



Designation: D2555 – 17a (Reapproved 2024)^{ε1}

Standard Practice for Establishing Clear Wood Strength Values¹

This standard is issued under the fixed designation D2555; 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.

^{ε1} NOTE—Reference 4 was corrected editorially in February 2024.

INTRODUCTION

The development of safe and efficient design values for lumber, laminated timber, plywood, round timbers, and other solid wood products, each with its own special requirements has, as a common starting point, the need for an authoritative compilation of clear wood strength values for the commercially important species. Also required are procedures for establishing, from these data, values applicable to groups of species or to regional groupings within a species where necessitated by marketing conditions. This practice has been developed to meet these needs and to provide, in addition, information on factors for consideration in the adjustment of the clear wood strength values to design values for engineering. Since factors such as species preference, species groupings, marketing practices, design techniques, and safety factors vary with each type of product and end use, it is contemplated that this practice will be supplemented where necessary by other appropriate standards relating to specific design values for each such product. Practice **D245** is an example of such a standard applicable to the interpretation of the clear wood strength values in terms of allowable properties for visually graded lumber.

A primary feature of this practice is the establishment of tables presenting the most reliable basic information developed on the strength of clear wood and its variability through many years of testing and experience. The testing techniques employed are those presented in Test Methods **D143**. Among the recognized limitations of such strength data are those resulting from the problems of sampling material from forests extending over large regions, and the uneconomical feasibility of completely testing an intensive sample. A practical approach to the improvement of strength data is through the application of the results of density surveys in which the specific gravity of the entire forest stand for each species is determined on a sound statistical basis. Through regression equations derived from presently available strength data, revised strength values are established from the specific gravity-strength relationship for clear wood. This procedure greatly extends current capabilities to develop new estimates of strength and to improve or verify estimates made in the past.

1. Scope

1.1 This practice covers the determination of strength values for clear wood of different species in the unseasoned condition, unadjusted for end use, applicable to the establishment of design values for different solid wood products such as lumber, laminated wood, plywood, and round timbers. Presented are:

1.1.1 Procedures by which test values obtained on small clear specimens may be combined with density data from extensive forest surveys to make them more representative,

1.1.2 Guidelines for the interpretation of the data in terms of assigned values for combinations of species or regional divisions within a species to meet special marketing needs, and

1.1.3 Information basic to the translation of the clear wood values into design values for different solid wood products for different end uses.

1.1.4 For species where density survey data are not as yet available for the re-evaluation of average strength properties, the presently available data from tests made under the sampling methods and procedures of Test Methods **D143** or Practice **E105** are provided with appropriate provision for their application and use. Because of the comprehensive manner in which the density survey is undertaken, it follows that the re-evaluated strength data are intended to be representative of the forest stand, or rather large forest subdivisions.

¹ This practice is under the jurisdiction of ASTM Committee **D07** on Wood and are the direct responsibility of Subcommittee **D07.02** on Lumber and Engineered Wood Products.

Current edition approved Feb. 1, 2024. Published February 2024. Originally approved in 1966. Last previous edition approved in 2017 as D2555 – 17a. DOI: 10.1520/D2555-17AR24E01.

1.1.5 Some useful mechanical properties (tensile strengths parallel and perpendicular to grain, modulus of rigidity for a longitudinal-transverse plane, and transverse modulus of elasticity) have not been extensively evaluated. Methods are described for estimating these properties by their relation to other properties.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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.*

1.4 *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:*²

- D143** Test Methods for Small Clear Specimens of Timber
- D245** Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber
- D2915** Practice for Sampling and Data-Analysis for Structural Wood and Wood-Based Products
- E105** Guide for Probability Sampling of Materials

3. Summary of Methods

3.1 Two methods are presented for establishing tables of clear wood strength properties for different species and regional subdivisions thereof in the unseasoned condition and unadjusted for end use. These are designated Method A and Method B.

3.1.1 Method A provides for the use of the results of surveys of wood density involving extensive sampling of forest trees, in combination with the data obtained from standard strength tests made in accordance with Test Methods **D143**. The average strength properties are obtained from wood density survey data through linear regression equations establishing the relation of specific gravity to the several strength properties.

NOTE 1—Density surveys have been completed for only a limited number of species. Data are thus not currently available for the use of Method A on all commercial species. As such data become available they will be incorporated in revisions of this practice.

3.1.2 Method B provides for the establishment of tables of strength values based on standard tests of small clear specimens in the unseasoned condition for use when data from density surveys are not available. Separate tables are employed

to present the data on woods grown in the United States and on woods grown in Canada.

4. Procedure for Establishing Clear Wood Strength Values

4.1 *Method A*—Six steps are involved in establishing strength values by the wood density survey procedure. These are: conducting the wood density survey, development of unit areas, determination of average specific gravity for a unit area, determination of strength-specific gravity relations, estimation of average strength properties for a unit area, and combining values for unit areas into basic groups and establishing average strength properties and estimates of variance for the groups. In these methods a basic group is a combination of unit areas representing a species or a regional division thereof.

4.1.1 *Conducting Wood Density Survey*—A well-designed and thorough wood density survey is required to provide needed data on specific gravity for the reevaluation of strength properties. Such a survey requires consideration of the geographic range to be covered, the representativeness of the sample, the techniques of density evaluation, and adequate data analysis.

NOTE 2—Detailed information on an acceptable method of conducting wood density surveys, together with survey data, are presented in the *U.S. Forest Service Research Paper FPL 27 (1)*.³

4.1.2 *Development of Unit Areas*—Subdivide the geographical growth range of each species into unit areas that contain 1 % or more of the estimated cubic foot volume of standing timber of the species and are represented by reliable estimates of specific gravity of at least 20 trees. Make up unit areas of U.S. Forest Service Survey Units, or similar units or subdivisions of units, for which reliable estimates of timber volume are available. Develop unit areas objectively by means of the following steps:

4.1.2.1 Select a base survey unit or subdivision of a survey unit to be grouped with others,

4.1.2.2 Group with similar adjacent areas to make up a unit area on the basis of a timber volume, and

4.1.2.3 Determine the number of tree specific gravity samples available in the proposed unit area.

NOTE 3—The rules for developing unit areas should represent an effort to subdivide objectively and uniquely the range of a species into small geographic areas, which are assumed to be considerably more homogeneous with respect to the mechanical properties of the species than is the entire range itself. The number of unit areas associated with a species is a function of the volume of timber on the smallest usable areas and the number of tree specific gravity samples taken. In general, the larger the range and the greater the commercial importance of the species, the greater are the number of unit areas. One acceptable procedure for establishing unit areas is presented in Appendix C of *U.S. Forest Service Research Paper FPL 27 (1)*.

4.1.3 *Determination of Average Specific Gravity for a Unit Area*—Calculate the average specific gravity of trees in each unit area as the simple average of individual estimates of specific gravity of trees within the unit area.

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.

³ The boldface numbers in parentheses refer to a list of references at the end of this standard.