.141	1.161	1.182	1.202	1.223	1.244	1.265	1.286
4.6	**4.60**	1.113	1.133	1.153	1.174	1.194	1.215	1.236	1.258	1.279	1.301
4.7	**4.65**	1.125	1.145	1.166	1.187	1.207	1.229	1.250	1.271	1.293	1.315
4.7	**4.70**	1.137	1.158	1.178	1.199	1.220	1.242	1.263	1.285	1.307	1.329
4.8	**4.75**	1.149	1.170	1.191	1.212	1.233	1.255	1.277	1.299	1.321	1.343
4.8	**4.80**	1.161	1.182	1.203	1.225	1.246	1.268	1.290	1.312	1.335	1.357
4.9	**4.85**	1.173	1.195	1.216	1.238	1.259	1.281	1.304	1.326	1.349	1.371
4.9	**4.90**	1.185	1.207	1.229	1.250	1.272	1.295	1.317	1.340	1.362	1.385
5.0	**4.95**	1.198	1.219	1.241	1.263	1.285	1.308	1.330	1.353	1.376	1.400
5.0	**5.00**	1.210	1.232	1.254	1.276	1.298	1.321	1.344	1.367	1.390	1.414
5.1	**5.05**	1.222	1.244	1.266	1.289	1.311	1.334	1.357	1.381	1.404	1.428
5.1	**5.10**	1.234	1.256	1.279	1.301	1.324	1.347	1.371	1.394	1.418	1.442

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	60.5	61	61.5	62	62.5	63	63.5	64	64.5	65
0.1	**0.05**	0.014	0.015	0.015	0.015	0.015	0.016	0.016	0.016	0.016	0.017
0.1	**0.10**	0.029	0.029	0.030	0.030	0.031	0.031	0.032	0.032	0.033	0.033
0.2	**0.15**	0.043	0.044	0.045	0.045	0.046	0.047	0.048	0.048	0.049	0.050
0.2	**0.20**	0.057	0.058	0.059	0.060	0.061	0.062	0.063	0.064	0.065	0.066
0.3	**0.25**	0.072	0.073	0.074	0.075	0.077	0.078	0.079	0.080	0.082	0.083
0.3	**0.30**	0.086	0.088	0.089	0.091	0.092	0.094	0.095	0.097	0.098	0.100
0.4	**0.35**	0.101	0.102	0.104	0.106	0.107	0.109	0.111	0.113	0.114	0.116
0.4	**0.40**	0.115	0.117	0.119	0.121	0.123	0.125	0.127	0.129	0.131	0.133
0.5	**0.45**	0.129	0.132	0.134	0.136	0.138	0.140	0.143	0.145	0.147	0.149
0.5	**0.50**	0.144	0.146	0.149	0.151	0.153	0.156	0.158	0.161	0.163	0.166
0.6	**0.55**	0.158	0.161	0.163	0.166	0.169	0.171	0.174	0.177	0.180	0.183
0.6	**0.60**	0.172	0.175	0.178	0.181	0.184	0.187	0.190	0.193	0.196	0.199
0.7	**0.65**	0.187	0.190	0.193	0.196	0.199	0.203	0.206	0.209	0.212	0.216
0.7	**0.70**	0.201	0.205	0.208	0.211	0.215	0.218	0.222	0.225	0.229	0.232
0.8	**0.75**	0.216	0.219	0.223	0.226	0.230	0.234	0.238	0.241	0.245	0.249
0.8	**0.80**	0.230	0.234	0.238	0.242	0.245	0.249	0.253	0.257	0.261	0.265
0.9	**0.85**	0.244	0.248	0.252	0.257	0.261	0.265	0.269	0.273	0.278	0.282
0.9	**0.90**	0.259	0.263	0.267	0.272	0.276	0.281	0.285	0.290	0.294	0.299
1.0	**0.95**	0.273	0.278	0.282	0.287	0.291	0.296	0.301	0.306	0.310	0.315
1.0	**1.00**	0.287	0.292	0.297	0.302	0.307	0.312	0.317	0.322	0.327	0.332
1.1	**1.05**	0.302	0.307	0.312	0.317	0.322	0.327	0.333	0.338	0.343	0.348
1.1	**1.10**	0.316	0.321	0.327	0.332	0.337	0.343	0.348	0.354	0.359	0.365
1.2	**1.15**	0.331	0.336	0.342	0.347	0.353	0.358	0.364	0.370	0.376	0.382
1.2	**1.20**	0.345	0.351	0.356	0.362	0.368	0.374	0.380	0.386	0.392	0.398
1.3	**1.25**	0.359	0.365	0.371	0.377	0.383	0.390	0.396	0.402	0.408	0.415
1.3	**1.30**	0.374	0.380	0.386	0.392	0.399	0.405	0.412	0.418	0.425	0.431
1.4	**1.35**	0.388	0.395	0.401	0.408	0.414	0.421	0.428	0.434	0.441	0.448
1.4	**1.40**	0.402	0.409	0.416	0.423	0.430	0.436	0.443	0.450	0.457	0.465
1.5	**1.45**	0.417	0.424	0.431	0.438	0.445	0.452	0.459	0.466	0.474	0.481
1.5	**1.50**	0.431	0.438	0.446	0.453	0.460	0.468	0.475	0.483	0.490	0.498
1.6	**1.55**	0.446	0.453	0.460	0.468	0.476	0.483	0.491	0.499	0.506	0.514
1.6	**1.60**	0.460	0.468	0.475	0.483	0.491	0.499	0.507	0.515	0.523	0.531
1.7	**1.65**	0.474	0.482	0.490	0.498	0.506	0.514	0.523	0.531	0.539	0.548
1.7	**1.70**	0.489	0.497	0.505	0.513	0.522	0.530	0.538	0.547	0.555	0.564
1.8	**1.75**	0.503	0.511	0.520	0.528	0.537	0.546	0.554	0.563	0.572	0.581
1.8	**1.80**	0.517	0.526	0.535	0.543	0.552	0.561	0.570	0.579	0.588	0.597
1.9	**1.85**	0.532	0.541	0.550	0.559	0.568	0.577	0.586	0.595	0.604	0.614
1.9	**1.90**	0.546	0.555	0.564	0.574	0.583	0.592	0.602	0.611	0.621	0.630
2.0	**1.95**	0.561	0.570	0.579	0.589	0.598	0.608	0.618	0.627	0.637	0.647

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	60.5	61	61.5	62	62.5	63	63.5	64	64.5	65
2.0	**2.00**	0.575	0.584	0.594	0.604	0.614	0.623	0.633	0.643	0.653	0.664
2.1	**2.05**	0.589	0.599	0.609	0.619	0.629	0.639	0.649	0.659	0.670	0.680
2.1	**2.10**	0.604	0.614	0.624	0.634	0.644	0.655	0.665	0.676	0.686	0.697
2.2	**2.15**	0.618	0.628	0.639	0.649	0.660	0.670	0.681	0.692	0.703	0.713
2.2	**2.20**	0.632	0.643	0.654	0.664	0.675	0.686	0.697	0.708	0.719	0.730
2.3	**2.25**	0.647	0.658	0.668	0.679	0.690	0.701	0.713	0.724	0.735	0.747
2.3	**2.30**	0.661	0.672	0.683	0.694	0.706	0.717	0.728	0.740	0.752	0.763
2.4	**2.35**	0.676	0.687	0.698	0.709	0.721	0.733	0.744	0.756	0.768	0.780
2.4	**2.40**	0.690	0.701	0.713	0.725	0.736	0.748	0.760	0.772	0.784	0.796
2.5	**2.45**	0.704	0.716	0.728	0.740	0.752	0.764	0.776	0.788	0.801	0.813
2.5	**2.50**	0.719	0.731	0.743	0.755	0.767	0.779	0.792	0.804	0.817	0.830
2.6	**2.55**	0.733	0.745	0.757	0.770	0.782	0.795	0.808	0.820	0.833	0.846
2.6	**2.60**	0.747	0.760	0.772	0.785	0.798	0.810	0.823	0.836	0.850	0.863
2.7	**2.65**	0.762	0.774	0.787	0.800	0.813	0.826	0.839	0.853	0.866	0.879
2.7	**2.70**	0.776	0.789	0.802	0.815	0.828	0.842	0.855	0.869	0.882	0.896
2.8	**2.75**	0.791	0.804	0.817	0.830	0.844	0.857	0.871	0.885	0.899	0.913
2.8	**2.80**	0.805	0.818	0.832	0.845	0.859	0.873	0.887	0.901	0.915	0.929
2.9	**2.85**	0.819	0.833	0.847	0.860	0.874	0.888	0.903	0.917	0.931	0.946
2.9	**2.90**	0.834	0.848	0.861	0.876	0.890	0.904	0.918	0.933	0.948	0.962
3.0	**2.95**	0.848	0.862	0.876	0.891	0.905	0.920	0.934	0.949	0.964	0.979
3.0	**3.00**	0.862	0.877	0.891	0.906	0.920	0.935	0.950	0.965	0.980	0.995
3.1	**3.05**	0.877	0.891	0.906	0.921	0.936	0.951	0.966	0.981	0.997	1.012
3.1	**3.10**	0.891	0.906	0.921	0.936	0.951	0.966	0.982	0.997	1.013	1.029
3.2	**3.15**	0.906	0.921	0.936	0.951	0.966	0.982	0.998	1.013	1.029	1.045
3.2	**3.20**	0.920	0.935	0.951	0.966	0.982	0.998	1.013	1.029	1.046	1.062
3.3	**3.25**	0.934	0.950	0.965	0.981	0.997	1.013	1.029	1.046	1.062	1.078
3.3	**3.30**	0.949	0.964	0.980	0.996	1.012	1.029	1.045	1.062	1.078	1.095
3.4	**3.35**	0.963	0.979	0.995	1.011	1.028	1.044	1.061	1.078	1.095	1.112
3.4	**3.40**	0.977	0.994	1.010	1.026	1.043	1.060	1.077	1.094	1.111	1.128
3.5	**3.45**	0.992	1.008	1.025	1.042	1.058	1.075	1.093	1.110	1.127	1.145
3.5	**3.50**	1.006	1.023	1.040	1.057	1.074	1.091	1.108	1.126	1.144	1.161
3.6	**3.55**	1.021	1.037	1.055	1.072	1.089	1.107	1.124	1.142	1.160	1.178
3.6	**3.60**	1.035	1.052	1.069	1.087	1.104	1.122	1.140	1.158	1.176	1.195
3.7	**3.65**	1.049	1.067	1.084	1.102	1.120	1.138	1.156	1.174	1.193	1.211
3.7	**3.70**	1.064	1.081	1.099	1.117	1.135	1.153	1.172	1.190	1.209	1.228
3.8	**3.75**	1.078	1.096	1.114	1.132	1.150	1.169	1.188	1.206	1.225	1.244
3.8	**3.80**	1.092	1.111	1.129	1.147	1.166	1.185	1.203	1.222	1.242	1.261
3.9	**3.85**	1.107	1.125	1.144	1.162	1.181	1.200	1.219	1.239	1.258	1.278
3.9	**3.90**	1.121	1.140	1.159	1.177	1.197	1.216	1.235	1.255	1.274	1.294

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	60.5	61	61.5	62	62.5	63	63.5	64	64.5	65
4.0	**3.95**	1.136	1.154	1.173	1.193	1.212	1.231	1.251	1.271	1.291	1.311
4.0	**4.00**	1.150	1.169	1.188	1.208	1.227	1.247	1.267	1.287	1.307	1.327
4.1	**4.05**	1.164	1.184	1.203	1.223	1.243	1.262	1.283	1.303	1.323	1.344
4.1	**4.10**	1.179	1.198	1.218	1.238	1.258	1.278	1.298	1.319	1.340	1.361
4.2	**4.15**	1.193	1.213	1.233	1.253	1.273	1.294	1.314	1.335	1.356	1.377
4.2	**4.20**	1.207	1.227	1.248	1.268	1.289	1.309	1.330	1.351	1.372	1.394
4.3	**4.25**	1.222	1.242	1.262	1.283	1.304	1.325	1.346	1.367	1.389	1.410
4.3	**4.30**	1.236	1.257	1.277	1.298	1.319	1.340	1.362	1.383	1.405	1.427
4.4	**4.35**	1.251	1.271	1.292	1.313	1.335	1.356	1.378	1.399	1.421	1.443
4.4	**4.40**	1.265	1.286	1.307	1.328	1.350	1.372	1.393	1.415	1.438	1.460
4.5	**4.45**	1.279	1.301	1.322	1.343	1.365	1.387	1.409	1.432	1.454	1.477
4.5	**4.50**	1.294	1.315	1.337	1.359	1.381	1.403	1.425	1.448	1.470	1.493
4.6	**4.55**	1.308	1.330	1.352	1.374	1.396	1.418	1.441	1.464	1.487	1.510
4.6	**4.60**	1.322	1.344	1.366	1.389	1.411	1.434	1.457	1.480	1.503	1.526
4.7	**4.65**	1.337	1.359	1.381	1.404	1.427	1.450	1.473	1.496	1.519	1.543
4.7	**4.70**	1.351	1.374	1.396	1.419	1.442	1.465	1.488	1.512	1.536	1.560
4.8	**4.75**	1.366	1.388	1.411	1.434	1.457	1.481	1.504	1.528	1.552	1.576
4.8	**4.80**	1.380	1.403	1.426	1.449	1.473	1.496	1.520	1.544	1.568	1.593
4.9	**4.85**	1.394	1.417	1.441	1.464	1.488	1.512	1.536	1.560	1.585	1.609
4.9	**4.90**	1.409	1.432	1.456	1.479	1.503	1.527	1.552	1.576	1.601	1.626
5.0	**4.95**	1.423	1.447	1.470	1.494	1.519	1.543	1.568	1.592	1.617	1.643
5.0	**5.00**	1.437	1.461	1.485	1.510	1.534	1.559	1.583	1.608	1.634	1.659
5.1	**5.05**	1.452	1.476	1.500	1.525	1.549	1.574	1.599	1.625	1.650	1.676
5.1	**5.10**	1.466	1.490	1.515	1.540	1.565	1.590	1.615	1.641	1.666	1.692

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
0.1	**0.05**	0.017	0.017	0.017	0.018	0.018	0.018	0.018	0.019	0.019	0.019
0.1	**0.10**	0.034	0.034	0.035	0.035	0.036	0.036	0.037	0.037	0.038	0.038
0.2	**0.15**	0.051	0.051	0.052	0.053	0.054	0.054	0.055	0.056	0.057	0.058
0.2	**0.20**	0.067	0.068	0.069	0.071	0.072	0.073	0.074	0.075	0.076	0.077
0.3	**0.25**	0.084	0.086	0.087	0.088	0.089	0.091	0.092	0.093	0.095	0.096
0.3	**0.30**	0.101	0.103	0.104	0.106	0.107	0.109	0.111	0.112	0.114	0.115
0.4	**0.35**	0.118	0.120	0.122	0.123	0.125	0.127	0.129	0.131	0.133	0.135
0.4	**0.40**	0.135	0.137	0.139	0.141	0.143	0.145	0.147	0.150	0.152	0.154
0.5	**0.45**	0.152	0.154	0.156	0.159	0.161	0.163	0.166	0.168	0.171	0.173
0.5	**0.50**	0.168	0.171	0.174	0.176	0.179	0.182	0.184	0.187	0.190	0.192
0.6	**0.55**	0.185	0.188	0.191	0.194	0.197	0.200	0.203	0.206	0.209	0.212
0.6	**0.60**	0.202	0.205	0.208	0.212	0.215	0.218	0.221	0.224	0.228	0.231
0.7	**0.65**	0.219	0.222	0.226	0.229	0.233	0.236	0.240	0.243	0.247	0.250
0.7	**0.70**	0.236	0.239	0.243	0.247	0.250	0.254	0.258	0.262	0.266	0.269
0.8	**0.75**	0.253	0.257	0.260	0.264	0.268	0.272	0.276	0.280	0.285	0.289
0.8	**0.80**	0.270	0.274	0.278	0.282	0.286	0.291	0.295	0.299	0.303	0.308
0.9	**0.85**	0.286	0.291	0.295	0.300	0.304	0.309	0.313	0.318	0.322	0.327
0.9	**0.90**	0.303	0.308	0.313	0.317	0.322	0.327	0.332	0.337	0.341	0.346
1.0	**0.95**	0.320	0.325	0.330	0.335	0.340	0.345	0.350	0.355	0.360	0.366
1.0	**1.00**	0.337	0.342	0.347	0.353	0.358	0.363	0.369	0.374	0.379	0.385
1.1	**1.05**	0.354	0.359	0.365	0.370	0.376	0.381	0.387	0.393	0.398	0.404
1.1	**1.10**	0.371	0.376	0.382	0.388	0.394	0.399	0.405	0.411	0.417	0.423
1.2	**1.15**	0.387	0.393	0.399	0.405	0.412	0.418	0.424	0.430	0.436	0.443
1.2	**1.20**	0.404	0.411	0.417	0.423	0.429	0.436	0.442	0.449	0.455	0.462
1.3	**1.25**	0.421	0.428	0.434	0.441	0.447	0.454	0.461	0.467	0.474	0.481
1.3	**1.30**	0.438	0.445	0.452	0.458	0.465	0.472	0.479	0.486	0.493	0.500
1.4	**1.35**	0.455	0.462	0.469	0.476	0.483	0.490	0.498	0.505	0.512	0.520
1.4	**1.40**	0.472	0.479	0.486	0.494	0.501	0.508	0.516	0.524	0.531	0.539
1.5	**1.45**	0.489	0.496	0.504	0.511	0.519	0.527	0.534	0.542	0.550	0.558
1.5	**1.50**	0.505	0.513	0.521	0.529	0.537	0.545	0.553	0.561	0.569	0.577
1.6	**1.55**	0.522	0.530	0.538	0.546	0.555	0.563	0.571	0.580	0.588	0.597
1.6	**1.60**	0.539	0.547	0.556	0.564	0.573	0.581	0.590	0.598	0.607	0.616
1.7	**1.65**	0.556	0.564	0.573	0.582	0.590	0.599	0.608	0.617	0.626	0.635
1.7	**1.70**	0.573	0.582	0.590	0.599	0.608	0.617	0.626	0.636	0.645	0.654
1.8	**1.75**	0.590	0.599	0.608	0.617	0.626	0.636	0.645	0.654	0.664	0.673
1.8	**1.80**	0.607	0.616	0.625	0.635	0.644	0.654	0.663	0.673	0.683	0.693
1.9	**1.85**	0.623	0.633	0.643	0.652	0.662	0.672	0.682	0.692	0.702	0.712
1.9	**1.90**	0.640	0.650	0.660	0.670	0.680	0.690	0.700	0.710	0.721	0.731
2.0	**1.95**	0.657	0.667	0.677	0.688	0.698	0.708	0.719	0.729	0.740	0.750

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class Midpoints		65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
2.0	**2.00**	0.674	0.684	0.695	0.705	0.716	0.726	0.737	0.748	0.759	0.770
2.1	**2.05**	0.691	0.701	0.712	0.723	0.734	0.744	0.755	0.767	0.778	0.789
2.1	**2.10**	0.708	0.718	0.729	0.740	0.751	0.763	0.774	0.785	0.797	0.808
2.2	**2.15**	0.724	0.736	0.747	0.758	0.769	0.781	0.792	0.804	0.816	0.827
2.2	**2.20**	0.741	0.753	0.764	0.776	0.787	0.799	0.811	0.823	0.835	0.847
2.3	**2.25**	0.758	0.770	0.781	0.793	0.805	0.817	0.829	0.841	0.854	0.866
2.3	**2.30**	0.775	0.787	0.799	0.811	0.823	0.835	0.848	0.860	0.873	0.885
2.4	**2.35**	0.792	0.804	0.816	0.829	0.841	0.853	0.866	0.879	0.892	0.904
2.4	**2.40**	0.809	0.821	0.834	0.846	0.859	0.872	0.884	0.897	0.910	0.924
2.5	**2.45**	0.826	0.838	0.851	0.864	0.877	0.890	0.903	0.916	0.929	0.943
2.5	**2.50**	0.842	0.855	0.868	0.881	0.895	0.908	0.921	0.935	0.948	0.962
2.6	**2.55**	0.859	0.872	0.886	0.899	0.913	0.926	0.940	0.954	0.967	0.981
2.6	**2.60**	0.876	0.890	0.903	0.917	0.930	0.944	0.958	0.972	0.986	1.001
2.7	**2.65**	0.893	0.907	0.920	0.934	0.948	0.962	0.977	0.991	1.005	1.020
2.7	**2.70**	0.910	0.924	0.938	0.952	0.966	0.981	0.995	1.010	1.024	1.039
2.8	**2.75**	0.927	0.941	0.955	0.970	0.984	0.999	1.013	1.028	1.043	1.058
2.8	**2.80**	0.943	0.958	0.973	0.987	1.002	1.017	1.032	1.047	1.062	1.078
2.9	**2.85**	0.960	0.975	0.990	1.005	1.020	1.035	1.050	1.066	1.081	1.097
2.9	**2.90**	0.977	0.992	1.007	1.022	1.038	1.053	1.069	1.084	1.100	1.116
3.0	**2.95**	0.994	1.009	1.025	1.040	1.056	1.071	1.087	1.103	1.119	1.135
3.0	**3.00**	1.011	1.026	1.042	1.058	1.074	1.090	1.106	1.122	1.138	1.155
3.1	**3.05**	1.028	1.043	1.059	1.075	1.091	1.108	1.124	1.140	1.157	1.174
3.1	**3.10**	1.045	1.061	1.077	1.093	1.109	1.126	1.142	1.159	1.176	1.193
3.2	**3.15**	1.061	1.078	1.094	1.111	1.127	1.144	1.161	1.178	1.195	1.212
3.2	**3.20**	1.078	1.095	1.111	1.128	1.145	1.162	1.179	1.197	1.214	1.232
3.3	**3.25**	1.095	1.112	1.129	1.146	1.163	1.180	1.198	1.215	1.233	1.251
3.3	**3.30**	1.112	1.129	1.146	1.163	1.181	1.198	1.216	1.234	1.252	1.270
3.4	**3.35**	1.129	1.146	1.164	1.181	1.199	1.217	1.235	1.253	1.271	1.289
3.4	**3.40**	1.146	1.163	1.181	1.199	1.217	1.235	1.253	1.271	1.290	1.308
3.5	**3.45**	1.162	1.180	1.198	1.216	1.235	1.253	1.271	1.290	1.309	1.328
3.5	**3.50**	1.179	1.197	1.216	1.234	1.252	1.271	1.290	1.309	1.328	1.347
3.6	**3.55**	1.196	1.215	1.233	1.252	1.270	1.289	1.308	1.327	1.347	1.366
3.6	**3.60**	1.213	1.232	1.250	1.269	1.288	1.307	1.327	1.346	1.366	1.385
3.7	**3.65**	1.230	1.249	1.268	1.287	1.306	1.326	1.345	1.365	1.385	1.405
3.7	**3.70**	1.247	1.266	1.285	1.304	1.324	1.344	1.364	1.384	1.404	1.424
3.8	**3.75**	1.264	1.283	1.302	1.322	1.342	1.362	1.382	1.402	1.423	1.443
3.8	**3.80**	1.280	1.300	1.320	1.340	1.360	1.380	1.400	1.421	1.442	1.462
3.9	**3.85**	1.297	1.317	1.337	1.357	1.378	1.398	1.419	1.440	1.461	1.482
3.9	**3.90**	1.314	1.334	1.355	1.375	1.396	1.416	1.437	1.458	1.480	1.501

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		65.5	66	66.5	67	67.5	68	68.5	69	69.5	70
Length Class	**Midpoints**										
4.0	**3.95**	1.331	1.351	1.372	1.393	1.413	1.435	1.456	1.477	1.499	1.520
4.0	**4.00**	1.348	1.368	1.389	1.410	1.431	1.453	1.474	1.496	1.517	1.539
4.1	**4.05**	1.365	1.386	1.407	1.428	1.449	1.471	1.493	1.514	1.536	1.559
4.1	**4.10**	1.382	1.403	1.424	1.446	1.467	1.489	1.511	1.533	1.555	1.578
4.2	**4.15**	1.398	1.420	1.441	1.463	1.485	1.507	1.529	1.552	1.574	1.597
4.2	**4.20**	1.415	1.437	1.459	1.481	1.503	1.525	1.548	1.571	1.593	1.616
4.3	**4.25**	1.432	1.454	1.476	1.498	1.521	1.543	1.566	1.589	1.612	1.636
4.3	**4.30**	1.449	1.471	1.493	1.516	1.539	1.562	1.585	1.608	1.631	1.655
4.4	**4.35**	1.466	1.488	1.511	1.534	1.557	1.580	1.603	1.627	1.650	1.674
4.4	**4.40**	1.483	1.505	1.528	1.551	1.575	1.598	1.622	1.645	1.669	1.693
4.5	**4.45**	1.499	1.522	1.546	1.569	1.592	1.616	1.640	1.664	1.688	1.713
4.5	**4.50**	1.516	1.540	1.563	1.587	1.610	1.634	1.658	1.683	1.707	1.732
4.6	**4.55**	1.533	1.557	1.580	1.604	1.628	1.652	1.677	1.701	1.726	1.751
4.6	**4.60**	1.550	1.574	1.598	1.622	1.646	1.671	1.695	1.720	1.745	1.770
4.7	**4.65**	1.567	1.591	1.615	1.639	1.664	1.689	1.714	1.739	1.764	1.790
4.7	**4.70**	1.584	1.608	1.632	1.657	1.682	1.707	1.732	1.757	1.783	1.809
4.8	**4.75**	1.601	1.625	1.650	1.675	1.700	1.725	1.751	1.776	1.802	1.828
4.8	**4.80**	1.617	1.642	1.667	1.692	1.718	1.743	1.769	1.795	1.821	1.847
4.9	**4.85**	1.634	1.659	1.685	1.710	1.736	1.761	1.787	1.814	1.840	1.867
4.9	**4.90**	1.651	1.676	1.702	1.728	1.753	1.780	1.806	1.832	1.859	1.886
5.0	**4.95**	1.668	1.693	1.719	1.745	1.771	1.798	1.824	1.851	1.878	1.905
5.0	**5.00**	1.685	1.711	1.737	1.763	1.789	1.816	1.843	1.870	1.897	1.924
5.1	**5.05**	1.702	1.728	1.754	1.780	1.807	1.834	1.861	1.888	1.916	1.943
5.1	**5.10**	1.718	1.745	1.771	1.798	1.825	1.852	1.879	1.907	1.935	1.963

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75
0.1	**0.05**	0.020	0.020	0.020	0.020	0.021	0.021	0.021	0.022	0.022	0.022
0.1	**0.10**	0.039	0.040	0.040	0.041	0.041	0.042	0.042	0.043	0.044	0.044
0.2	**0.15**	0.059	0.059	0.060	0.061	0.062	0.063	0.064	0.065	0.065	0.066
0.2	**0.20**	0.078	0.079	0.080	0.081	0.083	0.084	0.085	0.086	0.087	0.088
0.3	**0.25**	0.098	0.099	0.100	0.102	0.103	0.105	0.106	0.108	0.109	0.110
0.3	**0.30**	0.117	0.119	0.120	0.122	0.124	0.126	0.127	0.129	0.131	0.133
0.4	**0.35**	0.137	0.139	0.141	0.143	0.144	0.146	0.149	0.151	0.153	0.155
0.4	**0.40**	0.156	0.158	0.161	0.163	0.165	0.167	0.170	0.172	0.174	0.177
0.5	**0.45**	0.176	0.178	0.181	0.183	0.186	0.188	0.191	0.194	0.196	0.199
0.5	**0.50**	0.195	0.198	0.201	0.204	0.206	0.209	0.212	0.215	0.218	0.221
0.6	**0.55**	0.215	0.218	0.221	0.224	0.227	0.230	0.233	0.237	0.240	0.243
0.6	**0.60**	0.234	0.238	0.241	0.244	0.248	0.251	0.255	0.258	0.262	0.265
0.7	**0.65**	0.254	0.257	0.261	0.265	0.268	0.272	0.276	0.280	0.283	0.287
0.7	**0.70**	0.273	0.277	0.281	0.285	0.289	0.293	0.297	0.301	0.305	0.309
0.8	**0.75**	0.293	0.297	0.301	0.305	0.310	0.314	0.318	0.323	0.327	0.331
0.8	**0.80**	0.312	0.317	0.321	0.326	0.330	0.335	0.339	0.344	0.349	0.353
0.9	**0.85**	0.332	0.337	0.341	0.346	0.351	0.356	0.361	0.366	0.371	0.376
0.9	**0.90**	0.351	0.356	0.361	0.366	0.372	0.377	0.382	0.387	0.392	0.398
1.0	**0.95**	0.371	0.376	0.381	0.387	0.392	0.398	0.403	0.409	0.414	0.420
1.0	**1.00**	0.390	0.396	0.402	0.407	0.413	0.419	0.424	0.430	0.436	0.442
1.1	**1.05**	0.410	0.416	0.422	0.428	0.433	0.439	0.446	0.452	0.458	0.464
1.1	**1.10**	0.429	0.436	0.442	0.448	0.454	0.460	0.467	0.473	0.480	0.486
1.2	**1.15**	0.449	0.455	0.462	0.468	0.475	0.481	0.488	0.495	0.501	0.508
1.2	**1.20**	0.468	0.475	0.482	0.489	0.495	0.502	0.509	0.516	0.523	0.530
1.3	**1.25**	0.488	0.495	0.502	0.509	0.516	0.523	0.530	0.538	0.545	0.552
1.3	**1.30**	0.507	0.515	0.522	0.529	0.537	0.544	0.552	0.559	0.567	0.574
1.4	**1.35**	0.527	0.534	0.542	0.550	0.557	0.565	0.573	0.581	0.588	0.596
1.4	**1.40**	0.547	0.554	0.562	0.570	0.578	0.586	0.594	0.602	0.610	0.619
1.5	**1.45**	0.566	0.574	0.582	0.590	0.599	0.607	0.615	0.624	0.632	0.641
1.5	**1.50**	0.586	0.594	0.602	0.611	0.619	0.628	0.636	0.645	0.654	0.663
1.6	**1.55**	0.605	0.614	0.622	0.631	0.640	0.649	0.658	0.667	0.676	0.685
1.6	**1.60**	0.625	0.633	0.642	0.651	0.661	0.670	0.679	0.688	0.697	0.707
1.7	**1.65**	0.644	0.653	0.663	0.672	0.681	0.691	0.700	0.710	0.719	0.729
1.7	**1.70**	0.664	0.673	0.683	0.692	0.702	0.712	0.721	0.731	0.741	0.751
1.8	**1.75**	0.683	0.693	0.703	0.713	0.722	0.732	0.743	0.753	0.763	0.773
1.8	**1.80**	0.703	0.713	0.723	0.733	0.743	0.753	0.764	0.774	0.785	0.795
1.9	**1.85**	0.722	0.732	0.743	0.753	0.764	0.774	0.785	0.796	0.806	0.817
1.9	**1.90**	0.742	0.752	0.763	0.774	0.784	0.795	0.806	0.817	0.828	0.839
2.0	**1.95**	0.761	0.772	0.783	0.794	0.805	0.816	0.827	0.839	0.850	0.861

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	70.5	71	71.5	72	72.5	73	73.5	74	74.5	75
2.0	**2.00**	0.781	0.792	0.803	0.814	0.826	0.837	0.849	0.860	0.872	0.884
2.1	**2.05**	0.800	0.812	0.823	0.835	0.846	0.858	0.870	0.882	0.894	0.906
2.1	**2.10**	0.820	0.831	0.843	0.855	0.867	0.879	0.891	0.903	0.915	0.928
2.2	**2.15**	0.839	0.851	0.863	0.875	0.888	0.900	0.912	0.925	0.937	0.950
2.2	**2.20**	0.859	0.871	0.883	0.896	0.908	0.921	0.933	0.946	0.959	0.972
2.3	**2.25**	0.878	0.891	0.903	0.916	0.929	0.942	0.955	0.968	0.981	0.994
2.3	**2.30**	0.898	0.911	0.923	0.936	0.949	0.963	0.976	0.989	1.003	1.016
2.4	**2.35**	0.917	0.930	0.944	0.957	0.970	0.984	0.997	1.011	1.024	1.038
2.4	**2.40**	0.937	0.950	0.964	0.977	0.991	1.004	1.018	1.032	1.046	1.060
2.5	**2.45**	0.956	0.970	0.984	0.998	1.011	1.025	1.040	1.054	1.068	1.082
2.5	**2.50**	0.976	0.990	1.004	1.018	1.032	1.046	1.061	1.075	1.090	1.104
2.6	**2.55**	0.995	1.010	1.024	1.038	1.053	1.067	1.082	1.097	1.112	1.127
2.6	**2.60**	1.015	1.029	1.044	1.059	1.073	1.088	1.103	1.118	1.133	1.149
2.7	**2.65**	1.034	1.049	1.064	1.079	1.094	1.109	1.124	1.140	1.155	1.171
2.7	**2.70**	1.054	1.069	1.084	1.099	1.115	1.130	1.146	1.161	1.177	1.193
2.8	**2.75**	1.073	1.089	1.104	1.120	1.135	1.151	1.167	1.183	1.199	1.215
2.8	**2.80**	1.093	1.109	1.124	1.140	1.156	1.172	1.188	1.204	1.221	1.237
2.9	**2.85**	1.113	1.128	1.144	1.160	1.177	1.193	1.209	1.226	1.242	1.259
2.9	**2.90**	1.132	1.148	1.164	1.181	1.197	1.214	1.230	1.247	1.264	1.281
3.0	**2.95**	1.152	1.168	1.184	1.201	1.218	1.235	1.252	1.269	1.286	1.303
3.0	**3.00**	1.171	1.188	1.205	1.221	1.238	1.256	1.273	1.290	1.308	1.325
3.1	**3.05**	1.191	1.208	1.225	1.242	1.259	1.277	1.294	1.312	1.330	1.347
3.1	**3.10**	1.210	1.227	1.245	1.262	1.280	1.297	1.315	1.333	1.351	1.370
3.2	**3.15**	1.230	1.247	1.265	1.283	1.300	1.318	1.337	1.355	1.373	1.392
3.2	**3.20**	1.249	1.267	1.285	1.303	1.321	1.339	1.358	1.376	1.395	1.414
3.3	**3.25**	1.269	1.287	1.305	1.323	1.342	1.360	1.379	1.398	1.417	1.436
3.3	**3.30**	1.288	1.307	1.325	1.344	1.362	1.381	1.400	1.419	1.439	1.458
3.4	**3.35**	1.308	1.326	1.345	1.364	1.383	1.402	1.421	1.441	1.460	1.480
3.4	**3.40**	1.327	1.346	1.365	1.384	1.404	1.423	1.443	1.462	1.482	1.502
3.5	**3.45**	1.347	1.366	1.385	1.405	1.424	1.444	1.464	1.484	1.504	1.524
3.5	**3.50**	1.366	1.386	1.405	1.425	1.445	1.465	1.485	1.505	1.526	1.546
3.6	**3.55**	1.386	1.406	1.425	1.445	1.466	1.486	1.506	1.527	1.548	1.568
3.6	**3.60**	1.405	1.425	1.445	1.466	1.486	1.507	1.527	1.548	1.569	1.590
3.7	**3.65**	1.425	1.445	1.466	1.486	1.507	1.528	1.549	1.570	1.591	1.613
3.7	**3.70**	1.444	1.465	1.486	1.506	1.527	1.549	1.570	1.591	1.613	1.635
3.8	**3.75**	1.464	1.485	1.506	1.527	1.548	1.570	1.591	1.613	1.635	1.657
3.8	**3.80**	1.483	1.504	1.526	1.547	1.569	1.590	1.612	1.634	1.656	1.679
3.9	**3.85**	1.503	1.524	1.546	1.568	1.589	1.611	1.634	1.656	1.678	1.701
3.9	**3.90**	1.522	1.544	1.566	1.588	1.610	1.632	1.655	1.677	1.700	1.723

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		70.5	71	71.5	72	72.5	73	73.5	74	74.5	75
Length Class Midpoints											
4.0	**3.95**	1.542	1.564	1.586	1.608	1.631	1.653	1.676	1.699	1.722	1.745
4.0	**4.00**	1.561	1.584	1.606	1.629	1.651	1.674	1.697	1.720	1.744	1.767
4.1	**4.05**	1.581	1.603	1.626	1.649	1.672	1.695	1.718	1.742	1.765	1.789
4.1	**4.10**	1.600	1.623	1.646	1.669	1.693	1.716	1.740	1.763	1.787	1.811
4.2	**4.15**	1.620	1.643	1.666	1.690	1.713	1.737	1.761	1.785	1.809	1.833
4.2	**4.20**	1.640	1.663	1.686	1.710	1.734	1.758	1.782	1.806	1.831	1.856
4.3	**4.25**	1.659	1.683	1.706	1.730	1.755	1.779	1.803	1.828	1.853	1.878
4.3	**4.30**	1.679	1.702	1.727	1.751	1.775	1.800	1.824	1.849	1.874	1.900
4.4	**4.35**	1.698	1.722	1.747	1.771	1.796	1.821	1.846	1.871	1.896	1.922
4.4	**4.40**	1.718	1.742	1.767	1.791	1.816	1.842	1.867	1.892	1.918	1.944
4.5	**4.45**	1.737	1.762	1.787	1.812	1.837	1.863	1.888	1.914	1.940	1.966
4.5	**4.50**	1.757	1.782	1.807	1.832	1.858	1.883	1.909	1.935	1.962	1.988
4.6	**4.55**	1.776	1.801	1.827	1.853	1.878	1.904	1.931	1.957	1.983	2.010
4.6	**4.60**	1.796	1.821	1.847	1.873	1.899	1.925	1.952	1.978	2.005	2.032
4.7	**4.65**	1.815	1.841	1.867	1.893	1.920	1.946	1.973	2.000	2.027	2.054
4.7	**4.70**	1.835	1.861	1.887	1.914	1.940	1.967	1.994	2.021	2.049	2.076
4.8	**4.75**	1.854	1.881	1.907	1.934	1.961	1.988	2.015	2.043	2.071	2.098
4.8	**4.80**	1.874	1.900	1.927	1.954	1.982	2.009	2.037	2.064	2.092	2.121
4.9	**4.85**	1.893	1.920	1.947	1.975	2.002	2.030	2.058	2.086	2.114	2.143
4.9	**4.90**	1.913	1.940	1.967	1.995	2.023	2.051	2.079	2.107	2.136	2.165
5.0	**4.95**	1.932	1.960	1.988	2.015	2.043	2.072	2.100	2.129	2.158	2.187
5.0	**5.00**	1.952	1.980	2.008	2.036	2.064	2.093	2.121	2.150	2.180	2.209
5.1	**5.05**	1.971	1.999	2.028	2.056	2.085	2.114	2.143	2.172	2.201	2.231
5.1	**5.10**	1.991	2.019	2.048	2.076	2.105	2.135	2.164	2.193	2.223	2.253

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	75.5	76	76.5	77	77.5	78	78.5	79	79.5	80
0.1	0.05	0.022	0.023	0.023	0.023	0.024	0.024	0.024	0.025	0.025	0.025
0.1	0.10	0.045	0.045	0.046	0.047	0.047	0.048	0.048	0.049	0.050	0.050
0.2	0.15	0.067	0.068	0.069	0.070	0.071	0.072	0.073	0.074	0.074	0.075
0.2	0.20	0.090	0.091	0.092	0.093	0.094	0.096	0.097	0.098	0.099	0.101
0.3	0.25	0.112	0.113	0.115	0.116	0.118	0.119	0.121	0.123	0.124	0.126
0.3	0.30	0.134	0.136	0.138	0.140	0.142	0.143	0.145	0.147	0.149	0.151
0.4	0.35	0.157	0.159	0.161	0.163	0.165	0.167	0.169	0.172	0.174	0.176
0.4	0.40	0.179	0.181	0.184	0.186	0.189	0.191	0.194	0.196	0.199	0.201
0.5	0.45	0.201	0.204	0.207	0.210	0.212	0.215	0.218	0.221	0.223	0.226
0.5	0.50	0.224	0.227	0.230	0.233	0.236	0.239	0.242	0.245	0.248	0.251
0.6	0.55	0.246	0.250	0.253	0.256	0.259	0.263	0.266	0.270	0.273	0.276
0.6	0.60	0.269	0.272	0.276	0.279	0.283	0.287	0.290	0.294	0.298	0.302
0.7	0.65	0.291	0.295	0.299	0.303	0.307	0.311	0.315	0.319	0.323	0.327
0.7	0.70	0.313	0.318	0.322	0.326	0.330	0.334	0.339	0.343	0.347	0.352
0.8	0.75	0.336	0.340	0.345	0.349	0.354	0.358	0.363	0.368	0.372	0.377
0.8	0.80	0.358	0.363	0.368	0.373	0.377	0.382	0.387	0.392	0.397	0.402
0.9	0.85	0.381	0.386	0.391	0.396	0.401	0.406	0.411	0.417	0.422	0.427
0.9	0.90	0.403	0.408	0.414	0.419	0.425	0.430	0.436	0.441	0.447	0.452
1.0	0.95	0.425	0.431	0.437	0.442	0.448	0.454	0.460	0.466	0.472	0.478
1.0	1.00	0.448	0.454	0.460	0.466	0.472	0.478	0.484	0.490	0.496	0.503
1.1	1.05	0.470	0.476	0.483	0.489	0.495	0.502	0.508	0.515	0.521	0.528
1.1	1.10	0.492	0.499	0.506	0.512	0.519	0.526	0.532	0.539	0.546	0.553
1.2	1.15	0.515	0.522	0.529	0.536	0.542	0.550	0.557	0.564	0.571	0.578
1.2	1.20	0.537	0.544	0.552	0.559	0.566	0.573	0.581	0.588	0.596	0.603
1.3	1.25	0.560	0.567	0.575	0.582	0.590	0.597	0.605	0.613	0.620	0.628
1.3	1.30	0.582	0.590	0.598	0.605	0.613	0.621	0.629	0.637	0.645	0.653
1.4	1.35	0.604	0.612	0.621	0.629	0.637	0.645	0.653	0.662	0.670	0.679
1.4	1.40	0.627	0.635	0.643	0.652	0.660	0.669	0.678	0.686	0.695	0.704
1.5	1.45	0.649	0.658	0.666	0.675	0.684	0.693	0.702	0.711	0.720	0.729
1.5	1.50	0.672	0.680	0.689	0.698	0.708	0.717	0.726	0.735	0.745	0.754
1.6	1.55	0.694	0.703	0.712	0.722	0.731	0.741	0.750	0.760	0.769	0.779
1.6	1.60	0.716	0.726	0.735	0.745	0.755	0.765	0.774	0.784	0.794	0.804
1.7	1.65	0.739	0.749	0.758	0.768	0.778	0.788	0.799	0.809	0.819	0.829
1.7	1.70	0.761	0.771	0.781	0.792	0.802	0.812	0.823	0.833	0.844	0.855
1.8	1.75	0.783	0.794	0.804	0.815	0.826	0.836	0.847	0.858	0.869	0.880
1.8	1.80	0.806	0.817	0.827	0.838	0.849	0.860	0.871	0.882	0.894	0.905
1.9	1.85	0.828	0.839	0.850	0.861	0.873	0.884	0.895	0.907	0.918	0.930
1.9	1.90	0.851	0.862	0.873	0.885	0.896	0.908	0.920	0.931	0.943	0.955
2.0	1.95	0.873	0.885	0.896	0.908	0.920	0.932	0.944	0.956	0.968	0.980

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		75.5	76	76.5	77	77.5	78	78.5	79	79.5	80
Length Class Midpoints											
2.0	**2.00**	0.895	0.907	0.919	0.931	0.943	0.956	0.968	0.980	0.993	1.005
2.1	**2.05**	0.918	0.930	0.942	0.955	0.967	0.980	0.992	1.005	1.018	1.030
2.1	**2.10**	0.940	0.953	0.965	0.978	0.991	1.003	1.016	1.029	1.042	1.056
2.2	**2.15**	0.963	0.975	0.988	1.001	1.014	1.027	1.041	1.054	1.067	1.081
2.2	**2.20**	0.985	0.998	1.011	1.024	1.038	1.051	1.065	1.078	1.092	1.106
2.3	**2.25**	1.007	1.021	1.034	1.048	1.061	1.075	1.089	1.103	1.117	1.131
2.3	**2.30**	1.030	1.043	1.057	1.071	1.085	1.099	1.113	1.127	1.142	1.156
2.4	**2.35**	1.052	1.066	1.080	1.094	1.109	1.123	1.137	1.152	1.167	1.181
2.4	**2.40**	1.074	1.089	1.103	1.118	1.132	1.147	1.162	1.176	1.191	1.206
2.5	**2.45**	1.097	1.111	1.126	1.141	1.156	1.171	1.186	1.201	1.216	1.232
2.5	**2.50**	1.119	1.134	1.149	1.164	1.179	1.195	1.210	1.225	1.241	1.257
2.6	**2.55**	1.142	1.157	1.172	1.187	1.203	1.218	1.234	1.250	1.266	1.282
2.6	**2.60**	1.164	1.179	1.195	1.211	1.227	1.242	1.258	1.274	1.291	1.307
2.7	**2.65**	1.186	1.202	1.218	1.234	1.250	1.266	1.283	1.299	1.315	1.332
2.7	**2.70**	1.209	1.225	1.241	1.257	1.274	1.290	1.307	1.323	1.340	1.357
2.8	**2.75**	1.231	1.248	1.264	1.281	1.297	1.314	1.331	1.348	1.365	1.382
2.8	**2.80**	1.254	1.270	1.287	1.304	1.321	1.338	1.355	1.372	1.390	1.407
2.9	**2.85**	1.276	1.293	1.310	1.327	1.344	1.362	1.379	1.397	1.415	1.433
2.9	**2.90**	1.298	1.316	1.333	1.350	1.368	1.386	1.404	1.421	1.440	1.458
3.0	**2.95**	1.321	1.338	1.356	1.374	1.392	1.410	1.428	1.446	1.464	1.483
3.0	**3.00**	1.343	1.361	1.379	1.397	1.415	1.434	1.452	1.471	1.489	1.508
3.1	**3.05**	1.365	1.384	1.402	1.420	1.439	1.457	1.476	1.495	1.514	1.533
3.1	**3.10**	1.388	1.406	1.425	1.444	1.462	1.481	1.500	1.520	1.539	1.558
3.2	**3.15**	1.410	1.429	1.448	1.467	1.486	1.505	1.525	1.544	1.564	1.583
3.2	**3.20**	1.433	1.452	1.471	1.490	1.510	1.529	1.549	1.569	1.588	1.608
3.3	**3.25**	1.455	1.474	1.494	1.513	1.533	1.553	1.573	1.593	1.613	1.634
3.3	**3.30**	1.477	1.497	1.517	1.537	1.557	1.577	1.597	1.618	1.638	1.659
3.4	**3.35**	1.500	1.520	1.540	1.560	1.580	1.601	1.621	1.642	1.663	1.684
3.4	**3.40**	1.522	1.542	1.563	1.583	1.604	1.625	1.646	1.667	1.688	1.709
3.5	**3.45**	1.545	1.565	1.586	1.607	1.627	1.649	1.670	1.691	1.713	1.734
3.5	**3.50**	1.567	1.588	1.609	1.630	1.651	1.672	1.694	1.716	1.737	1.759
3.6	**3.55**	1.589	1.610	1.632	1.653	1.675	1.696	1.718	1.740	1.762	1.784
3.6	**3.60**	1.612	1.633	1.655	1.676	1.698	1.720	1.742	1.765	1.787	1.810
3.7	**3.65**	1.634	1.656	1.678	1.700	1.722	1.744	1.767	1.789	1.812	1.835
3.7	**3.70**	1.656	1.678	1.701	1.723	1.745	1.768	1.791	1.814	1.837	1.860
3.8	**3.75**	1.679	1.701	1.724	1.746	1.769	1.792	1.815	1.838	1.861	1.885
3.8	**3.80**	1.701	1.724	1.747	1.770	1.793	1.816	1.839	1.863	1.886	1.910
3.9	**3.85**	1.724	1.747	1.770	1.793	1.816	1.840	1.863	1.887	1.911	1.935
3.9	**3.90**	1.746	1.769	1.793	1.816	1.840	1.864	1.888	1.912	1.936	1.960

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		75.5	76	76.5	77	77.5	78	78.5	79	79.5	80
Length Class	**Midpoints**										
4.0	**3.95**	1.768	1.792	1.816	1.839	1.863	1.887	1.912	1.936	1.961	1.985
4.0	**4.00**	1.791	1.815	1.839	1.863	1.887	1.911	1.936	1.961	1.986	2.011
4.1	**4.05**	1.813	1.837	1.862	1.886	1.911	1.935	1.960	1.985	2.010	2.036
4.1	**4.10**	1.836	1.860	1.885	1.909	1.934	1.959	1.984	2.010	2.035	2.061
4.2	**4.15**	1.858	1.883	1.907	1.933	1.958	1.983	2.009	2.034	2.060	2.086
4.2	**4.20**	1.880	1.905	1.930	1.956	1.981	2.007	2.033	2.059	2.085	2.111
4.3	**4.25**	1.903	1.928	1.953	1.979	2.005	2.031	2.057	2.083	2.110	2.136
4.3	**4.30**	1.925	1.951	1.976	2.002	2.028	2.055	2.081	2.108	2.134	2.161
4.4	**4.35**	1.947	1.973	1.999	2.026	2.052	2.079	2.105	2.132	2.159	2.187
4.4	**4.40**	1.970	1.996	2.022	2.049	2.076	2.102	2.130	2.157	2.184	2.212
4.5	**4.45**	1.992	2.019	2.045	2.072	2.099	2.126	2.154	2.181	2.209	2.237
4.5	**4.50**	2.015	2.041	2.068	2.095	2.123	2.150	2.178	2.206	2.234	2.262
4.6	**4.55**	2.037	2.064	2.091	2.119	2.146	2.174	2.202	2.230	2.259	2.287
4.6	**4.60**	2.059	2.087	2.114	2.142	2.170	2.198	2.226	2.255	2.283	2.312
4.7	**4.65**	2.082	2.109	2.137	2.165	2.194	2.222	2.251	2.279	2.308	2.337
4.7	**4.70**	2.104	2.132	2.160	2.189	2.217	2.246	2.275	2.304	2.333	2.362
4.8	**4.75**	2.127	2.155	2.183	2.212	2.241	2.270	2.299	2.328	2.358	2.388
4.8	**4.80**	2.149	2.178	2.206	2.235	2.264	2.294	2.323	2.353	2.383	2.413
4.9	**4.85**	2.171	2.200	2.229	2.258	2.288	2.318	2.347	2.377	2.408	2.438
4.9	**4.90**	2.194	2.223	2.252	2.282	2.311	2.341	2.372	2.402	2.432	2.463
5.0	**4.95**	2.216	2.246	2.275	2.305	2.335	2.365	2.396	2.426	2.457	2.488
5.0	**5.00**	2.238	2.268	2.298	2.328	2.359	2.389	2.420	2.451	2.482	2.513
5.1	**5.05**	2.261	2.291	2.321	2.352	2.382	2.413	2.444	2.475	2.507	2.538
5.1	**5.10**	2.283	2.314	2.344	2.375	2.406	2.437	2.468	2.500	2.532	2.564

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	80.5	81	81.5	82	82.5	83	83.5	84	84.5	85
0.1	**0.05**	0.025	0.026	0.026	0.026	0.027	0.027	0.027	0.028	0.028	0.028
0.1	**0.10**	0.051	0.052	0.052	0.053	0.053	0.054	0.055	0.055	0.056	0.057
0.2	**0.15**	0.076	0.077	0.078	0.079	0.080	0.081	0.082	0.083	0.084	0.085
0.2	**0.20**	0.102	0.103	0.104	0.106	0.107	0.108	0.110	0.111	0.112	0.113
0.3	**0.25**	0.127	0.129	0.130	0.132	0.134	0.135	0.137	0.139	0.140	0.142
0.3	**0.30**	0.153	0.155	0.157	0.158	0.160	0.162	0.164	0.166	0.168	0.170
0.4	**0.35**	0.178	0.180	0.183	0.185	0.187	0.189	0.192	0.194	0.196	0.199
0.4	**0.40**	0.204	0.206	0.209	0.211	0.214	0.216	0.219	0.222	0.224	0.227
0.5	**0.45**	0.229	0.232	0.235	0.238	0.241	0.243	0.246	0.249	0.252	0.255
0.5	**0.50**	0.254	0.258	0.261	0.264	0.267	0.271	0.274	0.277	0.280	0.284
0.6	**0.55**	0.280	0.283	0.287	0.290	0.294	0.298	0.301	0.305	0.308	0.312
0.6	**0.60**	0.305	0.309	0.313	0.317	0.321	0.325	0.329	0.333	0.336	0.340
0.7	**0.65**	0.331	0.335	0.339	0.343	0.347	0.352	0.356	0.360	0.365	0.369
0.7	**0.70**	0.356	0.361	0.365	0.370	0.374	0.379	0.383	0.388	0.393	0.397
0.8	**0.75**	0.382	0.386	0.391	0.396	0.401	0.406	0.411	0.416	0.421	0.426
0.8	**0.80**	0.407	0.412	0.417	0.422	0.428	0.433	0.438	0.443	0.449	0.454
0.9	**0.85**	0.433	0.438	0.443	0.449	0.454	0.460	0.465	0.471	0.477	0.482
0.9	**0.90**	0.458	0.464	0.470	0.475	0.481	0.487	0.493	0.499	0.505	0.511
1.0	**0.95**	0.484	0.490	0.496	0.502	0.508	0.514	0.520	0.526	0.533	0.539
1.0	**1.00**	0.509	0.515	0.522	0.528	0.535	0.541	0.548	0.554	0.561	0.567
1.1	**1.05**	0.534	0.541	0.548	0.555	0.561	0.568	0.575	0.582	0.589	0.596
1.1	**1.10**	0.560	0.567	0.574	0.581	0.588	0.595	0.602	0.610	0.617	0.624
1.2	**1.15**	0.585	0.593	0.600	0.607	0.615	0.622	0.630	0.637	0.645	0.653
1.2	**1.20**	0.611	0.618	0.626	0.634	0.641	0.649	0.657	0.665	0.673	0.681
1.3	**1.25**	0.636	0.644	0.652	0.660	0.668	0.676	0.685	0.693	0.701	0.709
1.3	**1.30**	0.662	0.670	0.678	0.687	0.695	0.703	0.712	0.720	0.729	0.738
1.4	**1.35**	0.687	0.696	0.704	0.713	0.722	0.730	0.739	0.748	0.757	0.766
1.4	**1.40**	0.713	0.721	0.730	0.739	0.748	0.757	0.767	0.776	0.785	0.794
1.5	**1.45**	0.738	0.747	0.756	0.766	0.775	0.785	0.794	0.804	0.813	0.823
1.5	**1.50**	0.763	0.773	0.783	0.792	0.802	0.812	0.821	0.831	0.841	0.851
1.6	**1.55**	0.789	0.799	0.809	0.819	0.829	0.839	0.849	0.859	0.869	0.880
1.6	**1.60**	0.814	0.824	0.835	0.845	0.855	0.866	0.876	0.887	0.897	0.908
1.7	**1.65**	0.840	0.850	0.861	0.871	0.882	0.893	0.904	0.914	0.925	0.936
1.7	**1.70**	0.865	0.876	0.887	0.898	0.909	0.920	0.931	0.942	0.953	0.965
1.8	**1.75**	0.891	0.902	0.913	0.924	0.935	0.947	0.958	0.970	0.981	0.993
1.8	**1.80**	0.916	0.928	0.939	0.951	0.962	0.974	0.986	0.998	1.009	1.021
1.9	**1.85**	0.942	0.953	0.965	0.977	0.989	1.001	1.013	1.025	1.037	1.050
1.9	**1.90**	0.967	0.979	0.991	1.003	1.016	1.028	1.040	1.053	1.066	1.078
2.0	**1.95**	0.992	1.005	1.017	1.030	1.042	1.055	1.068	1.081	1.094	1.107

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	80.5	81	81.5	82	82.5	83	83.5	84	84.5	85
2.0	**2.00**	1.018	1.031	1.043	1.056	1.069	1.082	1.095	1.108	1.122	1.135
2.1	**2.05**	1.043	1.056	1.069	1.083	1.096	1.109	1.123	1.136	1.150	1.163
2.1	**2.10**	1.069	1.082	1.096	1.109	1.123	1.136	1.150	1.164	1.178	1.192
2.2	**2.15**	1.094	1.108	1.122	1.135	1.149	1.163	1.177	1.191	1.206	1.220
2.2	**2.20**	1.120	1.134	1.148	1.162	1.176	1.190	1.205	1.219	1.234	1.248
2.3	**2.25**	1.145	1.159	1.174	1.188	1.203	1.217	1.232	1.247	1.262	1.277
2.3	**2.30**	1.171	1.185	1.200	1.215	1.229	1.244	1.259	1.275	1.290	1.305
2.4	**2.35**	1.196	1.211	1.226	1.241	1.256	1.271	1.287	1.302	1.318	1.334
2.4	**2.40**	1.222	1.237	1.252	1.267	1.283	1.299	1.314	1.330	1.346	1.362
2.5	**2.45**	1.247	1.262	1.278	1.294	1.310	1.326	1.342	1.358	1.374	1.390
2.5	**2.50**	1.272	1.288	1.304	1.320	1.336	1.353	1.369	1.385	1.402	1.419
2.6	**2.55**	1.298	1.314	1.330	1.347	1.363	1.380	1.396	1.413	1.430	1.447
2.6	**2.60**	1.323	1.340	1.356	1.373	1.390	1.407	1.424	1.441	1.458	1.475
2.7	**2.65**	1.349	1.366	1.382	1.399	1.417	1.434	1.451	1.469	1.486	1.504
2.7	**2.70**	1.374	1.391	1.409	1.426	1.443	1.461	1.479	1.496	1.514	1.532
2.8	**2.75**	1.400	1.417	1.435	1.452	1.470	1.488	1.506	1.524	1.542	1.560
2.8	**2.80**	1.425	1.443	1.461	1.479	1.497	1.515	1.533	1.552	1.570	1.589
2.9	**2.85**	1.451	1.469	1.487	1.505	1.524	1.542	1.561	1.579	1.598	1.617
2.9	**2.90**	1.476	1.494	1.513	1.531	1.550	1.569	1.588	1.607	1.626	1.646
3.0	**2.95**	1.501	1.520	1.539	1.558	1.577	1.596	1.615	1.635	1.654	1.674
3.0	**3.00**	1.527	1.546	1.565	1.584	1.604	1.623	1.643	1.663	1.682	1.702
3.1	**3.05**	1.552	1.572	1.591	1.611	1.630	1.650	1.670	1.690	1.710	1.731
3.1	**3.10**	1.578	1.597	1.617	1.637	1.657	1.677	1.698	1.718	1.738	1.759
3.2	**3.15**	1.603	1.623	1.643	1.664	1.684	1.704	1.725	1.746	1.767	1.787
3.2	**3.20**	1.629	1.649	1.669	1.690	1.711	1.731	1.752	1.773	1.795	1.816
3.3	**3.25**	1.654	1.675	1.695	1.716	1.737	1.758	1.780	1.801	1.823	1.844
3.3	**3.30**	1.680	1.700	1.722	1.743	1.764	1.786	1.807	1.829	1.851	1.873
3.4	**3.35**	1.705	1.726	1.748	1.769	1.791	1.813	1.834	1.856	1.879	1.901
3.4	**3.40**	1.730	1.752	1.774	1.796	1.818	1.840	1.862	1.884	1.907	1.929
3.5	**3.45**	1.756	1.778	1.800	1.822	1.844	1.867	1.889	1.912	1.935	1.958
3.5	**3.50**	1.781	1.804	1.826	1.848	1.871	1.894	1.917	1.940	1.963	1.986
3.6	**3.55**	1.807	1.829	1.852	1.875	1.898	1.921	1.944	1.967	1.991	2.014
3.6	**3.60**	1.832	1.855	1.878	1.901	1.924	1.948	1.971	1.995	2.019	2.043
3.7	**3.65**	1.858	1.881	1.904	1.928	1.951	1.975	1.999	2.023	2.047	2.071
3.7	**3.70**	1.883	1.907	1.930	1.954	1.978	2.002	2.026	2.050	2.075	2.100
3.8	**3.75**	1.909	1.932	1.956	1.980	2.005	2.029	2.054	2.078	2.103	2.128
3.8	**3.80**	1.934	1.958	1.982	2.007	2.031	2.056	2.081	2.106	2.131	2.156
3.9	**3.85**	1.959	1.984	2.008	2.033	2.058	2.083	2.108	2.134	2.159	2.185
3.9	**3.90**	1.985	2.010	2.035	2.060	2.085	2.110	2.136	2.161	2.187	2.213

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	80.5	81	81.5	82	82.5	83	83.5	84	84.5	85
4.0	3.95	2.010	2.035	2.061	2.086	2.112	2.137	2.163	2.189	2.215	2.241
4.0	4.00	2.036	2.061	2.087	2.112	2.138	2.164	2.190	2.217	2.243	2.270
4.1	4.05	2.061	2.087	2.113	2.139	2.165	2.191	2.218	2.244	2.271	2.298
4.1	4.10	2.087	2.113	2.139	2.165	2.192	2.218	2.245	2.272	2.299	2.327
4.2	4.15	2.112	2.138	2.165	2.192	2.218	2.245	2.273	2.300	2.327	2.355
4.2	4.20	2.138	2.164	2.191	2.218	2.245	2.272	2.300	2.328	2.355	2.383
4.3	4.25	2.163	2.190	2.217	2.244	2.272	2.300	2.327	2.355	2.383	2.412
4.3	4.30	2.189	2.216	2.243	2.271	2.299	2.327	2.355	2.383	2.411	2.440
4.4	4.35	2.214	2.242	2.269	2.297	2.325	2.354	2.382	2.411	2.439	2.468
4.4	4.40	2.239	2.267	2.295	2.324	2.352	2.381	2.409	2.438	2.467	2.497
4.5	4.45	2.265	2.293	2.321	2.350	2.379	2.408	2.437	2.466	2.496	2.525
4.5	4.50	2.290	2.319	2.348	2.376	2.406	2.435	2.464	2.494	2.524	2.554
4.6	4.55	2.316	2.345	2.374	2.403	2.432	2.462	2.492	2.522	2.552	2.582
4.6	4.60	2.341	2.370	2.400	2.429	2.459	2.489	2.519	2.549	2.580	2.610
4.7	4.65	2.367	2.396	2.426	2.456	2.486	2.516	2.546	2.577	2.608	2.639
4.7	4.70	2.392	2.422	2.452	2.482	2.512	2.543	2.574	2.605	2.636	2.667
4.8	4.75	2.418	2.448	2.478	2.508	2.539	2.570	2.601	2.632	2.664	2.695
4.8	4.80	2.443	2.473	2.504	2.535	2.566	2.597	2.628	2.660	2.692	2.724
4.9	4.85	2.468	2.499	2.530	2.561	2.593	2.624	2.656	2.688	2.720	2.752
4.9	4.90	2.494	2.525	2.556	2.588	2.619	2.651	2.683	2.715	2.748	2.781
5.0	4.95	2.519	2.551	2.582	2.614	2.646	2.678	2.711	2.743	2.776	2.809
5.0	5.00	2.545	2.577	2.608	2.641	2.673	2.705	2.738	2.771	2.804	2.837
5.1	5.05	2.570	2.602	2.634	2.667	2.700	2.732	2.765	2.799	2.832	2.866
5.1	5.10	2.596	2.628	2.661	2.693	2.726	2.759	2.793	2.826	2.860	2.894

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	85.5	86	86.5	87	87.5	88	88.5	89	89.5	90
0.1	**0.05**	0.029	0.029	0.029	0.030	0.030	0.030	0.031	0.031	0.031	0.032
0.1	**0.10**	0.057	0.058	0.059	0.059	0.060	0.061	0.062	0.062	0.063	0.064
0.2	**0.15**	0.086	0.087	0.088	0.089	0.090	0.091	0.092	0.093	0.094	0.095
0.2	**0.20**	0.115	0.116	0.118	0.119	0.120	0.122	0.123	0.124	0.126	0.127
0.3	**0.25**	0.144	0.145	0.147	0.149	0.150	0.152	0.154	0.156	0.157	0.159
0.3	**0.30**	0.172	0.174	0.176	0.178	0.180	0.182	0.185	0.187	0.189	0.191
0.4	**0.35**	0.201	0.203	0.206	0.208	0.210	0.213	0.215	0.218	0.220	0.223
0.4	**0.40**	0.230	0.232	0.235	0.238	0.241	0.243	0.246	0.249	0.252	0.254
0.5	**0.45**	0.258	0.261	0.264	0.268	0.271	0.274	0.277	0.280	0.283	0.286
0.5	**0.50**	0.287	0.290	0.294	0.297	0.301	0.304	0.308	0.311	0.315	0.318
0.6	**0.55**	0.316	0.319	0.323	0.327	0.331	0.335	0.338	0.342	0.346	0.350
0.6	**0.60**	0.344	0.349	0.353	0.357	0.361	0.365	0.369	0.373	0.377	0.382
0.7	**0.65**	0.373	0.378	0.382	0.386	0.391	0.395	0.400	0.404	0.409	0.414
0.7	**0.70**	0.402	0.407	0.411	0.416	0.421	0.426	0.431	0.435	0.440	0.445
0.8	**0.75**	0.431	0.436	0.441	0.446	0.451	0.456	0.461	0.467	0.472	0.477
0.8	**0.80**	0.459	0.465	0.470	0.476	0.481	0.487	0.492	0.498	0.503	0.509
0.9	**0.85**	0.488	0.494	0.500	0.505	0.511	0.517	0.523	0.529	0.535	0.541
0.9	**0.90**	0.517	0.523	0.529	0.535	0.541	0.547	0.554	0.560	0.566	0.573
1.0	**0.95**	0.545	0.552	0.558	0.565	0.571	0.578	0.584	0.591	0.598	0.604
1.0	**1.00**	0.574	0.581	0.588	0.594	0.601	0.608	0.615	0.622	0.629	0.636
1.1	**1.05**	0.603	0.610	0.617	0.624	0.631	0.639	0.646	0.653	0.661	0.668
1.1	**1.10**	0.632	0.639	0.646	0.654	0.661	0.669	0.677	0.684	0.692	0.700
1.2	**1.15**	0.660	0.668	0.676	0.684	0.692	0.699	0.707	0.715	0.723	0.732
1.2	**1.20**	0.689	0.697	0.705	0.713	0.722	0.730	0.738	0.747	0.755	0.763
1.3	**1.25**	0.718	0.726	0.735	0.743	0.752	0.760	0.769	0.778	0.786	0.795
1.3	**1.30**	0.746	0.755	0.764	0.773	0.782	0.791	0.800	0.809	0.818	0.827
1.4	**1.35**	0.775	0.784	0.793	0.803	0.812	0.821	0.830	0.840	0.849	0.859
1.4	**1.40**	0.804	0.813	0.823	0.832	0.842	0.851	0.861	0.871	0.881	0.891
1.5	**1.45**	0.833	0.842	0.852	0.862	0.872	0.882	0.892	0.902	0.912	0.922
1.5	**1.50**	0.861	0.871	0.881	0.892	0.902	0.912	0.923	0.933	0.944	0.954
1.6	**1.55**	0.890	0.900	0.911	0.921	0.932	0.943	0.953	0.964	0.975	0.986
1.6	**1.60**	0.919	0.929	0.940	0.951	0.962	0.973	0.984	0.995	1.007	1.018
1.7	**1.65**	0.947	0.958	0.970	0.981	0.992	1.004	1.015	1.026	1.038	1.050
1.7	**1.70**	0.976	0.987	0.999	1.011	1.022	1.034	1.046	1.058	1.070	1.081
1.8	**1.75**	1.005	1.017	1.028	1.040	1.052	1.064	1.077	1.089	1.101	1.113
1.8	**1.80**	1.033	1.046	1.058	1.070	1.082	1.095	1.107	1.120	1.132	1.145
1.9	**1.85**	1.062	1.075	1.087	1.100	1.112	1.125	1.138	1.151	1.164	1.177
1.9	**1.90**	1.091	1.104	1.117	1.129	1.143	1.156	1.169	1.182	1.195	1.209
2.0	**1.95**	1.120	1.133	1.146	1.159	1.173	1.186	1.200	1.213	1.227	1.241

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		85.5	86	86.5	87	87.5	88	88.5	89	89.5	90
Length Class Midpoints											
2.0	**2.00**	1.148	1.162	1.175	1.189	1.203	1.216	1.230	1.244	1.258	1.272
2.1	**2.05**	1.177	1.191	1.205	1.219	1.233	1.247	1.261	1.275	1.290	1.304
2.1	**2.10**	1.206	1.220	1.234	1.248	1.263	1.277	1.292	1.306	1.321	1.336
2.2	**2.15**	1.234	1.249	1.263	1.278	1.293	1.308	1.323	1.338	1.353	1.368
2.2	**2.20**	1.263	1.278	1.293	1.308	1.323	1.338	1.353	1.369	1.384	1.400
2.3	**2.25**	1.292	1.307	1.322	1.338	1.353	1.368	1.384	1.400	1.416	1.431
2.3	**2.30**	1.321	1.336	1.352	1.367	1.383	1.399	1.415	1.431	1.447	1.463
2.4	**2.35**	1.349	1.365	1.381	1.397	1.413	1.429	1.446	1.462	1.478	1.495
2.4	**2.40**	1.378	1.394	1.410	1.427	1.443	1.460	1.476	1.493	1.510	1.527
2.5	**2.45**	1.407	1.423	1.440	1.456	1.473	1.490	1.507	1.524	1.541	1.559
2.5	**2.50**	1.435	1.452	1.469	1.486	1.503	1.521	1.538	1.555	1.573	1.590
2.6	**2.55**	1.464	1.481	1.499	1.516	1.533	1.551	1.569	1.586	1.604	1.622
2.6	**2.60**	1.493	1.510	1.528	1.546	1.563	1.581	1.599	1.617	1.636	1.654
2.7	**2.65**	1.521	1.539	1.557	1.575	1.594	1.612	1.630	1.649	1.667	1.686
2.7	**2.70**	1.550	1.568	1.587	1.605	1.624	1.642	1.661	1.680	1.699	1.718
2.8	**2.75**	1.579	1.597	1.616	1.635	1.654	1.673	1.692	1.711	1.730	1.749
2.8	**2.80**	1.608	1.626	1.645	1.665	1.684	1.703	1.722	1.742	1.762	1.781
2.9	**2.85**	1.636	1.656	1.675	1.694	1.714	1.733	1.753	1.773	1.793	1.813
2.9	**2.90**	1.665	1.685	1.704	1.724	1.744	1.764	1.784	1.804	1.824	1.845
3.0	**2.95**	1.694	1.714	1.734	1.754	1.774	1.794	1.815	1.835	1.856	1.877
3.0	**3.00**	1.722	1.743	1.763	1.783	1.804	1.825	1.845	1.866	1.887	1.909
3.1	**3.05**	1.751	1.772	1.792	1.813	1.834	1.855	1.876	1.897	1.919	1.940
3.1	**3.10**	1.780	1.801	1.822	1.843	1.864	1.885	1.907	1.929	1.950	1.972
3.2	**3.15**	1.809	1.830	1.851	1.873	1.894	1.916	1.938	1.960	1.982	2.004
3.2	**3.20**	1.837	1.859	1.880	1.902	1.924	1.946	1.968	1.991	2.013	2.036
3.3	**3.25**	1.866	1.888	1.910	1.932	1.954	1.977	1.999	2.022	2.045	2.068
3.3	**3.30**	1.895	1.917	1.939	1.962	1.984	2.007	2.030	2.053	2.076	2.099
3.4	**3.35**	1.923	1.946	1.969	1.991	2.014	2.038	2.061	2.084	2.108	2.131
3.4	**3.40**	1.952	1.975	1.998	2.021	2.044	2.068	2.091	2.115	2.139	2.163
3.5	**3.45**	1.981	2.004	2.027	2.051	2.075	2.098	2.122	2.146	2.170	2.195
3.5	**3.50**	2.010	2.033	2.057	2.081	2.105	2.129	2.153	2.177	2.202	2.227
3.6	**3.55**	2.038	2.062	2.086	2.110	2.135	2.159	2.184	2.209	2.233	2.258
3.6	**3.60**	2.067	2.091	2.116	2.140	2.165	2.190	2.215	2.240	2.265	2.290
3.7	**3.65**	2.096	2.120	2.145	2.170	2.195	2.220	2.245	2.271	2.296	2.322
3.7	**3.70**	2.124	2.149	2.174	2.200	2.225	2.250	2.276	2.302	2.328	2.354
3.8	**3.75**	2.153	2.178	2.204	2.229	2.255	2.281	2.307	2.333	2.359	2.386
3.8	**3.80**	2.182	2.207	2.233	2.259	2.285	2.311	2.338	2.364	2.391	2.417
3.9	**3.85**	2.210	2.236	2.262	2.289	2.315	2.342	2.368	2.395	2.422	2.449
3.9	**3.90**	2.239	2.265	2.292	2.318	2.345	2.372	2.399	2.426	2.454	2.481

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	85.5	86	86.5	87	87.5	88	88.5	89	89.5	90
4.0	**3.95**	2.268	2.294	2.321	2.348	2.375	2.402	2.430	2.457	2.485	2.513
4.0	**4.00**	2.297	2.324	2.351	2.378	2.405	2.433	2.461	2.488	2.517	2.545
4.1	**4.05**	2.325	2.353	2.380	2.408	2.435	2.463	2.491	2.520	2.548	2.577
4.1	**4.10**	2.354	2.382	2.409	2.437	2.465	2.494	2.522	2.551	2.579	2.608
4.2	**4.15**	2.383	2.411	2.439	2.467	2.495	2.524	2.553	2.582	2.611	2.640
4.2	**4.20**	2.411	2.440	2.468	2.497	2.526	2.554	2.584	2.613	2.642	2.672
4.3	**4.25**	2.440	2.469	2.498	2.526	2.556	2.585	2.614	2.644	2.674	2.704
4.3	**4.30**	2.469	2.498	2.527	2.556	2.586	2.615	2.645	2.675	2.705	2.736
4.4	**4.35**	2.498	2.527	2.556	2.586	2.616	2.646	2.676	2.706	2.737	2.767
4.4	**4.40**	2.526	2.556	2.586	2.616	2.646	2.676	2.707	2.737	2.768	2.799
4.5	**4.45**	2.555	2.585	2.615	2.645	2.676	2.707	2.737	2.768	2.800	2.831
4.5	**4.50**	2.584	2.614	2.644	2.675	2.706	2.737	2.768	2.800	2.831	2.863
4.6	**4.55**	2.612	2.643	2.674	2.705	2.736	2.767	2.799	2.831	2.863	2.895
4.6	**4.60**	2.641	2.672	2.703	2.735	2.766	2.798	2.830	2.862	2.894	2.926
4.7	**4.65**	2.670	2.701	2.733	2.764	2.796	2.828	2.860	2.893	2.925	2.958
4.7	**4.70**	2.698	2.730	2.762	2.794	2.826	2.859	2.891	2.924	2.957	2.990
4.8	**4.75**	2.727	2.759	2.791	2.824	2.856	2.889	2.922	2.955	2.988	3.022
4.8	**4.80**	2.756	2.788	2.821	2.853	2.886	2.919	2.953	2.986	3.020	3.054
4.9	**4.85**	2.785	2.817	2.850	2.883	2.916	2.950	2.983	3.017	3.051	3.085
4.9	**4.90**	2.813	2.846	2.880	2.913	2.946	2.980	3.014	3.048	3.083	3.117
5.0	**4.95**	2.842	2.875	2.909	2.943	2.977	3.011	3.045	3.079	3.114	3.149
5.0	**5.00**	2.871	2.904	2.938	2.972	3.007	3.041	3.076	3.111	3.146	3.181
5.1	**5.05**	2.899	2.933	2.968	3.002	3.037	3.071	3.106	3.142	3.177	3.213
5.1	**5.10**	2.928	2.962	2.997	3.032	3.067	3.102	3.137	3.173	3.209	3.244

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	90.5	91	91.5	92	92.5	93	93.5	94	94.5	95
0.1	**0.05**	0.032	0.033	0.033	0.033	0.034	0.034	0.034	0.035	0.035	0.035
0.1	**0.10**	0.064	0.065	0.066	0.066	0.067	0.068	0.069	0.069	0.070	0.071
0.2	**0.15**	0.096	0.098	0.099	0.100	0.101	0.102	0.103	0.104	0.105	0.106
0.2	**0.20**	0.129	0.130	0.132	0.133	0.134	0.136	0.137	0.139	0.140	0.142
0.3	**0.25**	0.161	0.163	0.164	0.166	0.168	0.170	0.172	0.173	0.175	0.177
0.3	**0.30**	0.193	0.195	0.197	0.199	0.202	0.204	0.206	0.208	0.210	0.213
0.4	**0.35**	0.225	0.228	0.230	0.233	0.235	0.238	0.240	0.243	0.245	0.248
0.4	**0.40**	0.257	0.260	0.263	0.266	0.269	0.272	0.275	0.278	0.281	0.284
0.5	**0.45**	0.289	0.293	0.296	0.299	0.302	0.306	0.309	0.312	0.316	0.319
0.5	**0.50**	0.322	0.325	0.329	0.332	0.336	0.340	0.343	0.347	0.351	0.354
0.6	**0.55**	0.354	0.358	0.362	0.366	0.370	0.374	0.378	0.382	0.386	0.390
0.6	**0.60**	0.386	0.390	0.395	0.399	0.403	0.408	0.412	0.416	0.421	0.425
0.7	**0.65**	0.418	0.423	0.427	0.432	0.437	0.442	0.446	0.451	0.456	0.461
0.7	**0.70**	0.450	0.455	0.460	0.465	0.470	0.476	0.481	0.486	0.491	0.496
0.8	**0.75**	0.482	0.488	0.493	0.499	0.504	0.509	0.515	0.520	0.526	0.532
0.8	**0.80**	0.515	0.520	0.526	0.532	0.538	0.543	0.549	0.555	0.561	0.567
0.9	**0.85**	0.547	0.553	0.559	0.565	0.571	0.577	0.584	0.590	0.596	0.602
0.9	**0.90**	0.579	0.585	0.592	0.598	0.605	0.611	0.618	0.625	0.631	0.638
1.0	**0.95**	0.611	0.618	0.625	0.632	0.638	0.645	0.652	0.659	0.666	0.673
1.0	**1.00**	0.643	0.650	0.658	0.665	0.672	0.679	0.687	0.694	0.701	0.709
1.1	**1.05**	0.675	0.683	0.690	0.698	0.706	0.713	0.721	0.729	0.736	0.744
1.1	**1.10**	0.708	0.715	0.723	0.731	0.739	0.747	0.755	0.763	0.772	0.780
1.2	**1.15**	0.740	0.748	0.756	0.764	0.773	0.781	0.790	0.798	0.807	0.815
1.2	**1.20**	0.772	0.780	0.789	0.798	0.806	0.815	0.824	0.833	0.842	0.851
1.3	**1.25**	0.804	0.813	0.822	0.831	0.840	0.849	0.858	0.867	0.877	0.886
1.3	**1.30**	0.836	0.846	0.855	0.864	0.874	0.883	0.893	0.902	0.912	0.921
1.4	**1.35**	0.868	0.878	0.888	0.897	0.907	0.917	0.927	0.937	0.947	0.957
1.4	**1.40**	0.901	0.911	0.921	0.931	0.941	0.951	0.961	0.972	0.982	0.992
1.5	**1.45**	0.933	0.943	0.953	0.964	0.974	0.985	0.996	1.006	1.017	1.028
1.5	**1.50**	0.965	0.976	0.986	0.997	1.008	1.019	1.030	1.041	1.052	1.063
1.6	**1.55**	0.997	1.008	1.019	1.030	1.042	1.053	1.064	1.076	1.087	1.099
1.6	**1.60**	1.029	1.041	1.052	1.064	1.075	1.087	1.099	1.110	1.122	1.134
1.7	**1.65**	1.061	1.073	1.085	1.097	1.109	1.121	1.133	1.145	1.157	1.170
1.7	**1.70**	1.094	1.106	1.118	1.130	1.142	1.155	1.167	1.180	1.192	1.205
1.8	**1.75**	1.126	1.138	1.151	1.163	1.176	1.189	1.202	1.214	1.227	1.240
1.8	**1.80**	1.158	1.171	1.184	1.197	1.210	1.223	1.236	1.249	1.262	1.276
1.9	**1.85**	1.190	1.203	1.216	1.230	1.243	1.257	1.270	1.284	1.298	1.311
1.9	**1.90**	1.222	1.236	1.249	1.263	1.277	1.291	1.305	1.319	1.333	1.347
2.0	**1.95**	1.254	1.268	1.282	1.296	1.310	1.325	1.339	1.353	1.368	1.382

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	90.5	91	91.5	92	92.5	93	93.5	94	94.5	95
2.0	**2.00**	1.287	1.301	1.315	1.330	1.344	1.359	1.373	1.388	1.403	1.418
2.1	**2.05**	1.319	1.333	1.348	1.363	1.378	1.393	1.408	1.423	1.438	1.453
2.1	**2.10**	1.351	1.366	1.381	1.396	1.411	1.427	1.442	1.457	1.473	1.489
2.2	**2.15**	1.383	1.398	1.414	1.429	1.445	1.460	1.476	1.492	1.508	1.524
2.2	**2.20**	1.415	1.431	1.447	1.462	1.478	1.494	1.511	1.527	1.543	1.559
2.3	**2.25**	1.447	1.463	1.480	1.496	1.512	1.528	1.545	1.561	1.578	1.595
2.3	**2.30**	1.480	1.496	1.512	1.529	1.546	1.562	1.579	1.596	1.613	1.630
2.4	**2.35**	1.512	1.528	1.545	1.562	1.579	1.596	1.614	1.631	1.648	1.666
2.4	**2.40**	1.544	1.561	1.578	1.595	1.613	1.630	1.648	1.666	1.683	1.701
2.5	**2.45**	1.576	1.593	1.611	1.629	1.646	1.664	1.682	1.700	1.718	1.737
2.5	**2.50**	1.608	1.626	1.644	1.662	1.680	1.698	1.717	1.735	1.753	1.772
2.6	**2.55**	1.640	1.658	1.677	1.695	1.714	1.732	1.751	1.770	1.789	1.807
2.6	**2.60**	1.672	1.691	1.710	1.728	1.747	1.766	1.785	1.804	1.824	1.843
2.7	**2.65**	1.705	1.724	1.743	1.762	1.781	1.800	1.820	1.839	1.859	1.878
2.7	**2.70**	1.737	1.756	1.775	1.795	1.814	1.834	1.854	1.874	1.894	1.914
2.8	**2.75**	1.769	1.789	1.808	1.828	1.848	1.868	1.888	1.908	1.929	1.949
2.8	**2.80**	1.801	1.821	1.841	1.861	1.882	1.902	1.923	1.943	1.964	1.985
2.9	**2.85**	1.833	1.854	1.874	1.895	1.915	1.936	1.957	1.978	1.999	2.020
2.9	**2.90**	1.865	1.886	1.907	1.928	1.949	1.970	1.991	2.013	2.034	2.056
3.0	**2.95**	1.898	1.919	1.940	1.961	1.982	2.004	2.026	2.047	2.069	2.091
3.0	**3.00**	1.930	1.951	1.973	1.994	2.016	2.038	2.060	2.082	2.104	2.126
3.1	**3.05**	1.962	1.984	2.006	2.028	2.050	2.072	2.094	2.117	2.139	2.162
3.1	**3.10**	1.994	2.016	2.038	2.061	2.083	2.106	2.129	2.151	2.174	2.197
3.2	**3.15**	2.026	2.049	2.071	2.094	2.117	2.140	2.163	2.186	2.209	2.233
3.2	**3.20**	2.058	2.081	2.104	2.127	2.150	2.174	2.197	2.221	2.244	2.268
3.3	**3.25**	2.091	2.114	2.137	2.160	2.184	2.208	2.232	2.255	2.279	2.304
3.3	**3.30**	2.123	2.146	2.170	2.194	2.218	2.242	2.266	2.290	2.315	2.339
3.4	**3.35**	2.155	2.179	2.203	2.227	2.251	2.276	2.300	2.325	2.350	2.375
3.4	**3.40**	2.187	2.211	2.236	2.260	2.285	2.310	2.334	2.360	2.385	2.410
3.5	**3.45**	2.219	2.244	2.269	2.293	2.318	2.344	2.369	2.394	2.420	2.445
3.5	**3.50**	2.251	2.276	2.301	2.327	2.352	2.378	2.403	2.429	2.455	2.481
3.6	**3.55**	2.284	2.309	2.334	2.360	2.386	2.411	2.437	2.464	2.490	2.516
3.6	**3.60**	2.316	2.341	2.367	2.393	2.419	2.445	2.472	2.498	2.525	2.552
3.7	**3.65**	2.348	2.374	2.400	2.426	2.453	2.479	2.506	2.533	2.560	2.587
3.7	**3.70**	2.380	2.406	2.433	2.460	2.486	2.513	2.540	2.568	2.595	2.623
3.8	**3.75**	2.412	2.439	2.466	2.493	2.520	2.547	2.575	2.602	2.630	2.658
3.8	**3.80**	2.444	2.471	2.499	2.526	2.554	2.581	2.609	2.637	2.665	2.694
3.9	**3.85**	2.477	2.504	2.532	2.559	2.587	2.615	2.643	2.672	2.700	2.729
3.9	**3.90**	2.509	2.537	2.564	2.593	2.621	2.649	2.678	2.707	2.735	2.764

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length Class	Midpoints	90.5	91	91.5	92	92.5	93	93.5	94	94.5	95
4.0	**3.95**	2.541	2.569	2.597	2.626	2.654	2.683	2.712	2.741	2.770	2.800
4.0	**4.00**	2.573	2.602	2.630	2.659	2.688	2.717	2.746	2.776	2.806	2.835
4.1	**4.05**	2.605	2.634	2.663	2.692	2.722	2.751	2.781	2.811	2.841	2.871
4.1	**4.10**	2.637	2.667	2.696	2.726	2.755	2.785	2.815	2.845	2.876	2.906
4.2	**4.15**	2.670	2.699	2.729	2.759	2.789	2.819	2.849	2.880	2.911	2.942
4.2	**4.20**	2.702	2.732	2.762	2.792	2.822	2.853	2.884	2.915	2.946	2.977
4.3	**4.25**	2.734	2.764	2.795	2.825	2.856	2.887	2.918	2.949	2.981	3.012
4.3	**4.30**	2.766	2.797	2.827	2.858	2.890	2.921	2.952	2.984	3.016	3.048
4.4	**4.35**	2.798	2.829	2.860	2.892	2.923	2.955	2.987	3.019	3.051	3.083
4.4	**4.40**	2.830	2.862	2.893	2.925	2.957	2.989	3.021	3.054	3.086	3.119
4.5	**4.45**	2.863	2.894	2.926	2.958	2.990	3.023	3.055	3.088	3.121	3.154
4.5	**4.50**	2.895	2.927	2.959	2.991	3.024	3.057	3.090	3.123	3.156	3.190
4.6	**4.55**	2.927	2.959	2.992	3.025	3.058	3.091	3.124	3.158	3.191	3.225
4.6	**4.60**	2.959	2.992	3.025	3.058	3.091	3.125	3.158	3.192	3.226	3.261
4.7	**4.65**	2.991	3.024	3.058	3.091	3.125	3.159	3.193	3.227	3.261	3.296
4.7	**4.70**	3.023	3.057	3.091	3.124	3.158	3.193	3.227	3.262	3.296	3.331
4.8	**4.75**	3.055	3.089	3.123	3.158	3.192	3.227	3.261	3.296	3.332	3.367
4.8	**4.80**	3.088	3.122	3.156	3.191	3.226	3.261	3.296	3.331	3.367	3.402
4.9	**4.85**	3.120	3.154	3.189	3.224	3.259	3.295	3.330	3.366	3.402	3.438
4.9	**4.90**	3.152	3.187	3.222	3.257	3.293	3.329	3.364	3.400	3.437	3.473
5.0	**4.95**	3.184	3.219	3.255	3.291	3.326	3.362	3.399	3.435	3.472	3.509
5.0	**5.00**	3.216	3.252	3.288	3.324	3.360	3.396	3.433	3.470	3.507	3.544
5.1	**5.05**	3.248	3.284	3.321	3.357	3.394	3.430	3.467	3.505	3.542	3.580
5.1	**5.10**	3.281	3.317	3.354	3.390	3.427	3.464	3.502	3.539	3.577	3.615

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	95.5	96	96.5	97	97.5	98	98.5	99	99.5	100
0.1	0.05	0.036	0.036	0.037	0.037	0.037	0.038	0.038	0.038	0.039	0.039
0.1	0.10	0.072	0.072	0.073	0.074	0.075	0.075	0.076	0.077	0.078	0.079
0.2	0.15	0.107	0.109	0.110	0.111	0.112	0.113	0.114	0.115	0.117	0.118
0.2	0.20	0.143	0.145	0.146	0.148	0.149	0.151	0.152	0.154	0.156	0.157
0.3	0.25	0.179	0.181	0.183	0.185	0.187	0.189	0.191	0.192	0.194	0.196
0.3	0.30	0.215	0.217	0.219	0.222	0.224	0.226	0.229	0.231	0.233	0.236
0.4	0.35	0.251	0.253	0.256	0.259	0.261	0.264	0.267	0.269	0.272	0.275
0.4	0.40	0.287	0.290	0.293	0.296	0.299	0.302	0.305	0.308	0.311	0.314
0.5	0.45	0.322	0.326	0.329	0.333	0.336	0.339	0.343	0.346	0.350	0.353
0.5	0.50	0.358	0.362	0.366	0.369	0.373	0.377	0.381	0.385	0.389	0.393
0.6	0.55	0.394	0.398	0.402	0.406	0.411	0.415	0.419	0.423	0.428	0.432
0.6	0.60	0.430	0.434	0.439	0.443	0.448	0.453	0.457	0.462	0.467	0.471
0.7	0.65	0.466	0.470	0.475	0.480	0.485	0.490	0.495	0.500	0.505	0.511
0.7	0.70	0.501	0.507	0.512	0.517	0.523	0.528	0.533	0.539	0.544	0.550
0.8	0.75	0.537	0.543	0.549	0.554	0.560	0.566	0.572	0.577	0.583	0.589
0.8	0.80	0.573	0.579	0.585	0.591	0.597	0.603	0.610	0.616	0.622	0.628
0.9	0.85	0.609	0.615	0.622	0.628	0.635	0.641	0.648	0.654	0.661	0.668
0.9	0.90	0.645	0.651	0.658	0.665	0.672	0.679	0.686	0.693	0.700	0.707
1.0	0.95	0.680	0.688	0.695	0.702	0.709	0.717	0.724	0.731	0.739	0.746
1.0	1.00	0.716	0.724	0.731	0.739	0.747	0.754	0.762	0.770	0.778	0.785
1.1	1.05	0.752	0.760	0.768	0.776	0.784	0.792	0.800	0.808	0.816	0.825
1.1	1.10	0.788	0.796	0.805	0.813	0.821	0.830	0.838	0.847	0.855	0.864
1.2	1.15	0.824	0.832	0.841	0.850	0.859	0.867	0.876	0.885	0.894	0.903
1.2	1.20	0.860	0.869	0.878	0.887	0.896	0.905	0.914	0.924	0.933	0.942
1.3	1.25	0.895	0.905	0.914	0.924	0.933	0.943	0.953	0.962	0.972	0.982
1.3	1.30	0.931	0.941	0.951	0.961	0.971	0.981	0.991	1.001	1.011	1.021
1.4	1.35	0.967	0.977	0.987	0.998	1.008	1.018	1.029	1.039	1.050	1.060
1.4	1.40	1.003	1.013	1.024	1.035	1.045	1.056	1.067	1.078	1.089	1.100
1.5	1.45	1.039	1.050	1.061	1.072	1.083	1.094	1.105	1.116	1.127	1.139
1.5	1.50	1.074	1.086	1.097	1.108	1.120	1.131	1.143	1.155	1.166	1.178
1.6	1.55	1.110	1.122	1.134	1.145	1.157	1.169	1.181	1.193	1.205	1.217
1.6	1.60	1.146	1.158	1.170	1.182	1.195	1.207	1.219	1.232	1.244	1.257
1.7	1.65	1.182	1.194	1.207	1.219	1.232	1.245	1.257	1.270	1.283	1.296
1.7	1.70	1.218	1.231	1.243	1.256	1.269	1.282	1.295	1.309	1.322	1.335
1.8	1.75	1.254	1.267	1.280	1.293	1.307	1.320	1.334	1.347	1.361	1.374
1.8	1.80	1.289	1.303	1.316	1.330	1.344	1.358	1.372	1.386	1.400	1.414
1.9	1.85	1.325	1.339	1.353	1.367	1.381	1.395	1.410	1.424	1.438	1.453
1.9	1.90	1.361	1.375	1.390	1.404	1.419	1.433	1.448	1.463	1.477	1.492
2.0	1.95	1.397	1.411	1.426	1.441	1.456	1.471	1.486	1.501	1.516	1.532

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

Length	Class Midpoints	95.5	96	96.5	97	97.5	98	98.5	99	99.5	100
2.0	**2.00**	1.433	1.448	1.463	1.478	1.493	1.509	1.524	1.540	1.555	1.571
2.1	**2.05**	1.468	1.484	1.499	1.515	1.531	1.546	1.562	1.578	1.594	1.610
2.1	**2.10**	1.504	1.520	1.536	1.552	1.568	1.584	1.600	1.617	1.633	1.649
2.2	**2.15**	1.540	1.556	1.572	1.589	1.605	1.622	1.638	1.655	1.672	1.689
2.2	**2.20**	1.576	1.592	1.609	1.626	1.643	1.659	1.676	1.693	1.711	1.728
2.3	**2.25**	1.612	1.629	1.646	1.663	1.680	1.697	1.715	1.732	1.750	1.767
2.3	**2.30**	1.648	1.665	1.682	1.700	1.717	1.735	1.753	1.770	1.788	1.806
2.4	**2.35**	1.683	1.701	1.719	1.737	1.755	1.773	1.791	1.809	1.827	1.846
2.4	**2.40**	1.719	1.737	1.755	1.774	1.792	1.810	1.829	1.847	1.866	1.885
2.5	**2.45**	1.755	1.773	1.792	1.811	1.829	1.848	1.867	1.886	1.905	1.924
2.5	**2.50**	1.791	1.810	1.828	1.847	1.867	1.886	1.905	1.924	1.944	1.964
2.6	**2.55**	1.827	1.846	1.865	1.884	1.904	1.923	1.943	1.963	1.983	2.003
2.6	**2.60**	1.862	1.882	1.902	1.921	1.941	1.961	1.981	2.001	2.022	2.042
2.7	**2.65**	1.898	1.918	1.938	1.958	1.979	1.999	2.019	2.040	2.061	2.081
2.7	**2.70**	1.934	1.954	1.975	1.995	2.016	2.037	2.057	2.078	2.099	2.121
2.8	**2.75**	1.970	1.991	2.011	2.032	2.053	2.074	2.096	2.117	2.138	2.160
2.8	**2.80**	2.006	2.027	2.048	2.069	2.091	2.112	2.134	2.155	2.177	2.199
2.9	**2.85**	2.041	2.063	2.084	2.106	2.128	2.150	2.172	2.194	2.216	2.238
2.9	**2.90**	2.077	2.099	2.121	2.143	2.165	2.187	2.210	2.232	2.255	2.278
3.0	**2.95**	2.113	2.135	2.158	2.180	2.203	2.225	2.248	2.271	2.294	2.317
3.0	**3.00**	2.149	2.171	2.194	2.217	2.240	2.263	2.286	2.309	2.333	2.356
3.1	**3.05**	2.185	2.208	2.231	2.254	2.277	2.301	2.324	2.348	2.372	2.395
3.1	**3.10**	2.221	2.244	2.267	2.291	2.315	2.338	2.362	2.386	2.410	2.435
3.2	**3.15**	2.256	2.280	2.304	2.328	2.352	2.376	2.400	2.425	2.449	2.474
3.2	**3.20**	2.292	2.316	2.340	2.365	2.389	2.414	2.438	2.463	2.488	2.513
3.3	**3.25**	2.328	2.352	2.377	2.402	2.427	2.451	2.477	2.502	2.527	2.553
3.3	**3.30**	2.364	2.389	2.414	2.439	2.464	2.489	2.515	2.540	2.566	2.592
3.4	**3.35**	2.400	2.425	2.450	2.476	2.501	2.527	2.553	2.579	2.605	2.631
3.4	**3.40**	2.435	2.461	2.487	2.513	2.539	2.565	2.591	2.617	2.644	2.670
3.5	**3.45**	2.471	2.497	2.523	2.549	2.576	2.602	2.629	2.656	2.683	2.710
3.5	**3.50**	2.507	2.533	2.560	2.586	2.613	2.640	2.667	2.694	2.721	2.749
3.6	**3.55**	2.543	2.570	2.596	2.623	2.651	2.678	2.705	2.733	2.760	2.788
3.6	**3.60**	2.579	2.606	2.633	2.660	2.688	2.715	2.743	2.771	2.799	2.827
3.7	**3.65**	2.615	2.642	2.670	2.697	2.725	2.753	2.781	2.810	2.838	2.867
3.7	**3.70**	2.650	2.678	2.706	2.734	2.762	2.791	2.819	2.848	2.877	2.906
3.8	**3.75**	2.686	2.714	2.743	2.771	2.800	2.829	2.858	2.887	2.916	2.945
3.8	**3.80**	2.722	2.751	2.779	2.808	2.837	2.866	2.896	2.925	2.955	2.985
3.9	**3.85**	2.758	2.787	2.816	2.845	2.874	2.904	2.934	2.964	2.994	3.024
3.9	**3.90**	2.794	2.823	2.852	2.882	2.912	2.942	2.972	3.002	3.033	3.063

Volume in Cubic Metres
(Divide Volumes by 1000 for shaded volumes only)

Diameter (cm)

		95.5	96	96.5	97	97.5	98	98.5	99	99.5	100
Length											
Class Midpoints											
4.0	**3.95**	2.829	2.859	2.889	2.919	2.949	2.979	3.010	3.041	3.071	3.102
4.0	**4.00**	2.865	2.895	2.926	2.956	2.986	3.017	3.048	3.079	3.110	3.142
4.1	**4.05**	2.901	2.931	2.962	2.993	3.024	3.055	3.086	3.118	3.149	3.181
4.1	**4.10**	2.937	2.968	2.999	3.030	3.061	3.093	3.124	3.156	3.188	3.220
4.2	**4.15**	2.973	3.004	3.035	3.067	3.098	3.130	3.162	3.195	3.227	3.259
4.2	**4.20**	3.008	3.040	3.072	3.104	3.136	3.168	3.200	3.233	3.266	3.299
4.3	**4.25**	3.044	3.076	3.108	3.141	3.173	3.206	3.239	3.272	3.305	3.338
4.3	**4.30**	3.080	3.112	3.145	3.178	3.210	3.243	3.277	3.310	3.344	3.377
4.4	**4.35**	3.116	3.149	3.182	3.215	3.248	3.281	3.315	3.349	3.382	3.416
4.4	**4.40**	3.152	3.185	3.218	3.252	3.285	3.319	3.353	3.387	3.421	3.456
4.5	**4.45**	3.188	3.221	3.255	3.288	3.322	3.357	3.391	3.425	3.460	3.495
4.5	**4.50**	3.223	3.257	3.291	3.325	3.360	3.394	3.429	3.464	3.499	3.534
4.6	**4.55**	3.259	3.293	3.328	3.362	3.397	3.432	3.467	3.502	3.538	3.574
4.6	**4.60**	3.295	3.330	3.364	3.399	3.434	3.470	3.505	3.541	3.577	3.613
4.7	**4.65**	3.331	3.366	3.401	3.436	3.472	3.507	3.543	3.579	3.616	3.652
4.7	**4.70**	3.367	3.402	3.438	3.473	3.509	3.545	3.581	3.618	3.655	3.691
4.8	**4.75**	3.402	3.438	3.474	3.510	3.546	3.583	3.620	3.656	3.693	3.731
4.8	**4.80**	3.438	3.474	3.511	3.547	3.584	3.621	3.658	3.695	3.732	3.770
4.9	**4.85**	3.474	3.511	3.547	3.584	3.621	3.658	3.696	3.733	3.771	3.809
4.9	**4.90**	3.510	3.547	3.584	3.621	3.658	3.696	3.734	3.772	3.810	3.848
5.0	**4.95**	3.546	3.583	3.620	3.658	3.696	3.734	3.772	3.810	3.849	3.888
5.0	**5.00**	3.582	3.619	3.657	3.695	3.733	3.771	3.810	3.849	3.888	3.927
5.1	**5.05**	3.617	3.655	3.693	3.732	3.770	3.809	3.848	3.887	3.927	3.966
5.1	**5.10**	3.653	3.692	3.730	3.769	3.808	3.847	3.886	3.926	3.966	4.006

Appendix K Tolerance Level 3 Stacked Volume Tables

(Using 0.65 m^3/m^3 (stacked)
stacked cubic metres per 0.40 m bolt
(hundreths)

D (cm)	m3 (Stacked)	D (cm)	m3 (Stacked)	D (cm)	m3 (Stacked)	D (cm)	m3 (Stacked)
1	0	21	2	41	8	61	18
2	.02	22	2	42	9	62	19
3	.04	23	3	43	9	63	19
4	.08	24	3	44	9	64	20
5	.1	25	3	45	10	65	20
6	.2	26	3	46	10	66	21
7	.2	27	4	47	11	67	22
8	.3	28	4	48	11	68	22
9	.4	29	4	49	12	69	23
10	.5	30	4	50	12	70	24
11	.6	31	5	51	13	71	24
12	.7	32	5	52	13	72	25
13	.8	33	5	53	14	73	26
14	.9	34	6	54	14	74	26
15	1.0	35	6	55	15	75	27
16	1.0	36	6	56	15	76	28
17	1.0	37	7	57	16	77	29
18	2.0	38	7	58	16	78	29
19	2.0	39	7	59	17	79	30
20	2.0	40	8	60	17	80	31

Ministry of Environment

SCO1
(Complete one page per pile)
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Total # of Pages _______

Date of Scale _____________Scaler Number ________Authorization _____________
(Day/month/year) (FMA, Permit or TSL)
Permit Number _____________ Agreement Number __________
Forest__________________
Division ___________________Area Name _______________Block______________
Pile Number ______________ Scaling Plan Number ________________________
Method of Scale:
☐ Stacked with 1m squares ☐Individual Logs ☐Logs in Piles ☐Tree length – tree count
☐Tree length - Pile face ☐Tree Length - Total population ☐Other specify____________
Cull table number(s) ____-____ Tree Length Table number(s) ____-____
____-____ ____-____
____-____ ____-____

Square Sample(s) ___________Pile Length ___________m Average Pile Height ______
Average Pile Width ___________m Multiplier ____________

Stacked to solid conversion _________m^3/m^3(stacked)

Summary of Volumes:

Total Gross Volume ____________m^3

Total Quality Volume ____________m^3

Total Defect Volume ____________m^3

Total Net Volume ____________m^3

Dues Class	Species	Product	Dues Reduction Category	Net Volume

To the best of my knowledge, the information on this ticket is accurate and has not been biased.

____
Signature of Scaler

Attach copies of all forms and distribute as follows:
Forest Service Prince Albert; Licensee; License issuing office; Scalers file

Appendix M Tally Sheets for Scaling Methods

Stacked Wood Field Scale Header Information

Ministry of Environment

SC01#__________

Date of Scale ____________ Scaler Number _________ Authorization ___________
(Day/Month/Year) (FMA/Permit/TSL)
Permit Number __________ Agreement Number ______________ Forest __________
Division __________ Area Name ____________________ Block ___________
Pile Number _________ Scaling Plan Number _____________________________________
GPS/UTM ____________________- __________________

☐ Scale 1 Side of pile Diameter Class ______ cm ☐ Defect Measured in sample (Hardwood only)
☐ Scale 2 Sides of pile Length (Width) Class ______ m ☐ Defect Measured in Entire Pile

Pile Face Length (**1**) ________ Pile Face Length (**2**) ________

Widths					
1		**11**		**21**	
2		**12**		**22**	
3		**13**		**23**	
4		**14**		**24**	
5		**15**		**25**	
6		**16**		**26**	
7		**17**		**27**	
8		**18**		**28**	
9		**19**		**29**	
10		**20**		**30**	

Heights Side 1					
1		**11**		**21**	
2		**12**		**22**	
3		**13**		**23**	
4		**14**		**24**	
5		**15**		**25**	
6		**16**		**26**	
7		**17**		**27**	
8		**18**		**28**	
9		**19**		**29**	
10		**20**		**30**	

Heights Side 2					
1		**11**		**21**	
2		**12**		**22**	
3		**13**		**23**	
4		**14**		**24**	
5		**15**		**25**	
6		**16**		**26**	
7		**17**		**27**	
8		**18**		**28**	
9		**19**		**29**	
10		**20**		**30**	

Average Pile Width = ________m Width Class = ________m Class Midpoint = ________m

Side 1	**Side 2**
Avg. Height = ________m	Avg. Height = ________m
Face Area = ________m^2 (Face Area = Face length x avg. Height)	Face Area = ________ m^2 (Face Area = Face length x avg. Height)
#Square Sample(s) = ________ (Square metre sample = face area x 10%)	#Square Sample(s) = ________ (Square metre sample = face area x 10%)
Outside Bark Diameter = ________	Outside Bark Diameter = ________
Inside Bark Diameter = ________	Inside Bark Diameter = ________
Number of Voids = ________	Number of Voids = ________

DIAMETER TALLY

SC01 Number _______ ☐Side 1 Diameter Tally ☐Side 2

		Species ____________			Species ____________			Species_______________		
Dia	Vol/ Piece	Tally	Total # Pieces	Volume	Tally	Total # Pieces	Volume	Tally	Total # Pieces	Volume

DEFECT TALLY

SC01 Number _______ ☐Side 1 Diameter Tally ☐Side 2 Page ____ of _____

Tally					Dues Class of Log			Volume of Defect by Dues Class								
LOG #	SP	LOG DIA	DEF DIA (mm)	DEF DIA CLASS	DUES CLASS	LOG VOLUME S1AD	LOG VOLUME S1BD	S1a	S1ad	S1b	S1bd	S2	S3	S3US	H1	H2
TOTALS			SP													
			SP													
			SP													

Stacked Wood Calculations

☐ Side 1 ☐ Side 2

Number of 1m Sample Squares

Face Length _______ X Avg. Height ______ X 10 % = ___________ 1m Sample Squares

Stacked Volume of Samples = 1m x 1m x Average Width x # 1m Sample Squares

# of 1m Samples ______ X Avg. Width ______ = ________________ m^3 (Stacked)

Stacked to Solid Conversion

Volume of Sample ___________ ÷ Stacked Volume of Samples _______ = ______________m^3/m^3 (Stacked) (Conversion)

Gross Stacked Volume

Face Length ___________ X Average Height __________ X Average Width _________ = _________m^3(st)

Gross Solid Volume of Pile

Gross Stacked Volume _________ X Conversion ________m^3/m^3(st) = ______________ m^3 Solid

Gross Volume Minus Deductions

Gross Solid Volume ___________ - Deductions ________ = ______________ m^3 Solid Volume

Sample Volumes by Species and Dues Class

% Species by Dues Class

Volume of Species by dues class in sample ÷ Volume of Sample X 100 = % Species by Dues Class

sp	S1a			sp	S1b			sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

Gross Solid Volume by Species and Dues Class

Gross Solid Volume minus deductions X % Species by Dues Class

sp	S1a			sp	S1b			sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

***if applicable Classify Volumes** (S1A – S1AD = S1A; S1B – S1BD = S1B)

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

☐ **% Defect Volume by Species and Dues Class** (if HW defects are represented in $1m^2$ samples; DV by species and dues class ÷ species and dues class in sample x 100)

☐ **Defect Volume by Species and Dues Class** (all defects were represented in entire pile)

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

Net Volume (Gross volume minus defect volume by species by dues class)

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

Logs in Piles Field Scale Header Information

Ministry of
Environment

SC01#___________

Date of Scale _____________ Scaler Number __________ Authorization ____________
(Day/Month/Year) (FMA/Permit/TSL)
Permit Number ___________ Agreement Number _______________ Forest ___________
Division ___________ Area Name ______________________ Block ____________
Pile Number __________ Scaling Plan Number ____
GPS/UTM ______________________- ____________________

☐ Scale 1 Side of pile Diameter Class ______ cm
☐ Scale 2 Sides of pile Length (Width) Class ______ m ☐ Defect Measured in Entire Pile

Widths					
1		11		21	
2		12		22	
3		13		23	
4		14		24	
5		15		25	
6		16		26	
7		17		27	
8		18		28	
9		19		29	
10		20		30	

Average Pile Width = ________m Width Class = ________m Class Midpoint = ________m

Volume Calculations Logs In Piles

☐ Side 1 ☐ Side 2

Gross Solid Volume by Species and Dues Class *(if applicable) Classify Sample Volumes First (S1A – S1AD = S1A; S1B – S1BD = S1B)

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

Defect Volume by Species and Dues Class

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

Net Volume by Species and Dues Class

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

DIAMETER TALLY

SC01 Number _______ **☐Side 1 Diameter Tally ☐Side 2** **Page ____ of _____**

		Species ____________			Species ____________			Species_______________		
Dia	Vol/ Piece	Tally	Total # Pieces	Volume	Tally	Total # Pieces	Volume	Tally	Total # Pieces	Volume

DEFECT TALLY

SC01 Number _______ ☐Side 1 Diameter Tally ☐Side 2 Page ____ of _____

Tally					Dues Class of Log			Volume of Defect by Dues Class								
LOG #	SP	LOG DIA	DEF DIA (mm)	DEF DIA CLASS	DUES CLASS	LOG VOLUME S1AD	LOG VOLUME S1BD	S1a	S1ad	S1b	S1bd	S2	S3	S3US	H1	H2
TOTALS			**SP**													
			SP													
			SP													

Tree Length Field Scale Header Information

Ministry of Environment

SC01#__________

Date of Scale ____________ Scaler Number _________ Authorization __________
(Day/Month/Year) (FMA/Permit/TSL)
Permit Number __________ Agreement Number ______________ Forest __________
Division __________ Area Name ____________________ Block ___________
Pile Number _________ Scaling Plan Number _____________________________________
GPS/UTM ____________________- __________________

☐ Tree Length- Count ☐ Tree Length-Pile Face ☐ Tree Length-Total Population
☐ Defect Measured in sample (Hardwood only)
☐ Defect Measured in Entire Pile
Diameter Class ______ Pile Face Length ______

Widths

1		11		21	
2		12		22	
3		13		23	
4		14		24	
5		15		25	
6		16		26	
7		17		27	
8		18		28	
9		19		29	
10		20		30	

Average Pile Width _________ m

Heights

1		11		21	
2		12		22	
3		13		23	
4		14		24	
5		15		25	
6		16		26	
7		17		27	
8		18		28	
9		19		29	
10		20		30	

Avg. Height ______m

Tree Length Table _________
____
____
____

Pile Face Method

Face area =
Average Height _________ X Face Length _________ = _____________ m^2
Number of 1 m^2 samples =
Face Area ________ X 20% = ________________# of 1 m^2 Sample
Multiplier =
Face Area ____________ ÷ # 1 m^2 Samples__________ = _______________Multiplier

Tree Count Method

Total Count of Trees in pile = _________________
Number of pieces to be sampled =
# of Trees in pile ______________X 20% = __________# trees scaled __________Actual # trees scaled
Total # of trees counted ________ ÷ Actual # trees scaled ___________ = ___________ Multiplier

DIAMETER TALLY

SC01 Number _______ **Diameter Tally** **Page ____ of _____**

	Species ____________		Species ____________		Species_______________	
Dia	Tally	Total # Pieces	Tally	Total # Pieces	Tally	Total # Pieces

DEFECT TALLY

SC01 Number _______ **Diameter Tally** **Page ____ of _____**

Tally					Dues Class of Log			Volume of Defect by Dues Class								
LOG #	SP	LOG DIA	DEF DIA (mm)	DEF DIA CLASS	DUES CLASS	LOG VOLUME S1AD	LOG VOLUME S1BD	S1a	S1ad	S1b	S1bd	S2	S3	S3US	H1	H2
TOTALS			SP													
			SP													
			SP													

Calculation Sheet for Tree Length Scaling

					Dues Class percentages- from tables				Gross Volume Distribution				
Dia Class	SP	Total Pieces	Volume per piece	Gross Volume	☐ S1a ☐ S1b ☐ H1	☐ S2 ☐ H2	☐ S3	☐ S3US	☐ S1a ☐ S1b ☐ H1	☐ S2 ☐ H2	☐ S3	☐ S3US	
Totals													

SC01# ___________ Sample Volumes by Species and Dues Class

Multiplier = ______ (*Multiplier not used with Total Population Method to calculate gross volume)

Gross Solid Volume by Species and Dues Class (if sample method used; sample volumes by species and dues class x multiplier)

sp	S1a			sp	S1b			sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

***(if applicable) Classify S1AD and S1BD** (S1A – S1AD = S1A; S1B – S1BD = S1B

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

☐ **Defect Volume by Species and Dues Class** (if defects were represented in 1m^2 samples; Defect equals DV in sample x Multiplier)

☐ **Defect Volume by Species and Dues Class** (all defects were represented in entire pile)

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

Net Volume by Species and Dues Class

sp	S1a	sp	S1ad	sp	S1b	sp	S1bd	sp	S2	sp	S3	sp	S3US	sp	H1	sp	H2

Individual Log

Ministry of Environment

Sample / SC01# ______________________

Date of Scale ____________ Scaler Number _________ Authorization ___________
(Day/Month/Year) (FMA/Permit/TSL)
Permit Number __________ Agreement Number ______________ Forest __________
Division __________ Area Name ____________________ Block ___________
Pile Number _________ Scaling Plan Number _____________________________________
GPS/UTM ____________________- __________________

													Defect Measurement									
Log #	Bolt #	SP	BT 1 mm	D1	Class / Exact	IB/ OB	BT 2 mm	d2	Class / Exact	IB/ OB	Length	Class/ Exact	Defect Type	D1 / Width	D2/ Thickness /Arc	Length	Excessive Sweep	Gross Volume	Defect Volume	Net Volume	Product	Dues Class

Sample/ SC01#__________________ Page ______ of ______

Log #	Bolt #	SP	BT 1 mm	D1	Class / Exact	IB/ OB	BT 2 mm	d2	Class / Exact	IB/ OB	Length	Class/ Exact	Defect Type	D1 / Width	D2/ Thickness /Arc	Length	Excessive Sweep	Gross Volume	Defect Volume	Net Volume	Product	Dues Class

Appendix N Provincial Wood Profile - Sample Scale Tally Sheet for Cut to Length Wood

Sample Number __ Delivery Slip No. ______________Agreement # ____________Unit Number_____________ Area Number____ Block Number ____________
Truck Number ___________ Date Harvested ________________ Date Hauled ________________ Date Scaled _______________ Load Slip # ______________
Gross Weight ____________kg Tare Weight ____________kg Net Weight ___________kg Stratum _______________Authorization _____________
Harvest Block ____________________________ Scalers ________________________Log Position: Butt Log, Mid Logs, Top Log Type: Merchantable, Waste

Diam Class	Dot Tally		No. Pieces		Volume/ Piece	Total Volume		Defect Tally													Lengths
	Inside Bark	Outside Bark	I.B.	O.B.		I.B.	O.B.	4	6	8	10	12	14	16	18	20	22	24			
6																					
8																					
10																					
12																					
14																					
16																					
18																					
20																					
22																					
24																					
26																					
28																					
30																					
32																					
34																					

Gross Volume (I.B.)_________m3

Defect Volume(I.B. & O.B) ___________m3 Net Volume(I.B) ___________m3 Conversion (I.B.)___________________kg/m3

Appendix O Sample Scale Tally Sheet for Pencil Bucking - Page 1

Sample Number ________

Scaler Number__________ Authorization ________________ Permit # ______________

Agreement # ___________ Forest _______________ Division ___________ Area Name ______________

Block Number ________________ Pile Number ____________ Truck Number __________ Date Harvested ______________ Date Weighed _______________Date Scaled______________ Load Slip # _____________

Forest Product Shipping & Receiving ______________ Gross Weight ___________kg Tare Weight ___________kg
Net Weight __________kg Stratum ________________________

Key:
Log Position: Butt Log(B), Mid Logs(M), Top(T) Log Type: Merchantable(M), Waste(W)

Quota Wood: Quota(Q), Residual(R), Not Applicable

Sample Scale Tally Sheet for Pencil Bucking - Page 2 **Page _____ of _____**

Tree #	Sp.	Bolt #	Log Pos=n	Log Type	Quota Wood	Min Butt Diam	Dia 1 I.B.	Type	Dia 1 O.B.	Type	Bark Thick (mm)	Dia at 1m	Butt Mid log Diam	Dia 2 I.B.	Type	Dia 2 O.B.	Type	Bark Thick 2 (mm)	Length	Type	Gross Volume I.B. (m3)	Defect Type	Defect Dimensions	Defect Volume (m3)	Net Volume I.B.(m3)

Appendix P Scaling Plan (field)

For Forest Product Permit Holders or TSL Holders
(Approval must be obtained, prior to transport of wood)

This plan is the authority for ____, licensee, of ____________________________________, to scale forest products in the manner indicated below.
(City/Town)
Annual Operating Plan #(s) ______________________________ Harvest Auth # ______________________
Approved Volume ____________________________ m^3

Method of scale: (As per the current edition of the Saskatchewan Scaling Standard)

- ☐ Tree Length
- ☐ Stacked with 1 m^2 samples
- ☐ Individual Logs
- ☐ Piled Logs

OR

Method of Measurement (if applicable)

- ☐ NTL01 (less than 250 m^3 annually)
- ☐ Tops (less than 10 cm) estimated
- ☐ Standing tree measurement

Place of Scale

- ☐ Scale timber at staging area before transport
- ☐ Other ____

Authorization to:

- ☐ Scale completed by another processing facility(s). Letter(s) of agreement(s) to be attached. List facility(s):

_______________________________ Max. accepted volume _____________m^3
_______________________________ Max. accepted volume _____________m^3
_______________________________ Max. accepted volume _____________m^3
_______________________________ Max. accepted volume _____________m^3

Woodflow reporting:

- ☐ Not required
- ☐ Required within 20 days of each month end as per attached form. Nil reports must be submitted if no activity in a given month.

All provisions and requirements of The Forest Resources Management Regulations and the current edition of the Saskatchewan Scaling Standard must be adhered to including:

- All timber must be piled in a manner in which an accurate scale can be made;
- Scaling must be completed within 90 days of harvest unless authorized in this plan;
- Timber must be piled in a manner that will allow identification of timber by individual licence and harvest area and will facilitate an accurate scale.
- Timber parcels must not be moved for 48 hours after being scaled;
- Scaling returns must be submitted by Forest Product Permit Holders according to terms set out in the licence. By Term Supply Licence holders, within 20 days after the end of each month.
- Any adjustments to this plan must be made, in writing, and submitted to the issuing officer. Approval must be obtained before timber can be transported.

__________________________________ __________________________________
Signature of applicant Date of application

For Saskatchewan Ministry of Environment Use Only

Approval is hereby given for this Scaling Plan.

Scaling plan number is : ____

Conditions of approval:

Additional conditions attached:

- ☐ Yes
- ☐ No

______________________________	________________	_________________________
Signature of approving Officer	Area Office/FS	Date of Approval

☐ This scaling plan is not approved.

Approval may be obtained by completing the following:

______________________________	________________	_________________________
Signature of approving Officer	Area Office/FS	Date of Approval

Copies to: License holder, Forest Service Branch, Inspecting office, Issuing office

Appendix Q Monthly Wood Flow Report

Company/Licensee Name: ____ **Site:** ___________________ **Report Submitted for the MONTH of:** ________________________ **YOUR OWN WOOD Harvested/Delivered from Bush: (E = estimated, A = actual)**

Forest	Division	Area	Block	YOUR Permit or TSL#	Product	Form	Condition	Genus/ Species	A Left in Bush (from previous month)	B Volume (m^3) Harvested in current month	C Volume Delivered from harvest location, To: (Name of Your site or other Company/Site)			D Left in Bush (current month) A+B–C = D
					□Sawlogs □Pulp □OSB □Other_________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A	E A	E A	E A	E A	
					□Sawlogs □Pulp □OSB □Other_________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A	E A	E A	E A	E A	
					□Sawlogs □Pulp □OSB □Other_________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A	E A	E A	E A	E A	
					□Sawlogs □Pulp □OSB □Other_________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A	E A	E A	E A	E A	
					□Sawlogs □Pulp □OSB □Other_________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A	E A	E A	E A	E A	
					□Sawlogs □Pulp □OSB □Other_________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A	E A	E A	E A	E A	
								TOTALS						

Monthly Wood flow - Page 2 WOOD YOU PURCHASE / RECEIVE FOR OTHERS

Wood You Purchase or Receive from Other Provincial Land Harvesters

Forest	Division	Area	Block	Permit or TSL#	Product	Form	Condition	Genus	Received/Purchased From: (FMA Company/Permitee/ TSL Holder Name)	Volume (m^3)
					□Sawlogs □Pulp □OSB □Other__________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	**FMA Company / Permitee or TSL Holder:** Name___________________________________ Site____________________________________	E A
					□Sawlogs □Pulp □OSB □Other__________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	**FMA Company / Permitee or TSL Holder:** Name___________________________________ Site____________________________________	E A
					□Sawlogs □Pulp □OSB □Other______ ____	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	**FMA Company / Permitee or TSL Holder:** Name___________________________________ Site____________________________________	E A
									TOTAL	

Wood You Purchased/Received from Private Land Owners or Federal Lands:

Purchased From: (Federal Land / Land Owner's Name)	**Land Location** (Legal Land Description)	Product	Form	Condition	Genus	Volume (m^3)
	______ ____ ____ ____ OR _____ ________ _______ 1/4 Sec TWP Rng Mer OR Zone Easting Northing	□Sawlogs □Pulp □OSB □Other__________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A
	______ ____ ____ ____ OR _____ ________ _______ 1/4 Sec TWP Rng Mer OR Zone Easting Northing	□Sawlogs □Pulp □OSB □Other__________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A
	______ ____ ____ ____ OR _____ ________ _______ 1/4 Sec TWP Rng Mer OR Zone Easting Northing	□Sawlogs □Pulp □OSB □Other__________	□Tree Length □Cut To Length □Mixed Length	□Green □Other_____	□ Swd □ Hwd □SPECIES____	E A
					TOTAL	

Monthly Wood flow - Page 3

Roundwood or Wood By-Products, from YOUR YARD, Shipped or Sold to Others:

Shipped/Sold To: (Name of Company/Individual)	**Product**	**Form**	**Condition**	**Gen**	**Volume (m^3)**
	☐Sawlogs ☐Pulp ☐Hog Fuel ☐Chips ☐Other___________	☐Tree Length ☐Cut To Length ☐Mixed Length	☐Green ☐Other_____	□ Swd □ Hwd ☐SPECIES____	EA
	☐Sawlogs ☐Pulp ☐Hog Fuel ☐Chips ☐Other___________	☐Tree Length ☐Cut To Length ☐Mixed Length	☐Green ☐Other_____	□ Swd □ Hwd ☐SPECIES____	EA
	☐Sawlogs ☐Pulp ☐Hog Fuel ☐Chips ☐Other___________	☐Tree Length ☐Cut To Length ☐Mixed Length	☐Green ☐Other_____	□ Swd □ Hwd ☐SPECIES____	EA
	☐Sawlogs ☐Pulp ☐Hog Fuel ☐Chips ☐Other___________	☐Tree Length ☐Cut To Length ☐Mixed Length	☐Green ☐Other_____	□ Swd □ Hwd ☐SPECIES____	EA
				TOTAL	

Print Name: ______________________________ Signature: _________________________ __ Date Submitted: ______________________________ ____

Send copies to: Scaling Unit, Forest Service, Prince Albert; and Licence Issuing Office

CODE INDEX

FORESTS:

FMA & AREA BASED TSL FORESTS

FMA & AREA BASED TSL FORESTS	Authorization:	Forest
L&M Wood Products Ltd. FMA	L&M FMA	L&M
Mistik Management Ltd. FMA	MISTIK FMA	MISTIK
Sakaw Askiy Management Inc. - Prince Albert FMA	SAKAW FMA	PAFMA
Weyerhaeuser/Edgewood - Pasqua Porcupine FMA	PPFMA	PPFMA
Kitsaki & 582633(Zelensky) TSL	A-KITZEL-KZ-02	KITZEL
Meadow Lake OSB TSL	A-MLOSB-ML-01	MLOSB
Mee-Toos Forest Products Ltd. TSL	A-MEETOOS-MT-02	MEETOOS
North West Communities TSL	A-NWC-NW-01	NWC

VOLUME BASED TSLs: V-SourceForest-CompanyIdentifier-Sequence#

(i.e. V-IF-CL-01)

**a volume based TSL, or a Crown Forest Product Permit can be issued on any forest

ISLAND FORESTS

ISLAND FORESTS	Forest Code:
Island Forest Canwood	IFCAN
Island Forest Fort A La Corne	IFFORT
Island Forest Nisbet	IFNISBET
Island Forest Torch River	IFTORCH

AGRICULTURE LANDS:

AGRICULTURE LANDS:	Forest
Kelvington Supply Area Forest Fringe Lands	FFKVSA
Meadow Lake Supply Area Forest Fringe Lands	FFMLSA
Prince Albert Supply Area Forest Fringe Lands	FFPASA
Spiritwood Supply Area Forest Fringe Lands	FFSPSA
Turtleford Supply Area Forest Fringe Lands	FFTFSA

CONSOLIDATED FUND LANDS:

CONSOLIDATED FUND LANDS:	Forest
Dept. of National Defense Air Weapons Range	NPFAWR
Nemibian Northern Provincial Forest	NPFNEM
Northern Provincial Forest North	NPFN
Suggi Lowlands Northern Provincial Forest	NPFSL
Turnor East Supply Area	NPFTE
Turnor West Supply Area	NPFTW

PROVINCIAL PARKS:

PROVINCIAL PARKS:	Forest
Cypress Hills Prov. Park	CHPP
Moose Mountain Prov.	MMPP
Candle Lake Prov. Park	CLPP
Meadow Lake Prov. Park	MLPP
La Ronge Prov. Park	LRPP
Greenwater Lake Prov.	GWLPP
Duck Mountain Prov. Park	DMPP
Narrow Hills Prov. Park	NHPP
Clearwater Provincial Park	CWRPP
Wildcat Hills Wilderness	NPFWHWA

SPECIES /CONDITION / FORM CODE:

SOFTWOOD (SW)

SPECIES	CODE
Balsam Fir	BF
Black Spruce	BS
Jack Pine	JP
Lodgepole Pine	LP
Tamarack Larch	TL
White Spruce	WS

HARDWOOD (HW)

SPECIES	CODE
Balsam Poplar aka Black Poplar	BP
Green Ash	GA
Manitoba Maple	MM
Trembling Aspen aka White Poplar	TA
White Birch	WB
White Elm	WE

CONDITION	CODE
Green	GR
Fire Kill	FK
Blow Down	BD
Insect	IN
Disease	DS
Flooded	FD
Other Salvage	OS

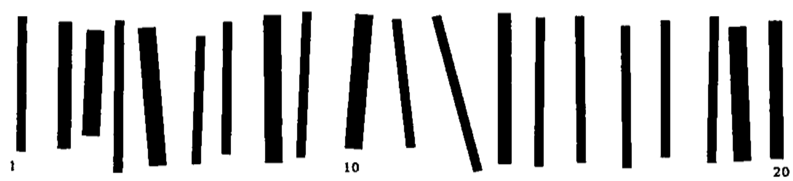
FORM	CODE
Tree length	TL
*Cut-to-length	CTL
Mixed Length	ML

***cut to length – each facility will have its own specifications on what lengths are useable for them**

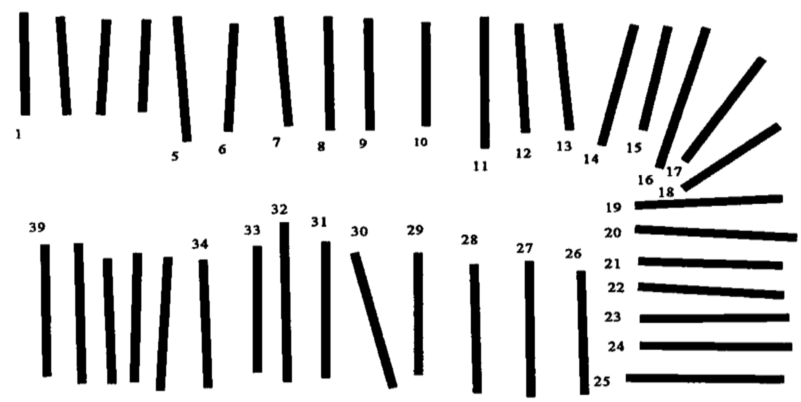
Appendix R Numbering Method for non-piled Timber

ATTACHMENT I

NUMBERING OF PENCIL BUCKING SAMPLE LOADS



Piles that are laid out in one line
Every tenth Piece maybe labeled
All labeling to be done on one face or end of logs
All first and last logs in a pile must be labeled



Piles that are not in a consistent line
First and last log always gets labeled
Ten logs before the corner or change in direction must be labeled
Ten logs after the corner or change in direction must be labeled
every tenth log to be labeled (other than corners)

Piles that change direction or have breaks in more than in 5 places, every log must be individually numbered.

Appendix S Tags for Marking or Designating Faxed Piles

SC01# ________________________ **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**	**SC01# ________________________** **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**
SC01# ________________________ **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**	**SC01# ________________________** **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**
SC01# ________________________ **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**	**SC01# ________________________** **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**
SC01# ________________________ **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**	**SC01# ________________________** **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**
SC01# ________________________ **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**	**SC01# ________________________** **DATE _________________________** **TIME _________________________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________** **VOLUME ___________________m^3**

FAXED **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**	**FAXED** **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**
FAXED **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**	**FAXED** **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**
FAXED **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**	**FAXED** **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**
FAXED **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**	**FAXED** **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**
FAXED **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**	**FAXED** **SC01# __________** **HARVEST AUTHORITY ____________** **PARCEL # _____________________** **AREA IDENTIFIER ____________**

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