



Designation: D4442 – 20

# Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials<sup>1</sup>

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 ( $\epsilon$ ) 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 procedures appear in the following order:

	Sections
Method A—Primary Oven-Drying Method	5
Method B—Secondary Oven-Drying Method	6

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

1.3 The secondary oven-drying method (Method B) is intended for the purposes where the primary procedure (Method A) is not desired or justified. Test results in this method are generally less precise than in Method A.

1.4 For materials that have been chemically treated or impregnated with creosote, petroleum, and their solutions such that the oven-drying procedures introduce greater bias than desired in the results, other methods, such as AWP A6, are recommended.

1.5 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

*Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

**D9 Terminology Relating to Wood and Wood-Based Products**

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

2.2 *Other Standard*:

**AWPA Standard A6 Standard Method for the Determination of Retention of Oil-Type Preservatives from Small Samples**<sup>3</sup>

## 3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of terms used in this standard, refer to Terminology **D9**.

3.1.2 *moisture content*—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

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

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

<sup>3</sup> Available from American Wood Protection Association (AWPA), P.O. Box 361784, Birmingham, AL 35236-1784, <http://www.awpa.com>.

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 the full range of use from fundamental research to industrial processing. Method A is the reference (primary) standard for determining moisture content of wood and wood-based materials, which is designed for obtaining the most precise values of moisture content consistent with the needs of the user. It 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 B provides relatively simple procedures of measuring moisture content, but generally with a lower precision than Method A. Representativeness of the specimens to the full-size product, including knots, sapwood, and heartwood, needs to be considered. These methods are not recommended for use with treated wood products impregnated with creosote, petroleum, and their solutions where the volatile non-wood chemicals contained in the specimen introduce greater bias than desired in the results.

#### 5. Method A—Primary Oven-Drying Method

##### 5.1 Apparatus:

5.1.1 *Oven*—A forced-convection oven that can be maintained at a temperature of  $103 \pm 2^\circ\text{C}$  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 (see **Note 1**). For calibration purposes, the oven shall be furnished with two shelves positioned at one third and two thirds of the cavity height.

**NOTE 1**—The ratio of sample mass to chamber volume and the air velocity within the oven are not critical if temperature and relative humidity within the oven are constant and uniform. To maintain uniform conditions throughout the oven the number of specimens in the oven should be limited and they should be well spaced to allow good air movement around all specimens. When high moisture content specimens are being dried, more frequent air exchanges are needed.

**NOTE 2**—For higher precision and smaller bias, the oven should be in a controlled climate room that maintains the relative humidity as low as possible. In a room with 70 % relative humidity, the same air in an oven heated to  $103^\circ\text{C}$  will have a relative humidity of 1.7 %. At a temperature of  $103^\circ\text{C}$  and 1.7 % relative humidity, the equilibrium moisture content of solid wood is approximately 0.13 %, according to Guide **D4933** Eq. X1.1.

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

Precision of Weighing, %	Balance Sensitivity, 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.

5.1.3 *Weighing Bottles*—Weighing bottles made of a vapor-tight material that can withstand the drying temperature in the

oven (5.1.1) shall be used. Each weighing bottle shall be furnished with a stopper to prevent moisture uptake or loss during handling and weighing of the specimens. The stopper shall be assigned and kept with each bottle in case each stopper has a slightly different weight.

5.1.4 *Desiccator*—A container filled with moisture absorbing material (desiccant) shall be used for maintaining moisture-free conditions of weighing bottles and for samples cooling.

5.2 *Test Material*—Any conveniently sized wood or wood-based material can be used, consistent with the use of closed weighing bottles (5.1.3) and the balance readability (5.1.2).

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 *Calibration Specimen Selection and Preparation*—A sample of Douglas-fir wood shall be ground to sawdust and the 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 vapor-tight weighing bottles with stoppers (see 5.1.3).

5.3.1.2 *Equilibration*—The moisture content of the specimens 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 Calibration 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 specimens 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 the specimens in a set shall be of similar size and shape in accordance with 5.2 without grinding (see **Note 3**). Calculate variability by the equation in 5.5.2.

**NOTE 3**—The specimen variability depends on various factors including the wood species, the size and the moisture condition of the specimens, because varying amounts of volatile compounds are evaporated during oven-drying (see Discussion of 3.1.2).

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 (for example, plastic bags) if any delay could occur between sampling and weighing.

5.4.3 Weigh each specimen in a closed weighing bottle (see 5.1.3) using a balance consistent with the desired precision (see 5.1.2) at room temperature.

**NOTE 4**—Be aware that static electricity affects the mass readings.