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Standard Test Methods for Structural Panels in Tension[1]

This standard is issued under the fixed designation D 3500; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 These test methods cover the determination of the tensile properties of structural panels.

1.2 Structural panels in use include plywood, waferboard, oriented strand board and composites of veneer, and other wood-based layers

1.3 *Test Method A, Tensile Test for Small Specimens*:

1.3.1 This test method employs small specimens that should have a reduced cross section at the center of their length to avoid failure in the grip area. The transition from full width of specimen to reduced section at the center should be gradual to minimize stress concentration.

1.3.2 When the measurements of elastic properties are to be made, the length of the reduced cross section at the center should be of sufficient length to accommodate an extensometer.

1.4 *Test Method B, Tensile Test for Large Specimens*:

1.4.1 This test method employs large specimens and responds well to manufacturing variables, plywood growth characteristics, and other defects influencing the tensile properties of structural panels.

1.4.2 The test specimens are large enough to contain the maximum sized defects found in plywood panels. The test specimens have a constant cross section since the size and location of defects control the location of failures and the effect of stress concentration at the grips is overshadowed.

1.4.3 This test method is recommended for the following:

1.4.3.1 Comparative tests of structural panels,

1.4.3.2 Determining the influence of any specific strength reducing defects on the tensile properties of structural panels,

1.4.3.3 Determination of tensile properties of plywood and composites containing veneer with growth and manufacturing characteristics.

1.5 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 2395 Test Methods for Specific Gravity of Wood and Wood-Base Materials[2]

D 4442 Test Method for Direct Moisture Content Measurement of Wood and Wood-Base Materials[2]

3. Significance and Use

3.1 These test methods determine the tensile properties of structural panels in response to stresses acting in the plane of the panel.

3.2 *Test Method A*—This test method is suited to material that is uniform with respect to tensile properties. It is normally applied to structural panels and plywood of clear, straight-grained veneers. It may also be used to evaluate the strength of scarf and finger joints and other manufacturing process variables that can be expected to influence the tensile properties of structural panels in a uniform manner across the width of the sheet.

3.3 *Test Method B*—This test method employs large test specimens and responds well to all manufacturing variables and growth characteristics that affect the tensile properties of structural panels.

3.4 It is recommended that where comparisons are to be made that the same test method and specimen size be used throughout. This is because the volume of material included in a test specimen can influence the tensile strength regardless of whether the material properties are uniform throughout the sheet or vary widely due to the presence of growth or manufacturing features.

4. Control of Moisture Content

4.1 Structural panel specimens to be tested at specific moisture contents or after reaching equilibrium moisture content at specific temperature and relative humidity conditions shall be conditioned to approximate constant weight in controlled atmospheric conditions. For approximating moisture conditions of structural panels used under dry conditions, a relative humidity of 65 ± 2 % at a temperature of (68 ± 6°F) (20 ± 3°C) is recommended.

[1] These test methods are under the jurisdiction of ASTM Committee D07 on Wood and are the direct responsibility of Subcommittee D07.03 on Panel Products.

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[2] *Annual Book of ASTM Standards,* Vol 04.10.

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5. Variables Influencing Tensile Properties of Structural Panels

5.1 *Moisture Content*—Moisture content shall be determined in accordance with Test Method D 4442.

5.2 *Specific Gravity*—Determine specific gravity in accordance with Test Methods D 2395. The specimen may be the same as that for moisture content determination but must have volume of at least 1 in.^{3} (16 cm^3) if from small specimens (Test Method A), and at least 3 in.^{3} (49 cm^3) if from large specimens (Test Method B). Specimens containing veneer shall be free of visible knots or voids in any ply.

TEST METHOD A—TENSILE PROPERTIES OF SMALL SPECIMENS

6. Test Specimens

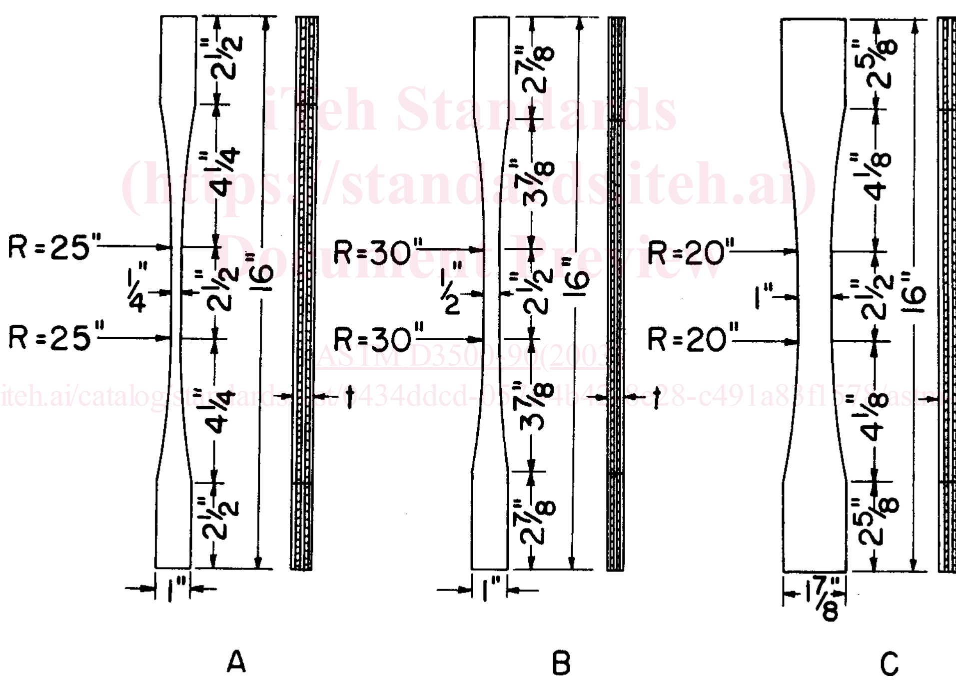
6.1 Specimens may be of Types A, B, or C in Fig. 1.

6.1.1 When the evaluation of elastic properties as well as ultimate tensile strength is required, the size and shape of the test specimen shall be selected on the basis of the construction and thickness of the material. For other structural panels, and plywood or composites with the grain of the individual veneer plies or laminations making grain angles of individual veneer lamina of 0 or 90°, Type A shall be used for material over ¼ in. (6 mm) in thickness and Type B for material ¼ in. (6 mm) or less in thickness. For plywood with an angle other than 0 or 90° between the length of the specimens and the grain orientation, Type C shall be used regardless of the thickness of the material. The specimens shall have a thickness equal to that of the material. The thickness and the width of each specimen at the critical section shall be measured to an accuracy of not less than ±0.3 % or 0.001 in. (0.02 mm) whichever is larger.

6.1.2 The test specimens shall be properly shaped, using a template in conjunction with a vertical-spindle wood-work-ing shaper or any other method that will give equally satisfactory results.

7. Loading Procedure

7.1 Hold the specimen in wedge-type self-tightening and self-aligning grips. Rate of crosshead motion shall be constant throughout the test such that the specimen breaks within 3 to 10 min after initiation of loading. A crosshead motion rate of



U.S. Customary Units, in.	Metric Equivalents mm	U.S. Customary Units, in.	Metric Equivalents mm
¼	6	3⅞	98
½	13	4⅛	105
1	25	4¼	108
1⅞	48	16	406
2½	64	20	503
2⅝	67	25	635
2⅞	73	30	762

NOTE 1—A generous radius of curvature at the minimum section as provided in this specimen is highly desirable.

FIG. 1 Dimensions and Details of Tension Test Specimens

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0.035 in./min (0.9 mm/min) is usually satisfactory. If failure does not occur within the desired 3 to 10-min time span, adjust the loading rate.

7.2 Measure the elapsed time from initiation of loading to maximum load and record to the nearest ½ min.

8. Load-Deformation Curves

8.1 Take data for load-deformation curves to determine the modulus of elasticity and the proportional limit. Choose increments of load so that not less than 12 and preferably 15 or more readings of load and deformation are taken to the proportional limit. Attach the deformation apparatus at the center of the specimen's length and width. Take deformation readings to the nearest 0.0001 in. (0.002 mm). Fig. 2 and Fig. 3 show 2-in. (51-mm) gage length Tripolitis extensometers that have been found satisfactory for this test.

TEST METHOD B—TENSILE STRENGTH OF LARGE SPECIMENS

9. Apparatus

9.1 Hold the structural panel specimen in grips that apply the required forces to the specimen without influencing load at, or location of, failure. Such devices shall not apply a bending moment to the test section, allow slippage under load, or inflict damage or stress concentrations to the test section. Figs. 4 and 5 illustrate the test set-up and grips.

9.2 *Grip Alignment*—For ideal test conditions, the grips should be self-aligning, that is, they should be attached to the force mechanism of the machine in such a manner that they will move freely into axial alignment as soon as the load is applied and thus apply uniformly distributed forces along and across the test cross section. When self-aligning grips are not available, the specimen may be clamped in the heads of a universal-type testing machine with wedge-type jaws.

9.3 *Contact Surface*—The contact surface between grips and test specimen shall be such that slippage does not occur. It is recommended that 11-in. (279-mm) long gripping area be used (measured parallel to direction of force). Large projections that damage the contact surface of the wood should be avoided. Grips that have been used successfully include: diamond floor plate, grips surfaced with coarse emery paper, and urethane friction padding.

10. Test Specimens

10.1 Specimens shall be precisely cut with all adjacent edges at right angles. The dimension of the specimen shall be at least 6 in. (152 mm) wide by 48 in. (1219 mm) long. The thickness and width shall be measured to an accuracy of not less than ±0.3 % or 0.001 in. (0.02 mm), whichever is larger.

11. Loading Procedure

11.1 Apply the load continuously throughout the test at a uniform rate of moveable crosshead motion that will produce failure of the specimen within a 3 to 10-min time period after initiation of loading. A strain rate of 0.001 in./in.·min (0.001 mm/mm·min)± 25 % has been found to give satisfactory results. This rate corresponds to a crosshead motion of approximately 0.025 in./min (0.625 mm/min) for a net specimen length of 26 in. (600 mm). Widely varying material properties or deformation of loading equipment may cause failure times to fall outside this range, requiring an adjustment of loading rate.

11.2 Measure the elapsed time from initiation of loading to maximum load and record to the nearest ½ min.

12. Load-Deformation Curves

12.1 When deformation measurements are needed for determining elastic properties mount a pair of transducers on the opposite faces of the specimen to minimize the effect of bending. Attach the transducers at the mid length and width of the specimen. It is recommended that the deflection be measured over a gage length of at least 5 in. (127 mm) and

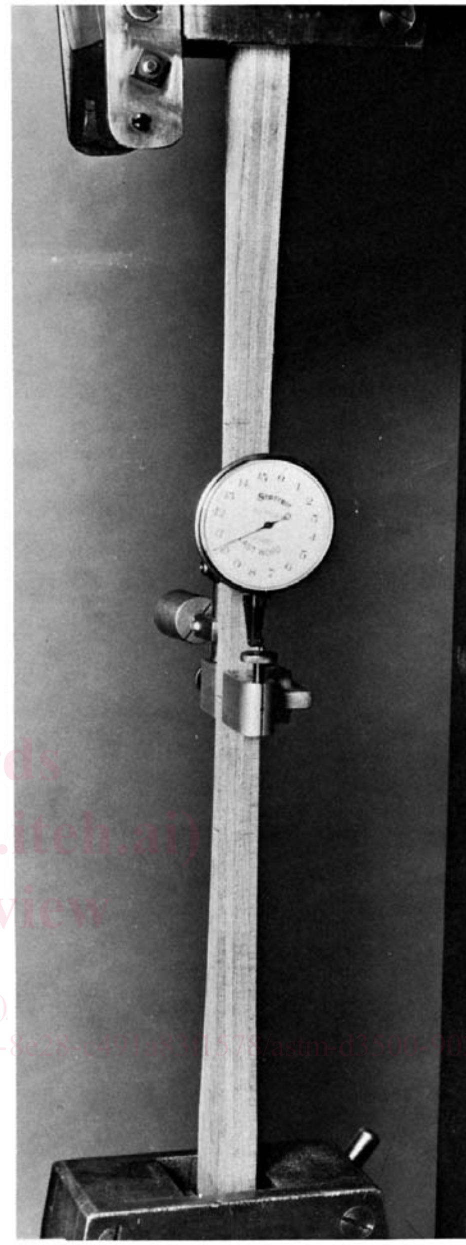

FIG. 2 Tension Test of Thick Plywood Showing Nonaveraging Type of Extensometer (2-in. Gage Length)

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