Designation: D4442 – 16

Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials[1]

This standard is issued under the fixed designation D4442; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 These test methods cover the determination of the moisture content (*MC*) of wood, veneer, and other wood-based materials, including those that contain adhesives and chemical additives. The test methods below describe primary (A) and secondary (B through D) procedures to measure moisture content:

Method A—Primary Oven-Drying Method
Method B—Secondary Oven-Drying Method
Method C—Distillation (Secondary) Method
Method D—Other Secondary Methods.

1.2 The primary oven-drying method (Method A) is intended as the sole primary method. It is structured for research purposes where the highest accuracy or degree of precision is needed.

1.3 The secondary methods (B through D) are intended for special purposes or under circumstances where the primary procedure (Method A) is not desired or justified. In these procedures, moisture content values cannot be reported with an accuracy greater than integer percentage values (that is, lower than in Method A).

1.4 Distillation (secondary) method is intended for use with materials that have been chemically treated or impregnated such that the oven-drying procedures introduce greater error than desired in the results.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D9 Terminology Relating to Wood and Wood-Based Products

D4933 Guide for Moisture Conditioning of Wood and Wood-Based Materials

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology D9.

3.1.2 *moisture content*—the amount of water contained in the wood, usually expressed as a percentage of the mass of the oven-dry wood (in accordance with Terminology D9).

3.1.2.1 *Discussion*—The moisture content of wood or other wood-based materials can be expressed either as a percentage of oven-dry mass of the sample (oven-dry basis) or as a percentage of the original mass (wet basis). The methods described in this standard refer to the oven-dry basis. Because oven-dry mass is used, moisture content values may exceed 100 %. The term moisture content when used with wood or other wood-based materials can be misleading since they frequently contain varying amounts of volatile compounds (extractives that are evaporated when determining moisture content). Definition of the moisture content of wood is further complicated when determined by a thermal method because of thermal degradation, which causes the final moisture-free mass to decrease from small but continuous losses.

4. Significance and Use

4.1 Moisture content is one of the most important variables affecting the properties of wood and wood-based materials. The procedures in these test methods are structured to permit

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These test methods replace, in part, Test Methods D2016, for Moisture Content of Wood, discontinued 1989.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

the full range of use from fundamental research to industrial processing. Method A is designed for obtaining the most precise values of moisture content consistent with the needs of the user. It also provides means of assessing variability contributed by the oven or specimen hygroscopicity, or both. In addition, criteria are described for defining the endpoint in oven-drying. Method A is the reference (primary) standard for determining moisture content of wood and wood-based materials. Methods B through D are secondary methods to permit relatively simple procedures of measuring moisture content, but with less precision than Method A.

5. Method A—Oven-Drying (Primary)

5.1 *Apparatus:*

5.1.1 *Oven*—A forced-convection oven that can be maintained at a temperature of 103 ± 2°C throughout the drying chamber for the time required to dry the specimen to the endpoint shall be used. Ovens shall be vented to allow the evaporated moisture to escape.

NOTE 1—The ratio of sample mass to chamber volume and the air velocity within the oven are not critical as long as temperature and relative humidity within the oven are constant. Room relative humidity should be less than 70 % relative humidity, at which condition the oven is at 1.7 % relative humidity. For best precision, drying should be carried out in a constant relative humidity room with the relative humidity as low as possible.

5.1.2 *Balance*—Based on a 10 g (oven-dry) specimen, minimum readability of the balance shall be determined by the desired reporting level of precision:

Reporting Precision Level, *MC*, %	Minimum Balance Readability, mg
0.01	1
0.05	5
0.1	10
0.5	50
1.0	100

For other oven-dry mass levels, the sensitivity requirement shall be scaled appropriately.

5.2 *Test Material*—Any conveniently sized wood or wood-based material can be used, consistent with the use of closed weighing jars (5.4.7) and the balance readability (5.1.2).

NOTE 2—If specimens contain any degree of volatilizable material other than water, it may be necessary to either use Method C or run Method A and C concurrently.

5.3 *Calibration and Standardization*—Determination of specimen variability requires a separate measurement of the contribution of variability within the oven.

5.3.1 *Determination of Oven Variability*—This section permits a separate evaluation of the oven variability from that of specimens distributed in the oven.

5.3.1.1 *Specimen Selection and Preparation*—Douglas-fir shall be ground to sawdust and that fraction contained in a 40/60 mesh screen used. The sample origin or drying history is not critical. The sawdust shall be tumbled in a closed container until thoroughly mixed. All replicates shall be prepared at the same time from the same batch of material. All material shall be transferred and stored in air-tight weighing jars.

5.3.1.2 *Equilibration*—The moisture content of the specimen is not important if the preparation techniques described under 5.3.1.1 are used. Equilibration is not required, although it is preferable that the material be as uniform as possible in moisture content.

5.3.1.3 *Number and Location of Specimens*—Each test shall consist of a set of eight replicated specimens. These shall be located at third-point positions with respect to height, width, and depth of the oven cavity. With this scheme four samples will be positioned on each of two shelves at one third and two thirds of the cavity height.

5.3.2 *Determination of Combined Specimen and Oven Variability*—Procedures are the same as 5.3.1.1 – 5.3.1.3 except that specimens of any origin and size or shape can be used. Calculate variability by the equation in 5.5.2.

5.3.3 *Procedure*—Use the primary oven-drying procedure (5.4).

5.4 *Procedure:*

5.4.1 Specimens to be equilibrated shall be processed as in Guide D4933.

5.4.2 Store specimens in individual vapor-tight containers if any delay could occur between sampling and weighing.

5.4.3 Weigh the specimens using a balance consistent with the desired precision (see 5.1.2).

5.4.4 Preheat the oven to a temperature of 103 ± 2°C

5.4.5 Place specimens in the oven within the volume tested for oven precision.

5.4.6 *Endpoint*—Assume that the endpoint has been reached when the mass loss in a 3 h interval is equal to or less than twice the selected balance sensitivity. For example, given a specimen weight of 10 g and for a balance sensitivity of 1 mg chosen in 5.1.2 to allow reporting to a 0.01 % *MC* precision, the endpoint is assumed to have been reached when the change in weight is 2 mg or less in a 3 h period.

5.4.7 *Handling and Weighing Procedures*—Dried samples shall be stored in a desiccator with fresh desiccant until they have reached room temperature. All weighings shall be carried out using closed weighing jars.

5.5 *Calculations:*

5.5.1 Calculate moisture content as follows:

$$MC, \% = (A - B)/B \times 100 \quad (1)$$

where:

A = original mass, g, and
B = oven-dry mass, g.

Example—A specimen of wood weighs 56.70 g. After oven-drying, the mass is 52.30 g.

$$MC, \% = (56.70 - 52.30)/52.30 \times 100 \quad (2)$$

$$= (4.40/52.30) \times 100 = 8.4\,\%$$

NOTE 3—If wood has been treated with a nonvolatile chemical, or if a wood-based material contains a large amount of non-wood chemicals that cannot be neglected, and if the mass of the retained chemical(s) is known, the moisture content may be determined as follows:

$$MC, \% = (A - B)/D \times 100 \quad (3)$$

where:

D = B minus mass of retained chemical in sample.