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Standard Test Methods for Nondestructive Evaluation of the Stiffness of Wood and Wood-Based Materials Using Transverse Vibration or Stress Wave Propagation¹

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INTRODUCTION

Nondestructive testing methods are used to determine the physical and mechanical properties of wood and wood-based materials. These test methods help ensure structural performance of products manufactured from a variety of wood species and quality levels of raw materials. These test methods also assist in evaluating the influence of environmental conditions on product performance.

Dynamic test methods based on the transverse vibration of a simply or freely supported beam, or the propagation of a longitudinal stress wave are methods used to nondestructively evaluate wood-based materials. These methods yield results comparable to traditional static test methods, permitting standardization of results, interchange and correlation of data, and establishment of a cumulative body of information on wood species and products of the world.

1. Scope

1.1 These test methods cover the non-destructive determination of the following dynamic properties of wood and wood-based materials from measuring the fundamental frequency of vibration:

1.1.1 Flexural (see Refs **(1-3)**)² stiffness and apparent modulus of elasticity (E_{ν}) properties using simply or freely supported beam transverse vibration in the vertical direction, and

1.1.2 Axial stiffness and apparent longitudinal modulus of elasticity (E_{sw}) using stress wave propagation time in the longitudinal direction.

1.2 The test methods can be used for a broad range of wood-based materials and products ranging from logs, timbers, lumber, and engineered wood products.

1.2.1 The two flexural methods can be applied to flexural products such as glulam beams and I-joists.

1.2.2 The longitudinal stress wave methods are limited to solid wood and homogeneous grade glulam (for example, columns but not products with distinct subcomponents such as wood I-joists).

1.3 The standard recognizes three implementation classes for each of these test methods.

1.3.1 *Class I*—Defines the fundamental method to achieve the highest degree of repeatability and reproducibility that can be achieved under laboratory conditions.

NOTE 1—Testing should follow Class I methods to develop training and validation data sets for method conversion models (see **Annex A2**).

1.3.2 *Class II*—Method with permitted modifications to the Class I method that can be used to address practical issues found in the field, and where practical deviations from the Class I protocol are known and their effects can be accounted.

NOTE 2—Practical deviations include, for example, environmental and test boundary conditions. Class II methods allow for corrections to test results to account for quantifiable effect such as machine frame deflections.

1.3.3 *Class III*—Method permitting the broadest range of application, with permitted modifications to suit a wider range of practical needs with an emphasis on repeatability.

NOTE 3—Online testing machines implemented to grade/sort lumber may be treated as Class III.

1.4 The standard provides guidance for developing a model for estimating a non-destructive test method result (for example, static modulus of elasticity obtained in accordance with Test Methods **D198**) from another non-destructive test method result (for example, dynamic longitudinal modulus of elasticity from measurement of longitudinal stress wave propagation time).

¹ These test methods are under the jurisdiction of ASTM Committee **D07** on Wood and is the direct responsibility of Subcommittee **D07.01** on Fundamental Test Methods and Properties.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.