WI 120809.03

T 268

DRAFT NO. 2

DATE Spring 2013

WORKING GROUP CHAIRMAN to be determined

SUBJECT CATEGORY Pulp Properties

RELATED METHODS See "Additional Information"

CAUTION:
This Test Method may include safety precautions which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Material Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

Weight-volume measurement of pulpwood (Reaffirmation of T 268 om-08)

(no changes from Draft 1)

1. Scope

1.1 A method is described (*1*, *2*) for determining the weight of pulpwood per unit of volume (a standard-racked cord).

1.2 The determination in this method refers to an ideally racked cord, which usually is not identical to commercially scaled wood, because:

1.2.1 There is always a change in apparent volume after sawing longer lengths into shorter lengths and repiling.

1.2.2 The voids along the sides and bottom of the cord as racked experimentally are partly filled in the ordinary scaled cord.

1.2.3 Shaking and jolting during shipment (if the scaling is done at the unloading terminal) normally cause the wood to settle more compactly.

1.3 This method will also provide data on the gross weight of wood in a cord; the average, maximum, and minimum diameters of bark-free logs; percentage bark by green weight and volume; average length of logs; moisture content; density; solid wood volume; and the total oven-dry weight of bark-free wood per cord.

2. Significance

2.1 The purchase of pulpwood at the mill site may be based on either the weight or the size (number of cords) of the truck or rail car loads. To calculate pulpwood costs and to determine wood-to-pulp yields it is critical to determine the relationships between the volume and green weight of wood and the amount of bark-free wood.

2.2 This method provides the sampling procedure used to select pulpwood logs for the determination of moisture content and oven-dry, bark free weight of wood in a cord.

3. Definitions

3.1 *Standard-rack cord* is the piled volume of unbarked cordwood logs, obtained by filling a rack of prescribed dimensions in a specified manner to equal 3.63 m^3 (128 ft^3).

3.2 *Solid volume* per cord refers to the solid volume of wood, exclusive of bark, in a cord of unbarked logs.

3.3 *Green wood* is usually defined as wood that is freshly cut or that which has not been dried substantially during storage. For the purpose of this method the term “green wood” is applied also to wood “as received” or “as taken for test.”

3.4. *Average diameter* of a log is the diameter of a cylinder that would have the same cross sectional area as the log.

4. Apparatus

4.1 *Standard cord rack,* a strongly braced rack, 2.4 m (8 ft) long, with ends 1.2 m (4 ft) high (inside dimensions) and at least 0.9 m (3 ft) wide; open at the top, front, and back. The front top corners of the ends have projections to carry a string stretched between the end members and level with their top surfaces, with the string at a distance of 150 to 200 mm (6 to 8 in) in front of the rack.

4.2 *Specimen locator*, a rod 2.4 m (8 ft) long with 6 strings, each about 1.2 m (4 ft) long, having a small weight attached to the bottom end of each string, attached to the rod respectively at 20, 60, 100, 140, 180 and 220 mm (8, 24, 40, 56, 72 and 88 in) from one end.

4.3 *Platform scale,* approximately 100-kg (250-lb) capacity, accurate to within 0.5 kg (1 lb) to determine weight of logs.

4.4 *Power saw,* a circular saw, preferably over 610 mm (24 in) in diameter.

4.5 *Rule,* of wood or metal with a metal hook at the end to act as a zero stop.

4.6 *Steel tape,* calibrated to read the diameter or area of the cross section of a cylinder from a circumferential measurement.

4.7 *Containers,* for storing disks while testing; for example, two or more 35-L (10-gal) covered garbage cans, with tight-fitting lids.

4.8 *Scale,* capable of measuring the weight of wood disks weighing up to 5 kg with an accuracy of 1 g.

5. Sampling and test specimens

5.1 Obtain a bulk sample of at least 7.25 m^2 (2 cords) or at least 0.1% of the total shipment, in accordance with TAPPI T 257 "Sampling and Preparing Wood for Analysis."

5.2 Unless the wood is in approximately 1.2-m (4-ft) lengths, measure and record the actual lengths of about 20 specimen logs selected at random from the sample, preferably by numbering the logs in the bulk sample and using a table of random numbers. If the length of the logs is more than 1.2 m (4 ft), saw off a piece from each log so that the test specimens are 1.2 ± 0.1 m (4 ft ± 4 in) in length. When doing so, saw off the additional piece alternately from the thick and the thin ends of the logs.

6. Procedure

6.1 Rack the randomly selected log specimens from the bulk sample into the standard cord rack, taking care that they are randomly placed in the rack without bias as to fitting them in approximately sized positions.

6.2 When the rack is nearly filled with randomly selected logs, stretch a string between the projections at the top corners of the two end members of the rack, at the exact height of their top surfaces and 150 to 200 mm (6 to 8 in) in front of them Completely fill the rack, carefully placing the logs in the top layer so that the ends of the logs crossed by the string have an approximately equal total area above and below the string.

6.3 Selection of specimen logs for analysis from a racked cord.

6.3.1 Determine the radius, *r*, of the smallest log in the racked cord. Position the specimen locator (described in 4.2) in front of the rack by holding or fixing the rod at the top of the rack parallel to the ground. The six strings will now hang down in front of the racked cord. Mark with the crayon each log whose center is within radius, *r*, from any one of the six strings. In order to achieve the desired precision from this method (discussed in section 9.2) at least 20 logs must be selected. If this procedure does not identify at least 20 logs, use the alternate procedure described in 6.3.2.

6.3.2. *Alternate Procedure.* Determine the radius, *r*, of the smallest log in the racked cord. Position the specimen locator (described in 4.2) in front of the rack by holding or fixing the rod at the top of the rack parallel to the ground. The six strings will now hang down in front of the racked cord. Mark with the crayon each log whose center is within a distance of the radius, *r*, plus 12.5 mm (0.5 in) from any one of the six strings.

6.3.3 If the alternate procedure still does not produce the minimum desired 20 logs, mark all logs within a distance of the radius, *r*, plus 25 mm (1 in) from any one of the strings. Continue to increment the acceptance distance by 12.5 mm (0.5 in) until the minimum of 20 logs has been selected.

6.4 If it is desired for future reference, take a photograph of the racked cord of wood.

6.5 Obtain and record the net weight of the entire cord as rapidly as possible, weighing it either as a unit or log by log, depending on the scale available. Separate the marked specimen logs from the remainder of the cord. With the hook rule, determine the lengths of each and record the figures to the nearest 5 mm (1/4 in).

6.6 Saw one knot-free disk of uniform thickness between 20 and 25 mm (between 3/4 and 1 in) from each of the specimen logs. From logs originally 1.2 m (4 ft) in length, saw these disks at points 250 to 600 mm (10 to 24 in) from either end; from those originally in 1.5-m (5-ft) or other lengths and from which shorter (1.2-m or 4-ft) lengths have been cut, saw the disks from a section 125 to 600 mm (5 to 24 in) from the freshly cut ends. Number the disks and place them immediately in a closed container.

6.7 With each disk, proceed with the following steps rapidly.

6.7.1 Remove a disk from the container, weigh and record its weight to the nearest gram.

6.7.2 By means of the graduated steel tape, measure and record its average diameter of area including the bark, if present.

6.7.3 Remove the bark, if present, from the disk.

6.7.4 Weigh the peeled disk and record the weight.

6.7.5 Measure and record the diameter or area of the peeled disk.

6.8 If it is necessary to interrupt the performance of the foregoing steps, return the disk to the container until the testing is resumed. Store the disks in the same or another closed container prior to determining their density.

6.9 Determine the average green- and dry-wood densities and the moisture content of the bark-free disks, in accordance with TAPPI T 258 “Basic Density and Moisture Content of Pulpwood.”

7. Calculations

7.1 From the data obtained on the specimen disks, calculate and record, in addition to the densities and moisture content, the following:

7.1.1 Average diameter (barked), to the nearest 2 mm (to the nearest 0.1 in).

7.1.2 Range of diameters (barked), the average diameter of the largest and the smallest disk.

7.1.3 Percentage of bark by weight, *B*, calculated as follows:

$$B = \frac{A - E}{A} = \times 100$$

where:

A = total weight of disks before barking

E = total weight of disks after barking

7.1.4 Percentage volume of bark, *F*, calculated as follows:

$$F = \frac{G - H}{G} \times 100$$

where:

G = total areas of cross sections before barking
H = total areas of cross sections after barking

NOTE 1: Obtain the areas of the cross section of each directly from the tape used for measuring if the tape is appropriately calibrated.

7.1.5 Average length of the specimen logs. (If desired, also calculate the percentage of logs over and/or under standard.) Divide the average length of the logs by 1.2 if in meters (by 4.0 if in ft) to give a correction factor *f*.

7.1.6 Gross weight per cord of 3.63 m^3 (128 ft^3) as received. Correct this if the logs are other than standard length by multiplying the weight by the factor *f* (see 7.1.5).

7.1.7 Calculate the weight of moisture-free wood per cord as received, in kilograms or pounds, *C*, as follows:

$$C = \frac{W(100 - B)}{A} \times \frac{100 - M}{100}$$

where:

W = weight per cord of unbarked wood as received, kg (lb) (section 6.5)
B = percentage of bark by weight (section 7.1.3)
M = percentage of moisture, by weight, of bark-free wood as tested (section 6.9).

7.1.8 Solid peeled volume per racked cord of wood, V_p, calculated as follows:

$$V_p = \frac{C}{D}$$

where:

V_p = solid bark-free volume of wood per cord at time of racking, m^3 (ft^3)
C = weight of moisture-free wood per cord, kg (lb) (section 7.1.7)
D = density based on moisture-free weight (green volume), kg/m^3 (lb/ft^3) (section 6.9)

7.1.9 Solid volume per cord of wood and bark at time of racking in cubic meters (in cubic feet), *U*, calculated as follows:

$$U = \frac{V}{(100 - F)}$$

where:

V = solid bark-free volume of wood per cord at time of racking, m^3 (ft^3) (section 7.1.8)

F = percentage of bark by volume (section 7.1.4)

8. Report

8.1 For a complete report give the following to three significant figures:

8.1.1 Total gross weight of wood as received, per cord, in kilograms (pounds).

8.1.2 Average, maximum, and minimum diameters of bark-free logs, in millimeters (inches).

8.1.3 Bark, percentage by green weight and by volume.

8.1.4 Average length of logs and, if desired, the percentage of logs over (or under) standard.

8.1.5 Moisture, percentage of green weight.

8.1.6 Density, in kilograms per cubic meter (in pounds per cubic foot) (based on moisture-free weight and green volume).

8.1.7 Solid volume per cord of unbarked green wood, in cubic meters (in cubic feet).

8.1.8 Total weight of moisture-free barked wood per cord, in kilograms (in pounds).

9. Precision

9.1 The precision of this method cannot practically be determined. The accuracy depends on the precision of the measurements, the adequacy and uniformity of the specimens tested and the uniformity of the density and moisture content along the length of the logs.

9.2 The density at intervals 200 to 300 mm (8 to 12 in) apart along the length of a stick of pulpwood may vary as much as 6 to 8% depending on the presence of knots, scars, etc. The moisture content may vary even more, in green wood as much as 10% over the length. As great as they may be however, both these variations are usually less than the variation in density and moisture from log to log. These natural variations are minimized by examining a larger number of individual logs; therefore, at least 20 logs should be taken as a test unit.

10. Keywords

Pulpwood, Density, Bark, Logs, Sampling, Length, Weight, Volume

11. Additional information

11.1 Effective date of issue: to be assigned.

11.2 The use of vertical strings in place of the crossed strings for selecting the specimens avoids favoring the logs in the center.

Literature cited

1. Youtz, M. S., and Lauer, B. E., "The Commercial Evaluation of Pulp Cord Wood," *Paper Trade J.* **97**(12):38 (Sept. 21, 1933).
2. Keepers, C. H., "A New Method of Wood Evaluation," *Paper Trade J.* **117**(9): 23 (August 26, 1943); *J. Forestry* **43**(1): 16 (January 1945).

Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department. ■