

DEVELOPING A NEW ASTM STANDARD ON RECOMMENDED PROCEDURES FOR USE AND CALIBRATION OF PORTABLE MOISTURE METERS

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Introduction

At first glance the importance, or even relation, of an ASTM (American Society for Testing and Materials) standard on moisture meters to the everyday business of lumber drying may seem somewhat tenuous. To most persons concerned with drying and quality control of lumber the governing regulations are the grading rules pertaining to the species they are drying. However, there is a link between the two described below.

Grading Rules

The purpose of grading rules is to maintain a standard or measure of value between mills manufacturing the same or similar woods, so that uniform qualities will be the result. Under the term "qualities" one should include consideration of moisture content requirements for dry lumber.

The grading rules that govern the softwood lumber produced on the West Coast of the United States and Canada typically define dry lumber as "lumber which has been dried to a moisture content of 19% or less". Other than defining moisture content as "the weight of water in wood expressed as a percentage of the weight of the wood from which all water has been removed (oven dry)", no mention is made in the rules of how to measure moisture content in practice.

Lumber Standards

Lumber that has been manufactured and measured according to the provisions of any of the grading rules for softwood lumber may be regarded as meeting the provisions of one of two governing standards, the American Softwood Lumber Standard PS 20-70 or the Canadian Standards Association Standard CSA 0141-1970 Softwood Lumber.

The U.S. standard defines dry lumber in the same way as in the grading rules, but also states "Provisions for seasoned lumber shall be expressed in terms of maximum moisture content to be allowed at any point on each piece". While a criticism of this provision is not the subject of this paper, it must be pointed out that the statement is open to more than one interpretation. The standard goes on, "Moisture content determinations shall be made with electric meters of the type described in Section 9 of ASTM D2016, Standard Methods of Test for Moisture Content of Wood, and the procedures to be used in making such determinations shall be in accordance with those described in Section 11, Method B of ASTM D2016".

The Canadian Softwood Lumber Standard differs from the above only in that it actually reproduces the relevant sections from ASTM D2016 as an appendix to the standard.

Before considering in detail the existing standard and proposed changes to be included in a new standard, a brief description of ASTM and its mode of operation might be of interest to those unfamiliar with the organization.

American Society for Testing and Materials

ASTM is a scientific and technical organization, founded in 1898 for the development of standards on characteristics and performance of materials, products, systems and services, and the promotion of related knowledge. The society operates through more than 135 main technical committees, including D.07 Wood, with 1550 sub-committees including D.07.11 Moisture Content of Wood. All committees function under regulations that ensure balanced representation among producers, users, and general interest participants.

ASTM is in effect a management system for the development of voluntary, consensus standards. Voluntary means the standards are developed voluntarily by those affected and they are used voluntarily by those who need them. Consensus means that every person or organization having an interest in the standard has an opportunity to voice his opinions in the technical committee. Whether he takes advantage of that opportunity is up to him.

The writing of a new standard begins by the preparation of a draft by a task force, the members of which need not be members of ASTM. The draft then passes through the subcommittee, the main committee and finally the society as a whole. At each step the action is formalized by a letter ballot.

D2016 In Its Present Form

The present standard contains test procedures for both direct methods of moisture content determination, e.g. by oven drying and by distillation, and indirect methods, i.e. by use of electric moisture meters. It is proposed to separate the two and retain the numerical designation D2016 for the moisture-meter standard and write another completely new standard for direct methods.

Those sections that do deal with electric moisture meters are largely specific to certain manufacturers' models. For example, the temperature-correction data that are given can be used for only one particular power-loss meter model or one capacitance meter. Similarly the standard states that resistance-type meters should be limited to D.C. voltage use only. One justification, therefore, for developing a new standard is to generalize the information provided so that it may be usefully applied in the development and testing of new meters, and that more generalized and appropriate calibrations be used for existing meters.

Although some mention is made of variables that affect the performance of moisture meters, it is proposed that greater emphasis be placed on these in the standard.

The standard provides no guidelines for laboratory and field calibration of meters. It is proposed that these be written into the new standard.

Accomplishments to Date

A first draft has been prepared and will be circulated to all subcommittee members and to anyone else on request. Not all areas that have been considered to need changing have as yet been addressed, but some that have are as follows.

Range

This refers to the meter scales and is probably most applicable to conductance meters. The range of moisture content that can be measured with reliability by conductance meters is from 7% to about 27%. Meter scales should not extend to more than this limit to avoid implying reliability of readings greater than this value.

Species Corrections

The standard presently states that for conductance meters, if the species of wood being tested is other than that for which the moisture meter is directly calibrated, a species correction supplied by the instrument manufacturer should be used. It is proposed to turn this requirement around to read that manufacturers' data for either the dial calibration species or corrections for other species should be used only if the data have been developed according to acceptable calibration procedures. Where the data are not available, the meter may be calibrated by the user using these same procedures.

Similarly for dielectric meters, unless the dial scale is in arbitrary units, the calibration of the reference species should have been carried out according to acceptable procedures. If the dial is in arbitrary units, then calibration for any species follows these procedures.

Full details of the calibration procedures, including test-sample preparation and conditioning to a range of moisture contents, are contained in the "Meter calibration" section of the draft proposed standard, which is available upon request.

Temperature Corrections

Correction curves are shown in the present standard for the effect of wood temperature on readings of conductance meters, with the implication that they are applicable to all species. The task force preparing this draft has been made aware that the curves are not applicable to all species and certainly should not have been extrapolated for some species at less than 70°F. No temperature calibration procedures have as yet been drawn up, but it seems likely that for users a rigorous methodology, such as has been proposed for meter calibration (below), will be necessary to cover the range of temperatures encountered in the kiln and in yard storage.

Meter Calibration

A very detailed approach is proposed here whereby the exact procedure to be used is laid down, including:

- (a) number of specimens to be used;
- (b) conditioning to 5 EMC levels according to methods in another new ASTM standard presently under development, Equalization and Conditioning of Wood and Wood Products;
- (c) testing with a given meter;
- (d) determining true moisture content by a method described in the other new standard mentioned earlier, Direct Methods of Moisture Content Measurement.

Electrode Types

Needle-type electrodes for conductance meters have generally had either two or four pins. However, the two configurations give different meter readings on the same piece of wood. To avoid this, uniformity of electrode types is necessary and it is proposed that electrodes shall have two pins, insulated except for the tips. If any other electrode is used, readings are to be adjusted as specified by the manufacturer. The manufacturer shall provide documented evidence to justify the adjustment required for each non-standard electrode.

Effect of Moisture Gradients

Conductance meters with insulated electrodes can be used to determine moisture content at any thickness, limited only by the length of the pins. For a single meter reading corrected for species, the 95 percent confidence interval for predicting the true moisture content between the electrode tips is approximately ± 0.5 to ± 2.0 percent moisture content, depending on species. Average moisture content can be obtained through the thickness by integrating moisture content versus thickness.

Dielectric moisture meters give readings that are influenced not only by moisture content, species and wood temperature, but also by several other factors including moisture gradient, depth of electric-field penetration, thickness of material, surface condition, and electrode contact pressure and conformance. It should not be implied that the readings obtained, after temperature and species correction, refer to a specific depth in the wood. With the rare exception of wood that has been totally equilibrated so that no gradients exist, readings are qualitative at best and certainly inferior in their estimation of true moisture content compared with readings obtained by conductance meters with standard electrodes.

Implications of a New Standard

This paper began by indicating the connecting links between the existing ASTM Standard on Moisture Content of Wood and the moisture content provisions of the lumber standards and the

grading rules. Changing or replacing the ASTM standard does not automatically alter the above provisions, since the use of an ASTM standard is entirely voluntary.

The choice of where in or on a piece of wood moisture meter readings are taken has not been addressed by the present task force. It may be argued that the directions for obtaining such data, to check adherence to grading rules requirements, are not appropriate for inclusion in the new standard. However, the correct use of a meter and the correct interpretation of the data are appropriate points that a standard should cover.

Further Development

Several issues including the above remain to be resolved. The input of this audience would be welcomed, either by criticism of what has been proposed to date, or by addition of further information or opinions for consideration.