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Standard Test Methods for MOISTURE CONTENT OF WOOD[1]

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This method has been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards.

INTRODUCTION

The importance of moisture content control of lumber and other wood products for various uses cannot be overemphasized. Moisture content control in the processing and fabrication of consumer items of wood requires a rapid and reliable means of moisture determination. Four methods of wood moisture content determination are described herein: One, the electronical method, is non-destructive and practically instantaneous; the other three, namely the oven-drying method, a distillation method, and a hygrometric method, are destructive in that they require that the lot be sampled for specimens that are subsequently analyzed for moisture content.

1. Scope

1.1 These methods cover the determination of the moisture content of wood. The methods provide a means whereby producers, fabricators, processors, and users of wood and wood products can facilitate inspection for adherence to moisture quality-control specifications. The requirements, advantages, and limitations of the different methods are outlined.

1.2 The methods described are commonly used in research and by the producing industries to ascertain the amount of moisture present in specific specimens representing the lot or on samples tested with the electronic moisture meters. These different methods are not equally suitable for moisture content determinations in any given case; therefore, it is important to select the one that is best for the intended application and a specific method may be specified. If these methods are referenced without designation of the specific method to be used, it shall be assumed that all methods are equally acceptable and that the choice will be made by the party responsible for the moisture-content determination. The following guide to the advantages and limitations of the various methods will assist in making the proper choice:

1.2.1 *Method A—Oven-Drying Method*—The moisture content is calculated from weight values obtained before and after drying a representative specimen of wood in an oven. This has been the most universally accepted method for determining moisture content in research, in wood-seasoning operations such as air drying, predrying, and kilin drying, in moisture content control techniques in processing in wood-working factories. Its limitations are that it is a destructive test in that the samples representing the lot must be cut to produce the specimens; it takes several hours to make an accurate analysis; and accuracy is limited if the wood contains an appreciable amount of volatile extractives, or if the wood has been impreg-

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nated with either volatile or nonvolatile chemicals.

1.2.2 *Method B—Electronic Moisture Meter Method*—Moisture content control often requires a rapid, nondestructive and reliable means of inspection for moisture content, and this requirement is met most conveniently by electronic moisture meters. Reliable results, however, can be obtained with moisture meters only when they are correctly used. A standard procedure should be established and accepted by users of these instruments and the method presented herein is intended to provide a uniform procedure for the use of electronic moisture meters for wood so that determinations made with them may be reliable and strictly comparable.

1.2.3 *Method C—Distillation Method*—The distillation method is destructive as is the oven-dry method. The procedure for selecting the specimen for analysis is the same as for the oven-drying method. The method is used when the wood contains volatiles other than water, such as pitch or oil-type preservatives, or has been impregnated with other chemicals that are soluble in toluene. The method generally consists of distilling the water from the fractured specimen along with a liquid that is immiscible with water such as toluene, catching the water in a trap and measuring its volume, and calculating the moisture content. The time required for the test method is often less than 2 h. This method also may be used to determine the quantity of any volatile material such as creosote in the wood specimen.

1.2.4 *Method D—Hygrometric Method*—The hygrometric method is also destructive as are the oven-drying and distillation methods. However, it is a fairly rapid method for obtaining moisture content estimates on wood samples that have been treated with preservatives or other chemicals. The method is limited to wood having a moisture content less than the fiber-saturation point.

2. Definitions and Description of Terms

2.1 *Moisture Content of Wood*—The moisture content of wood as determined by any of the methods described herein shall be expressed as a percentage of the oven-dry weight of the wood unless otherwise stipulated. The physical and mechanical properties of wood as they vary with changes in moisture content are generally reported as a function of moisture content expressed as a percentage of the oven-dry weight of the wood. Moisture content values may exceed 100 percent.

2.2 *unit*—one of a number of similar products, parts, specimens, etc., of wood.

2.3 *lot*—a specific quantity of similar wood units or collection of similar units from a common source; in wood moisture-inspection work, the quantity offered for inspection and acceptance at any one time. It may be a collection of mill items such as boards, dimension, dimension stock, or veneer, or semifinished parts or subassemblies such as furniture items, flooring, trusses, beams, or panels, that are inspected for moisture content during production, or a consignment of finished products to be sent out for service.

2.4 *sample*—a portion of material or a group of units taken from a larger quantity of material or collection of units, which serves to provide information that can be used as a basis for action on the larger quantity or on the production process.

2.5 *specimen*—a section, block, core, or other type of test piece cut from a sample or, in the case of nondestructive determinations, the area of a sample piece subjected to a moisture content analysis.

3. Sampling

3.1 The objective of sampling for moisture content specimens or for nondestructive electronic moisture meter tests is to obtain values that represent the lot. Three objectives are sought, namely: (*1*) an unbiased estimate of the population, or lot, mean; (*2*) an unbiased estimate of the variance; and (*3*) the estimates to be as accurate as possible for the time and money spent.

Method A—Oven-Drying Method

4. Apparatus

4.1 *Oven*—An oven that can be maintained at a temperature of 103 ± 2 C (217.4 ± 3.6 F) throughout the drying chamber for the time required to dry the specimen to constant weight. Ovens may require forced-air circulation to maintain uniform temperature. An accurate thermometer or pyrometer shall be used to check the temperature. For convenience, ovens will normally be thermostatically

controlled. Ovens shall be vented to allow the evaporated moisture to escape.

4.2 *Weighing Device*—A scale or balance that will weigh a specimen within accuracy of ±0.2 percent. The accuracy and sensitivity of the weighing apparatus shall be checked at least every year against standard weights. Knife edges shall be kept clean to assure accuracy. A torsion balance, Harvard trip balance, triple-beam balance, and automatic direct-reading balance are examples of suitable equipment.

5. Test Specimens

5.1 Specimens vary widely, depending on the type of material being analyzed and the anticipated use of the results. Specimens shall be selected that represent the lot. Unless otherwise specified, specimens shall be full cross sections no less than 25 mm (1 in.) along the grain, but longer as needed to provide a minimum volume of 33 cm^3 (2 $in.^3$). The section shall be cut with a sharp saw. All loosely attached slivers shall be removed from the section before it is weighed. Specimens from large items such as logs, poles, posts, piling, and timbers shall be (*1*) full cross sections, (*2*) representative sectors of such sections, (*3*) increment core borings, or (*4*) auger chips. When the latter two types of specimens are used on round items to represent the average moisture content of the sample, they shall be divided into zones and a weighted average moisture content determined arithmetically from the relative proportion of the cross section each zone represents. Because of the small volume of borings and auger chips, a more sensitive balance is required than would be required for specimens cut from lumber and other sawed items.

6. Procedure

6.1 *Initial Weighing*—Weigh each specimen immediately after cutting from the sample representing the lot or else protect it from a moisture change until weighed. Weigh each specimen to an accuracy of ±0.2 percent, for example, if the specimen weighs 250 g, obtain the weight to the nearest 0.5 g. Record the weight either on the specimen or on a data sheet that is numbered to correspond with the number on the specimen. If a delay between cutting the specimen and weighing cannot be avoided, place the specimen in a vapor-tight container or wrapper immediately upon cutting and allow it to remain in the container or wrapper until it can be weighed. Suitable wrappers can be made of aluminum foil or polyethylene film. The delay between cutting and weighing of the protected specimen shall be as short as possible, but in no case to exceed 2 h. Obtaining weights in grams rather than in grains or ounces simplifies calculations.

6.2 *Drying*—After they have been weighed, place the specimens in an oven when convenient and heat at 103 ± 2 C (217.4 ± 3.6 F) until they reach constant weight. Place the specimens in the oven in a manner that will allow free access of heated air to each. To test for constant weight, weigh the heaviest specimens at intervals of 2 h or more until they show no further weight loss within the accuracy of weighing required. Avoid drying for periods longer than necessary to achieve constant weight since prolonged distillation or oxidation of the wood will produce a weight loss reflecting a higher-than-actual moisture content. Newly cut specimens should not be placed in the oven with partially dried ones since the drier specimens will be retarded in drying.

NOTE 1—As a guide, an air-dry specimen about 50 by 100 mm (2 by 4 in.) in cross section and 25 mm (1 in.) along the grain will usually attain constant weight within 24 h at the specified temperature when dried in an electric oven having good forced-air circulation.

6.3 *Final Weighing*—Weigh each specimen immediately after it is removed from the oven upon attaining constant weight or store in a desiccator while awaiting weighing. The accuracy shall be the same as required for initial weighing.

7. Calculation

7.1 Calculate the moisture content as follows:

$$\text{Moisture content, percent} = [(A - B)/B] \times 100$$

or, for more convenient slide rule or computer calculation:

$$\text{Moisture content, percent} = ((A/B) - 1) \times 100$$

where:

A = original weight, and
B = oven-dry weight.

Example—A 25-mm (1-in.) specimen of lumber weighed 56.7 g. After oven-drying, the weight was 52.3 g.