

Scaling roundwood/Measurement of wood chips, tree residues, and by-products



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| Revised | 0302.1-09/0302.2-09: Outside front cover and title pages 0302.1-09: Clauses 10.1.4 and 10.8.1.2.1(d) 0302.2-09: Clause 7.2.3 |
| New | National Standards of Canada text |
| Deleted | None |

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CAN/CSA-0302.2-09**
National Standards of Canada
(approved February 2011)

Scaling roundwood/Measurement of wood chips, tree residues, and by-products



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chips, tree residues, and by-products

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- (f) A large sampling error added to the errors identified in Item (b) produces almost unusable estimates of volume or mass of wood. However, a greater accuracy requires a very large sample when the populations are characterized by a high variance.

10 Mass scaling

Note: This Clause covers the minimum procedures for determining the mass of quantities of roundwood, including tree lengths loaded on trucks, trailers, railway cars, tracked vehicles, ships, and other means of transport and roundwood loaded on pallets and in bundles. This Clause also specifies how to convert mass into solid or stacked volume.

10.1 Weighing machines

10.1.1 General

Mass shall be determined by the use of motor vehicle scales or other appropriate weighing machines that comply with the applicable legislation.

Note: In Canada, scales and weighing machines are approved through the Government of Canada's Weights and Measures Act and Weights and Measures Regulations.

10.1.2 Capacity

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

10.1.3 Motor vehicles

When motor vehicle weigh scales are used, the wood shall be weighed on the vehicle in one operation. After the unloading, the empty vehicle shall be weighed in one operation to determine its tare.

Δ 10.1.4 Railway cars

Railway cars shall not be exempt from the determination of tare requirement of Clause 10.1.3 unless exempted by the authority having jurisdiction over timber scaling.

10.2 Determination of mass

10.2.1

The mass shall be expressed in tonnes or kilograms and include, if present, bark, moisture, rot, and foreign material.

10.2.2

The mass of a load shall be obtained by subtracting the mass of the empty vehicle(s) (the tare) from the mass of the loaded vehicle(s) (the gross).

10.2.3

The mass shall be recorded in unit graduations not greater than

- (a) 10 kg for scales with a capacity of less than 100 tonnes; or
- (b) 20 kg for scales with a capacity of 100 tonnes or greater.

10.2.4

The mass of wood may be reduced to the oven-dry mass of bark-free wood after being sampled for bark and moisture content.

10.2.5

Deductions for the mass of foreign material, if any, shall be made from the mass of the load(s) if such deductions are not accounted for in an applied volume-to-mass ratio.

10.3 Conversion of mass to solid volume

10.3.1 General

The total mass of a population shall be converted to bark-free solid volume by

- (a) measuring samples consisting of
 - (i) complete or partial loads of not less than 3 m³; or
 - (ii) parts (disks) of individual trees from loads;
- (b) determining the volume-to-mass ratio from the sample data; and
- (c) multiplying the total mass by the volume-to-mass ratio.

Note: *The volume-to-mass ratio can be based on historical sampling.*

10.3.2 Determination of volume-to-mass ratio

The ratio shall be determined by dividing the volume of the samples by their mass, as follows:

$$r = \frac{\sum v}{\sum m}$$

where

r = volume-to-mass ratio, in units specified in Clause 10.3.3

m = mass of a sample unit, g, kg, or tonnes, as applicable

v = volume of a sample unit, cm³, m³, or m³ (stacked), as applicable

10.3.3 Expression of quantities in volume-to-mass ratio

The ratio, r , may be expressed in

- (a) cubic centimetres per gram (gross or net to 0.001 cm³);
- (b) cubic metres per kilogram (gross or net to 0.001 m³);
- (c) cubic metres per tonne (gross or net to 0.001 m³);
- (d) stacked cubic metres per kilogram (gross or net to 0.01 m³ (stacked)); or
- (e) stacked cubic metres per tonne (gross or net to 0.01 m³ (stacked)).

10.4 Conversion of mass to solid volume by volume scaling of sample units

10.4.1 Procedure

10.4.1.1 General

The total mass of an aggregate (the population) of truck loads is converted to solid volume in cubic metres by measuring each log, piece, or tree length of some of the loads or partial loads and establishing an average volume-to-mass ratio. The volume-to-mass ratio obtained is then multiplied by the total mass to convert the mass to solid volume, as follows.

$$\hat{V} = r \cdot M$$

where

\hat{V} = estimated total volume

M = total mass (weigh scale)

r = volume-to-mass ratio

$$r = \frac{\text{net volume of wood}}{\text{mass of wood with bark}}$$

$$= \frac{\text{gross volume of wood} - \text{deductions for bark and rot}}{\text{mass of wood with bark}}$$

10.7 Conversion of mass to stacked volume

Note: It is standard practice to convert mass to solid volume. This Clause is provided for situations when conversion to stacked volume is desired instead.

10.7.1

The sample loads shall be scaled in accordance with the procedures specified in Clause 8.

10.7.2

The ratio obtained shall be expressed as volume-to-mass, with volume expressed in stacked cubic metres.

10.7.3

Deductions from the stacked volume shall be made in accordance with the procedures specified in Clause 8.

10.7.4

The ratio from the sample loads shall be determined as follows:

$$r_s = \sum v_s / \sum m$$

where

r_s = volume-to-mass ratio (stacked)

m = mass of sample loads

v_s = stacked volume of sample loads

r_s shall be multiplied by the total mass for the whole population to obtain the volume, expressed in total stacked cubic metres, for the population, as follows:

$$\hat{V}_s = r_s \cdot M$$

10.8 Determination of oven-dry mass and conversion of oven-dry mass to solid volume

Note: This Clause deals with practices not commonly employed in production mass scaling but can be used to establish more precise solid volume determinations by eliminating moisture and bark percentage variables.

10.8.1 Determination of oven-dry mass

10.8.1.1 General

Reduction of mass to gross oven-dry mass shall be accomplished by subtracting the moisture content of the load(s) from the gross mass.

10.8.1.2 Determination of moisture content

10.8.1.2.1 Equipment

The following equipment shall be used:

- (a) a slow-speed chainsaw for making wood disks;

- (b) a sharp pocketknife;
- (c) a drying oven with a thermostat (to keep the oven running at the temperature specified in Clause 10.8.1.3.2(b)); and
- Δ (d) a laboratory balance with a capacity of at least 10 kg and sensitive to 1 g.

10.8.1.2.2 Procedure

Wood disks approximately 3 cm thick shall be sawn from logs or tree lengths selected at random from the loads of the population to be sampled. To eliminate bias due to moisture loss from the ends of logs, the disks should be sawn at least 20 cm in from the end of the logs. To eliminate bias as a result of known variation in moisture content between the top, butt, and centre sections of tree stems, disks sawn from tree lengths should be taken at a point where the moisture content is representative of the stem.

Note: For an alternative method, see Annex E.

10.8.1.2.3 Calculation of moisture percentage

The moisture percentage shall be expressed as follows:

$$\frac{\text{total mass of sample} - \text{oven-dry mass of sample}}{\text{total mass of sample}} \times 100 = \% \text{ moisture of wood and bark}$$

10.8.1.3 Determination of bark content

10.8.1.3.1 General

The bark content shall be the mass of the oven-dry bark expressed as a percentage of the total mass of oven-dry wood and bark combined. The bark content shall be obtained from disk samples in green condition. The disks used for moisture content determination may be used for bark content determination.

10.8.1.3.2 Procedure

The following procedure shall be used:

- (a) Use the pocketknife to remove the bark from the disks.
- (b) Place the disks and bark in the drying oven at 103 ± 2 °C.
- (c) Leave the disks and bark in the oven until no further loss of mass is noticeable.
- (d) Weigh the disks and bark separately, to the nearest gram.

10.8.1.3.3 Calculation of bark percentage

The bark percentage shall be expressed as follows:

$$\frac{\text{oven-dry mass of bark}}{\text{oven-dry mass of wood disks} + \text{oven-dry mass of bark}} \times 100 = \% \text{ bark sample}$$

10.8.1.4 Determination of net oven-dry mass

The net oven-dry mass shall be obtained by deducting the following from the mass of the loaded vehicle in the following sequence:

- (a) the tare of the vehicle;
- (b) the mass of the foreign material;
- (c) the mass equivalent of the moisture percentage; and
- (d) the mass equivalent of the oven-dry bark percentage.

Note: The following is a sample calculation for determining net oven-dry mass:

$$\begin{array}{r} 150.00 \text{ t (mass of vehicle and load of wood)} \\ - \underline{10.00 \text{ t (tare of vehicle)}} \end{array}$$

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where

V = volume

H = height of frustum

D = diameter of the large base of the frustum

d = diameter of the small base of the frustum

6.11 Calculation of the volume of a prismoid

The large base, small base, and intermediate base are parallel. The volume is calculated as follows:

$$V = 1/6 \times H \times (B + b + 4S)$$

where

V = volume

H = height of prismoid

B = surface area of the large base of the prismoid

b = surface area of the small base of the prismoid

S = surface area of the section made at the halfway point in the height of the prismoid

6.12 Corrections for ground conditions

When a pile of wood chips or hogged material is placed on ground that has a steep slope or topographical irregularities that can affect the pile's volume, the volume represented by the irregularities shall be determined using the procedure for determining the volume of the pile and, as appropriate, added to or subtracted from the volume of wood chips. The volume of the corrections for projections above or depressions in the area where the pile will be placed shall be made before wood chips are accumulated.

6.13 Wood chip conversion factors

Conversion factors are a useful aid in converting wood chip volumes and masses, more specifically bulk volumes, into mass or equivalent solid volume, and solid volume (unchipped) into mass or bulk volume of chips. The values are generally determined through a combination of experience, laboratory testing, and field testing.

Note: Tables A.1 and A.2 specify the average relative density of Canadian commercial tree species and Annex B provides examples of methods for determining the mass and volume of wood chips from conversion factors.

7 Mass scaling

Note: This Clause specifies minimum procedures for determining the mass of a quantity of wood chips loaded on transports such as trucks, trailers, railway cars, tracked vehicles, and ships, and for the conversion of mass to equivalent solid volume. These procedures are also applicable to determining the mass of forest residues and by-products.

7.1 Units of measurement

The mass of wood chips shall be expressed in tonnes, kilograms, or grams.

7.2 Weighing machines

7.2.1

Mass shall be determined using motor vehicle scales or other appropriate weighing machines that comply with applicable legislation.

Note: In Canada, scales and weighing machines are approved through the Government of Canada's Weights and Measures Act and Weights and Measures Regulations.

7.2.2

7.2.2.1

Where motor vehicle weigh scales are used, the load of wood chips shall be weighed on the vehicle in one operation.

7.2.2.2

After unloading, the empty vehicle shall also be weighed in one operation to determine its tare.

Δ 7.2.3

Railway cars shall not be required to meet the requirements of Clause 7.2.2.1 when federally approved axle scales are used. However, railway cars shall be required to meet the requirements of Clause 7.2.2.2, unless exempted by the authority having jurisdiction over timber scaling.

7.2.4

Weightometers may be used to determine the mass of wood chips or material that is expected to be transported along a conveyor belt.

Note: *Weightometers need frequent calibration and should be protected from dust and extraneous material.*

7.3 Determination of mass

7.3.1

The mass shall include, if present, contaminants inherent to trees, foreign contaminants, rot, and moisture.

7.3.2

The mass may be reduced to the oven-dry mass after being sampled for contaminants and moisture content.

7.3.3

The mass of a load shall be obtained by subtracting the mass of the empty vehicle (tare) from the mass of the loaded vehicle.

7.3.4

The mass shall be recorded in unit graduations not greater than

- (a) 10 kg for scales with a capacity of less than 100 tonnes; or
- (b) 20 kg for scales with a capacity of 100 tonnes or greater.

7.3.5

Deductions for mass of foreign material, if any, may be made from the mass of the load(s), if such deductions are not accounted for in an applied mass-to-volume ratio.

7.4 Determination of oven-dry mass

7.4.1 General

Mass shall be reduced to gross oven-dry mass by subtracting the moisture content of the load from the gross mass.

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Preface

This is the fourth edition of CSA O302.1, *Scaling roundwood*, which supersedes the previous editions, published in 2000, 1986, and 1977, and the third edition of CSA O302.2, *Measurement of wood chips, tree residues, and by-products*, which supersedes the previous editions, published in 2000 and 1986 under the title *Measurement of Woodchips, Tree Residues, and Byproducts*.

CSA O302.1 sets out criteria for scaling roundwood. It is intended as a source document on log scaling for producers and purchasers of primary wood products in Canada. It is also intended to provide a commonly accepted basis for scaling procedures established by the provinces and territories for determining the measure of timber cut and subject to timber fees.

CSA O302.2 sets out sampling procedures and reliability criteria for the measurement of the wood content and quality of wood chips produced as a primary product at a mill or landing site or as a by-product or residue of a sawmilling or other conversion operation. It addresses the determination of chip quality and wood content of chips, considering both individual chips and large-volume chip piles, e.g., barges of wood chips.

These Standards include the following noteworthy changes from the previous editions:

- (a) because fuelwood does not need special recognition, the fuelwood clause has been removed from CSA O302.1;
- (b) significant changes have been made to the requirements on instruments specified in [Clause 12](#) of CSA O302.1; and
- (c) the equations and examples for sample scaling and mass scaling in CSA O302.1 have been revised to be more user friendly.

These Standards were prepared by the Technical Committee on Scaling of Primary Forest Products, under the jurisdiction of the Strategic Steering Committee on Forest Products, and have been formally approved by the Technical Committee. These Standards will be submitted to the Standards Council of Canada for approval as National Standards of Canada.

March 2009

Notes:

- (1) Use of the singular does not exclude the plural (and vice versa) when the sense allows.
- (2) Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.
- (3) This publication was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity”. It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this publication.
- (4) CSA Standards are subject to periodic review, and suggestions for their improvement will be referred to the appropriate committee.
- (5) All enquiries regarding this Standard, including requests for interpretation, should be addressed to Canadian Standards Association, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.
Requests for interpretation should
 - (a) define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
 - (b) provide an explanation of circumstances surrounding the actual field condition; and
 - (c) be phrased where possible to permit a specific “yes” or “no” answer.

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are published in CSA's periodical Info Update, which is available on the CSA Web site at www.csa.ca.

CSA Standard

O302.1-09
Scaling roundwood



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O302.1-09

Scaling roundwood

1 Scope

1.1

This Standard specifies minimum requirements for scaling roundwood in SI (metric) units and covers processes for quality and quantification assurance.

Note: *Requirements on measuring and estimating quantities of wood chips, tree residues, and by-products are specified in CSA O302.2.*

1.2

This Standard is intended for individuals or agencies charged with scaling and check scaling of primary forest products in Canada.

1.3

In CSA Standards, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; “may” is used to express an option or that which is permissible within the limits of the standard; and “can” is used to express possibility or capability. Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material. Notes to tables and figures are considered part of the table or figure and may be written as requirements. Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

Note: See [Annex H](#) for additional publications.

CSA (Canadian Standards Association)

CAN/CSA-Z234.1-00 (R2006)

Metric practice guide

Government of Canada

National Resources Canada. Canada’s Forest Inventory (Canfi) 2001. Appendix 2: Symbols of Commercial Tree Species. <http://cfs.nrcan.gc.ca/subsite/canfi/appendix-2>. Accessed March 4, 2009.

Weights and Measures Act, RSC 1985, c. W-6

Weights and Measures Regulations, CRC, c. 1605

OIML (International Organization of Legal Metrology)

R 35-1 (2007)

Material measures of length for general use. Part 1: Metrological and technical requirements