Designation: D 1037 – 99

Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials[1]

This standard is issued under the fixed designation D 1037; 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.

INTRODUCTION

The test methods presented herein have been developed and are presented to serve two distinct purposes. They are divided into two parts, Parts A and B, depending on the purpose for which they are intended. The choice between a particular test method and its alternative should be made with a full understanding of the intended purpose of each, because values obtained from tests may, in some cases, differ. Of the test methods presented in both parts, some have been in generally accepted use for many years, some are modifications and refinements of previously developed test methods, and some are more recent developments. Where test methods are suitable for more than one of the purposes, they are delineated in Part A, but not repeated in Part B. It is the intent that reference to the appropriate section of the test method shall suffice in specifications developed for the different materials.

Part A. General Test Methods for Evaluating the Basic Properties of Wood-Base Fiber and Particle Panel Materials—Part A is for use in obtaining basic properties suitable for comparison studies with other materials of construction. These refined test methods are applicable for this purpose to all materials covered by Definitions D 1554.

Part B. Acceptance and Specification Test Methods for Hardboard—Part B is for specific use in specifications for procurement and acceptance testing of hardboard. These test methods are generally employed for those purposes in the industry. By confining their intended use as indicated, it has been possible to achieve adequate precision of results combined with economy and speed in testing, which are desirable for specification use.

PART A—GENERAL TEST METHODS FOR EVALUATING THE BASIC PROPERTIES OF WOOD-BASE FIBER AND PARTICLE PANEL MATERIALS

1. Scope

1.1 These test methods cover the determination of the properties of wood-base fiber and particle panel materials as follows:

[1] These test methods are under the jurisdiction of ASTM Committee D-7 on Wood and are the direct responsibility of Subcommittee D07.03 on Panel Products.

Current edition approved April 10, 1999. Published July 1999. Originally published as D 1037 – 49. Last previous edition D 1037 – 96a.

Compression-Shear Test 137-146

1.2 There are accepted basic test procedures for various fundamental properties of materials that may be used without modification for evaluating certain properties of wood-based fiber and particle panel materials. These test methods are included elsewhere in the *Annual Book of ASTM Standards.* The pertinent ones are listed in Table 1. A few of the test methods referenced are for construction where the wood-base materials often are used.

1.3 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

1.4 *This standard does not purport to address all of the safety problems, 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:*

C 273 Test Method for Shear Test in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores[2]

D 143 Methods of Testing Small Clear Specimens of Timber[3]

D 905 Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading[4]

D 1554 Definitions of Terms Relating to Wood-Base Fiber and Particle Panel Materials[3]

D 3501 Methods of Testing Plywood in Compression[3]

TABLE 1 Basic Test Procedures for Evaluating Properties of Wood Base-Fiber and Particle Panel Materials

ASTM Designation	Test Methods for
C 177	Steady-State Heat-Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[A]
C 209	Cellulosic Fiber Insulating Board[A]
C 236	Steady-State Thermal Performance of Building Assemblies by Means of the Guarded Hot Box[A]
C 384	Impedance and Absorption of Acoustical Materials by the Impedance Tube Method[A]
C 423	Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method[A]
D 149	Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies[B]
D 150	A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials[B]
D 257	D-C Resistance or Conductance of Insulating Materials[B]
D 495	High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation[B]
D 1666	Conducting Machining Tests of Wood and Wood-Base Materials[C]
D 1761	Mechanical Fasteners in Wood[C]
E 72	Conducting Strength Tests of Panels for Building Construction[D]
E 84	Surface Burning Characteristics of Building Materials[D]
E 90	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions[A]
E 96	Water Vapor Transmission of Materials[A]
E 97	Directional Reflectance Factor, 45-deg 0-deg, of Opaque Specimens by Broad-Band Filter Reflectometry[E]
E 119	Fire Tests of Building Construction and Materials[D]
E 136	Behavior of Materials in a Vertical Tube Furnace at 750°C[D]
E 152	Fire Tests of Door Assemblies[D]
E 162	Surface Flammability of Materials Using a Radiant Heat Energy Source[D]
E 661	Performance of Wood and Wood-Based Floor and Roof Sheathing Under Concentrated Static and Impact Loads[D]
E 662	Specific Optical Density of Smoke Generated by Solid Materials[D]
E 906	Heat and Visible Smoke Release Rates for Materials and Products[D]

[A] *Annual Book of ASTM Standards*, Vol 04.06.
[B] *Annual Book of ASTM Standards*, Vol 10.01.
[C] *Annual Book of ASTM Standards*, Vol 04.10.
[D] *Annual Book of ASTM Standards*, Vol 04.07.
[E] *Annual Book of ASTM Standards*, Vol 14.02.

3. Significance and Use

3.1 These test methods cover small-specimen tests for wood-base fiber and particle panel materials that are made to provide:

3.1.1 Data for comparing the mechanical and physical properties of various materials,

3.1.2 Data for determining the influence on the basic properties of such factors as raw material and processing variables, post-treatments of panels, and environmental influences, and

3.1.3 Data for manufacturing control, product research and development, and specification acceptance.

4. Selection of Test Method

4.1 Not all the tests outlined in these test methods may be necessary to evaluate any particular board for any specified use. In each instance, therefore, it will be necessary to determine which tests shall be made.

5. Test Specimens

5.1 The number of specimens to be chosen for test and the method of their selection depend on the purpose of the particular tests under consideration, so that no general rule can be given to cover all instances. It is recommended that whenever possible, a sufficient number of tests be made to permit statistical treatment of the test data. In the evaluation of a board material, specimens for test should be obtained from a representative number of boards. In properties reflecting differences due to the machine direction of the board, specimens from each board shall be selected both with the long dimension parallel to the long dimension of the sheet, and with the long dimension perpendicular to the long dimension of the sheet.

6. Control of Moisture Content and Temperature

6.1 The physical and mechanical properties of building boards depend on the moisture content at time of test. Therefore, material for test in the dry condition shall be conditioned to constant weight and moisture content in a conditioning chamber maintained at a relative humidity of 65 ± 1 % and a temperature of 20 ± 3°C (68 ± 6°F) (Note 1 and Note 2). If there is any departure from this recommended condition, it shall be so stated in this report.

NOTE 1—In following the recommendation that the temperature be controlled to 20 ± 3°C (68 ± 6°F), it should be understood that it is desirable to maintain the temperature as nearly constant as possible at some temperature within this range.

[2] *Annual Book of ASTM Standards,* Vol 15.03.
[3] *Annual Book of ASTM Standards,* Vol 04.10.
[4] *Annual Book of ASTM Standards,* Vol 15.06.

NOTE 2—Requirements for relative humidity vary for different materials. The condition given above meets the standard for wood and wood-base materials.

SIZE AND APPEARANCE OF BOARDS

7. Size of Finished Boards

7.1 When measurements of finished boards are required, the width of each finished board shall be obtained by measuring the width at each end and at midlength to an accuracy of not less than ±0.3 % or 1⁄16 in. (2 mm), whichever is smaller. Likewise, three measurements of length shall be made, one near each edge, and one at midwidth with like accuracy.

8. Variation in Thickness

8.1 For the determination of variations in thickness, specimens at least 6-in. (150-mm) square shall be used. The thickness of each specimen shall be measured at five points, near each corner and near the center, and the average thickness and the variation in thickness noted. These measurements shall be made to an accuracy of not less than ±0.3 %, when possible.

9. Specific Gravity

9.1 Specific gravity (or density) and moisture content determinations are required on each static bending test specimen. The moisture content shall be determined from a coupon taken from each bending specimen, and the specific gravity computed from the dimensions and weight of the bending specimen at time of test and the moisture content. The average specific gravity of the bending specimens as determined after conditioning to equilibrium (Section 6) shall be reported as the specific gravity of the board. The maximum and minimum values for specific gravity (based on volume at test and weight when oven–dry) shall also be noted.

NOTE 3—When it is desired to make specific gravity determinations independent of any other test, specimens of any convenient size may be selected. These shall be measured, weighed, and dried as outlined in Sections 127 and 128.

10. Surface Finish

10.1 The finish of both surfaces shall be described. A photograph of each surface may be taken to show the texture of the board. This photograph shall show suitable numbering so that the building board may be properly identified.

STATIC BENDING

11. Scope

11.1 Static bending tests shall be made both on specimens when conditioned and when soaked. One half of the test specimens shall be prepared with the long dimension parallel and the other half with the long dimension perpendicular to the long dimension of the board in order to evaluate directional properties.

12. Test Specimen

12.1 Each test specimen shall be 3 in. (76 mm) in width if the nominal thickness is greater than ¼ in. (6 mm), and 2 in. (50 mm) in width if the nominal thickness is ¼ in. or less. The depth (thickness) shall be the thickness of the material. The length of each specimen shall be 2 in. (50 mm) plus 24 times the nominal depth (Note 4 and Note 5). The width, length, and thickness of each specimen shall be measured to an accuracy of not less than ±0.3 %.

NOTE 4—In cutting specimens to meet the length requirements of 2 in. (50 mm) plus 24 times the nominal thickness, it is not intended that the length be changed for small variations in thickness. Rather it is the thought that the nominal thickness of the board under test should be used for determining the specimen length.

NOTE 5—Long-span specimens are desired for tests in bending so that the effects of deflections due to shear deformations will be minimized and the values of moduli of elasticity obtained from the bending tests will approximate the true moduli of the materials.

13. Specimens Soaked Before Test

13.1 The specimens to be tested in the soaked condition shall be submerged in water at 20 ± 3°C (68 ± 6°F) for 24 h before the test and shall be tested immediately upon removal from the water. When it is desired to obtain the effect of complete saturation the specimens shall be soaked for such longer period as may be necessary. The time of soaking and the amount of water absorbed shall be reported.

14. Span and Supports

14.1 The span for each test shall be 24 times the nominal thickness (depth) of the specimen (Note 6). The supports shall be such that no appreciable crushing of the specimen will occur at these points during the test. The supports either shall be rounded or shall be knife edges provided with rollers and plates under the specimen at these points. When rounded supports, such as those shown in Fig. 1, are used, the radius of the rounded portion shall be at least 1½ times the thickness of the material being tested. If the material under test deviates from a plane (Note 7), laterally adjustable supports[5] shall be provided.

NOTE 6—Establishment of a span-depth ratio is required to allow an accurate comparison of test values for materials of different thicknesses. It should be noted that the span is based on the nominal thickness of the material and it is not intended that the spans be changed for small variations in thickness.

NOTE 7—The laterally adjustable knife edges may be necessary for the specimens tested in the soaked condition because of warping or twisting that may occur due to soaking.

15. Center Loading

15.1 The specimens shall be loaded at the center of span with the load applied to the finished face at a uniform rate through a loading block rounded as is shown in Fig. 1. The bearing blocks shall be at least 3 in. (76 mm) in width and shall have a thickness (parallel to span) equal to twice the radius of curvature of the rounded portion of the loading block. The radius of the rounded portion shall be approximately equal to 1½ times the thickness of the specimen.

16. Speed of Testing

16.1 Apply the load continuously throughout the test at a uniform rate of motion of the movable crosshead of the testing machine calculated as follows (Note 8 and Note 9):

[5] Details of laterally adjustable supports may be found in Fig. 1 of Methods D 3501.

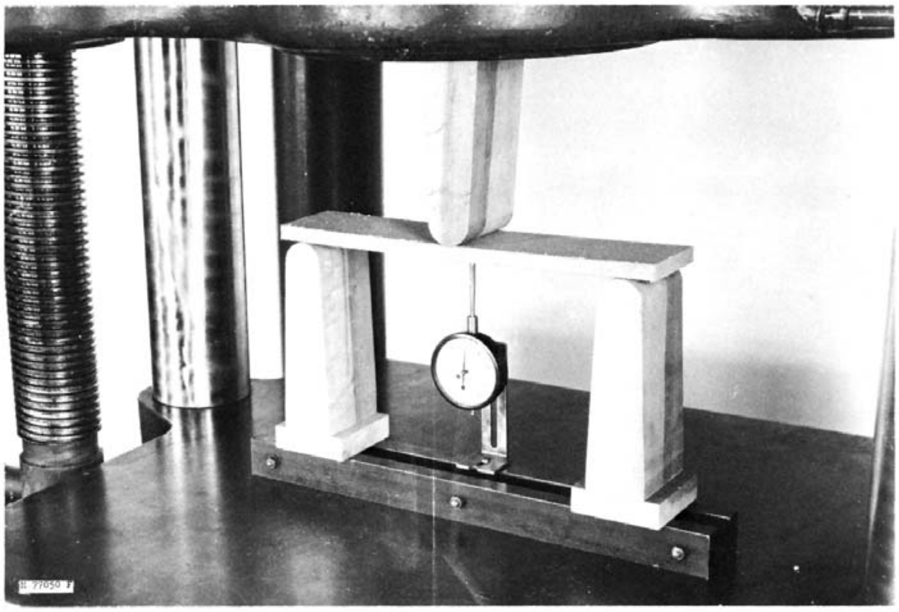


FIG. 1 Static Bending Test Assembly

$$N = zL^2/6d \quad (1)$$

where:

N = rate of motion of moving head, in./min (mm/min),
z = unit rate of fiber strain, in./in. (mm/mm) of outer fiber length per minute (0.005),
L = span, in. (mm), and
d = depth (thickness) of specimen, in. (mm).

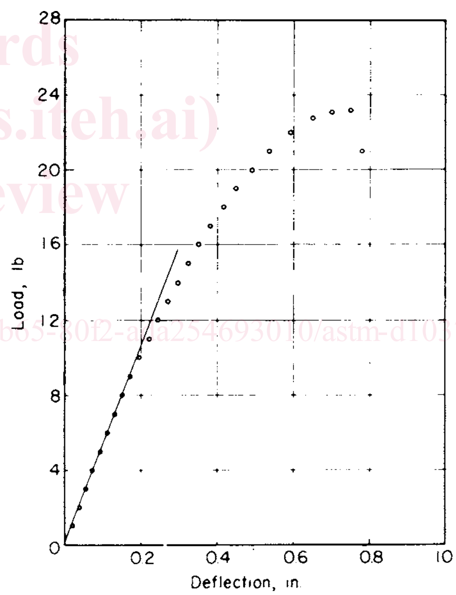
NOTE 8—The testing machine speed used shall not vary by more than ±50 % from that specified for a given test. The testing machine speed used shall be recorded on the data sheet. The crossheaded speed shall mean the free-running, or no-load, crosshead speed for testing machines of the mechanical-drive type, and the loaded crosshead speed for testing machines of the hydraulic-loading type.

NOTE 9—The calculated rates of head descent are, therefore, 0.12 in./min (3 mm/min) for specimens ¼ in. (6 mm) in thickness, 0.24 in./min (6 mm/min) for specimens ½ in. (12 mm) in thickness, 0.36 in./min (9 mm/min) for specimens ¾ in. (18 mm) in thickness and 0.48 in./min (12 mm/min) for specimens 1 in. (25 mm) in thickness.

17. Load-Deflection Curves

17.1 Obtain load-deflection curves to maximum load for all bending tests. Obtain the deflection of the center of the specimen by measuring the deflection of the bottom of the specimen at the center by means of an indicating dial (Note 10) attached to the base of the testing jig, with the dial plunger in contact with the bottom of the specimen at the center. This arrangement is shown in Fig. 1. Note the load and deflection at first failure and at maximum load. Take readings of deflection at least to the nearest 0.005 in. (0.10 mm). Fig. 2 shows a typical load-deflection curve. Deflections also may be measured with transducer-type gages and plotted simultaneously against load.

NOTE 10—The range of standard 0.001-in. (0.02-mm) indicating dials is 1 in. (25 mm). The total deflection of some thicknesses of boards may exceed 1 in. at failure. When this happens, either a 2-in. (50-mm) total-travel indicating dial or a suitable 2:1 reducing lever in conjunction with a 1-in. travel dial should be used so that maximum deflections can be obtained.



Metric Equivalents

in.	0.2	0.4		0.6	0.8		1.0
mm	5	10		15	20		25
lb	4	8	12	16	20	24	28
kg	1.8	3.6	5.4	7.2	9	10.8	12.6

FIG. 2 Typical Load-Deflection Curve for Static Bending Test

18. Description of Failure

18.1 Note the character of the failure. The report shall include the sequence of failure and note whether or not the initial failure was in compression or tension. Photographs of typical failures will be helpful.

19. Moisture Content and Specific Gravity

19.1 Weigh the specimen immediately before the test, and after the test cut a moisture 1 in. (25 mm) by the width of specimen from the body of the specimen. Determine the moisture content and specific gravity of each specimen in accordance with Sections 9, 127, and 128.

20. Calculation and Report

20.1 Calculate the modulus of rupture for each specimen by the following equation, and include the values determined in the report:

$$R = 3PL/2bd^2 \quad (2)$$

20.2 Calculate the stress at proportional limit for each specimen by the following equation, and include the values determined in the report:

$$Spl = 3P_1L/2bd^2 \quad (3)$$

20.3 Calculate the stiffness (apparent modulus of elasticity) for each specimen by the following equation, and include the values determined in the report:

$$E = P_1L^3/4bd^3y_1 \quad (4)$$

20.4 Calculate the work-to-maximum load for each specimen by the following equation, and include the values determined in the report:

$$Wml = A/bdL \quad (5)$$

where:

A = area under load-deflection curve to maximum load, lbf·in. (N·m),
b = width of specimen, in. (mm),
d = thickness (depth) of specimen, in. (mm),
E = stiffness (apparent modulus of elasticity), psi (kPa),
L = length of span, in. (mm),
P = maximum load, lbf (N),
P_1 = load at proportional limit, lbf (N),
R = modulus of rupture, psi (kPa),
Spl = stress at proportional limit, psi (kPa),
Wml = work to maximum load, lbf·in./in.^{3}(N·mm/mm^3), and
y_1 = center deflection at proportional limit load, in. (mm).

TENSILE STRENGTH PARALLEL TO SURFACE

21. Scope

21.1 The test for tensile strength parallel to the surface shall be made on specimens both in the dry and in the soaked condition. Tests shall be made on specimens both with the long dimension parallel and perpendicular to the long dimension of the board to determine whether or not the material has directional properties.

NOTE 11—This test may be applied to material 1 in. (25 mm) or less in thickness. When the materials exceed 1 in. in thickness, crushing at the grips during test is likely to adversely affect the test values obtained. It is recommended that for material greater than 1 in. in thickness, the material be resawed to ½ in. (12 mm) thickness. Test values obtained from resawed specimens may be only approximate, because strengths of material near the surface may vary from the remainder.

22. Test Specimen

22.1 Each test specimen shall be prepared as shown in Fig. 3. The reduced section shall be cut to the size shown with a band saw. The thickness and the minimum width of each specimen at the reduced section shall be measured to an accuracy of not less than ±0.3 %. The minimum width of the reduced section shall be determined to at least the nearest 0.01 in. (0.25 mm). These two dimensions shall be used to determine the net cross-sectional area for determining maximum stress.

23. Specimens Soaked Before Test

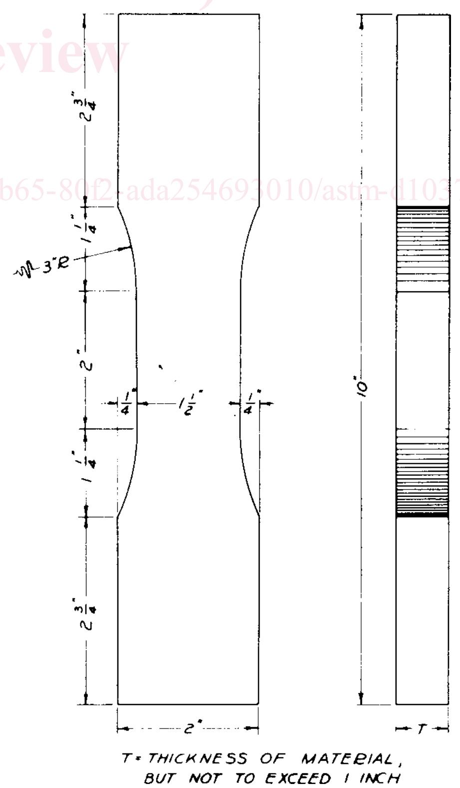
23.1 Specimens to be tested in the soaked condition shall be prepared in accordance with Section 13.

24. Method of Loading

24.1 Use self-aligning, self-tightening grips with serrated gripping surfaces at least 2 in. (50 mm) in width and at least 2 in. in length to transmit the load from the testing machine to the specimen. Fig. 4 shows a typical assembly for the tension test of building boards.

25. Speed of Testing

25.1 Apply the load continuously throughout the test at a uniform rate of motion of the movable crosshead of the testing machine of 0.15 in./min (4 mm/min) (see Note 8).



Metric Equivalents

in.	¼	1	1¼	1½	2	2¾	3	10
mm	6	25.4	32	38	51	70	76	254

FIG. 3 Detail of Specimen for Tension Test Parallel to Surface

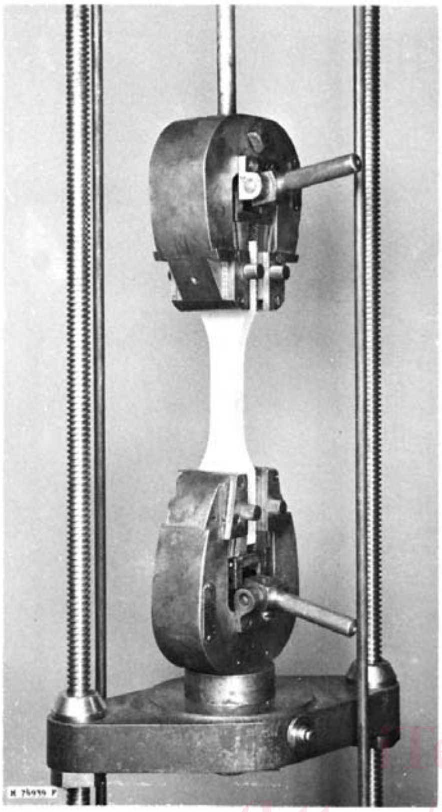


FIG. 4 Assembly for Tension Test Parallel to Surface

26. Test Data and Report

26.1 Obtain maximum loads from which calculate the stress. If the failure is within ½ in. (12 mm) of either grip, disregard the test value. The report shall include maximum loads and the location and description of the failures.

27. Moisture Content

27.1 Determine the moisture content of each specimen as specified in Sections 9, 14 and 15.

TENSILE STRENGTH PERPENDICULAR TO SURFACE

28. Scope

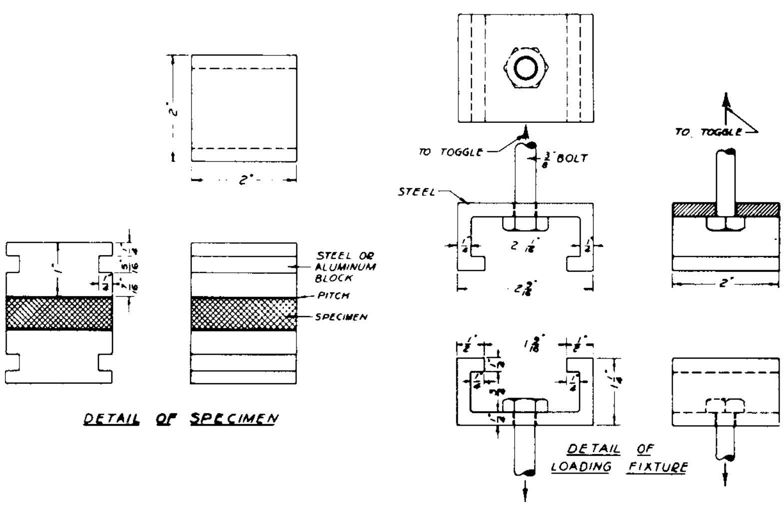
28.1 The test for tensile strength perpendicular to the surface shall be made on specimens in the dry condition to determine cohesion of the fiberboard in the direction perpendicular to the plane of the board.

NOTE 12—This test is included because of the increased use of fiberboards, hardboards, and particle boards where wood, plywood, or other materials are glued to the board, or where the internal bond strength of the board is an important property. Tests in the soaked condition shall be made if the material is to be used under severe conditions.

29. Test Specimen

29.1 The test specimen shall be 2-in. (50-mm) square and the thickness shall be that of the finished board. Loading blocks of steel or aluminum alloy 2-in. square and 1 in. (25 mm) in thickness shall be effectively bonded with a suitable adhesive (Note 13) to the 2-in. square faces of the specimen as shown in Fig. 5, which is a detail of the specimen and loading fixtures. Cross-sectional dimensions of the specimen shall be measured to an accuracy of not less than ±0.3 %. The maximum distance from the center of the universal joint or self-aligning head to the glued surface of the specimen shall be 3 in. (76 mm).

NOTE 13—Any suitable adhesive that provides an adequate bond may be used for bonding the specimen to the loading blocks. Epoxy resins are recommended as a satisfactory bonding agent. The pressure required to bond the blocks to the specimen will depend on the density of the board and the adhesive used, and should not be so great as to measurably damage the specimen. The resulting bond shall be at least as strong as the cohesive strength of the material perpendicular to the plane of the panel.



Metric Equivalents

in.	¼	5⁄16	3⁄8	7⁄16	½	¾	1¼	1 9⁄16	2	2 1⁄16	2 9⁄16
mm	6	7.5	9	10.5	12.7	19	31.7	39	51	52	64.3

FIG. 5 Detail of Specimen and Loading Fixture for Tension Test Perpendicular to Surface

30. Procedure

30.1 Engage the loading fixtures, such as are shown in Fig. 5, attached to the heads of the testing machine, with the blocks attached to the specimen. Stress the specimen by separation of the heads of the testing machine until failure occurs. The direction of loading shall be as nearly perpendicular to the faces of the specimen as possible, and the center of load shall pass through the center of the specimen.

31. Speed of Testing

31.1 Apply the load continuously throughout the test at a uniform rate of motion of the movable crosshead of the testing machine 0.08 in./in. (cm/cm) of thickness per min.

NOTE 14—It is not intended that the testing machine speed shall be varied for small differences in fiberboard thickness, but rather that it shall not vary more than ±50 % from that specified above (see Note 8).

32. Test Data and Report

32.1 Obtain maximum loads from which calculate the stress at failure. Calculate strength values in pounds per square inch (kilopascals), for which the measured dimensions of the specimen shall be used. Include the location of the line of failure in the report.

33. Moisture Content

33.1 Determine the moisture content of each specimen on a separate sample prepared from the same material, as specified in Sections 127 and 128.

COMPRESSION STRENGTH PARALLEL TO SURFACE

34. Scope

34.1 The test for compression strength parallel to the surface shall be made on specimens both in the dry and in the soaked condition. Tests shall be made of specimens both with the load applied parallel and perpendicular to the long dimension of the board to determine whether or not the material has directional properties.

34.2 Because of the large variation in character of wood-base fiber and particle panel materials and the differences in manufactured thicknesses, one procedure is not applicable for all materials. One of the three procedures detailed as follows shall be used depending on the character and thickness of the board being evaluated:

34.2.1 *Procedure A (Laminated Specimen)*, shall be used for materials ⅜ in. (10 mm) or more but less than 1 in. (25 mm) in nominal thickness, particularly when modulus of elasticity and stress at proportional limit are required. In this procedure when materials less than 1 in. in thickness are evaluated, two or three thicknesses shall be laminated to provide a nominal thickness of at least 1 in. but no amount more than that amount than necessary. The nominal size of the specimen shall be 1 by 4 in. (25 by 101 mm) (with the 4-in. dimension parallel to the applied force) by the thickness as laminated.

34.2.2 *Procedure B (Lateral Support)*, shall be used for materials less than ⅜ in. in thickness, particularly when modulus of elasticity and stress at proportional limit are required. Specimens shall be 1 by 4 in. by the thickness as manufactured and evaluations made in a suitable lateral support device. The 4-in. long dimensions shall be parallel to the applied force.

34.2.3 *Procedure C (Short Column)*, shall be used when maximum crushing strength only is required or where the thickness of the board material is 1 in. or more and either maximum crushing strength modulus of elasticity, and stress at proportional limit or only maximum crushing strength is required. When the material being evaluated is 1 in. or less in thickness, the width of the specimen shall be 1 in., the thickness shall be as manufactured, and the length (height as tested) shall be four times the thickness. When the material being evaluated is more than 1 in. in thickness, the width shall be equal to the nominal thickness and the length (height as loaded) shall be four times the nominal thickness.

35. Test Specimen

35.1 The test specimens shall be carefully sawed with surfaces smooth and planes at right angles to the faces of the boards as manufactured. For the laminated specimens (Procedure A), pieces of board at least 1 in. (25 mm) larger in length and width than the finished size of specimen shall be laminated using thin spreads of epoxy resin or other adhesive that does not contain water or other swelling agent (Note 15). Pressures shall not exceed 50 psi (343.2 kPa). Specimens shall be sawed from the laminated pieces after at least 8 h of curing of the resin at room temperature. The width and thickness shall be measured to at least the nearest 0.001 in. (0.025 mm). These two dimensions shall be used to calculate net cross-sectional area for modulus of elasticity, and stress at proportional limit and maximum load.

NOTE 15—An adhesive that contains water or other swelling agent might produce initial stresses adjacent to the glue lines.

36. Specimens Soaked Before Test

36.1 Specimens to be tested in the soaked condition shall be prepared in accordance with Section 13.

37. Procedure

37.1 Load the specimens through a spherical loading block, preferably of the suspended self-aligning type. Center them carefully in the testing machine in a vertical plane as shown in Fig. 6 (unsupported 4-in. (101-mm specimen)) and Fig. 7 (laterally supported pack device).[6] Apply loading at a uniform rate of head travel of the testing machine of 0.005 in. (0.12 mm)/in. of length/min.

NOTE 16—Speed of test therefore for the 4-in. specimen of Test Methods A and B shall be 0.020 in./min (see Note 8 for permitted variation in testing speed).

38. Load-Deformation Curves

38.1 When required, obtain load-deformation curves for the full duration of each test. Fig. 6 shows a Lamb's Roller Compressometer on an unsupported specimen. Fig. 7 shows a

[6] The lateral support device is detailed in Fig. 2 of Methods D 3501.

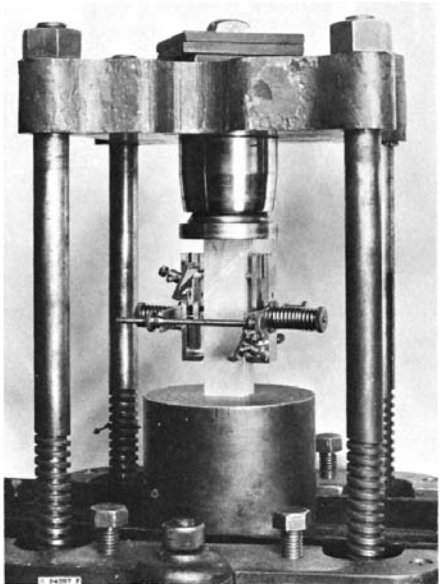


FIG. 6 Assembly for Compression Parallel to Surface Test of Unsupported Specimen

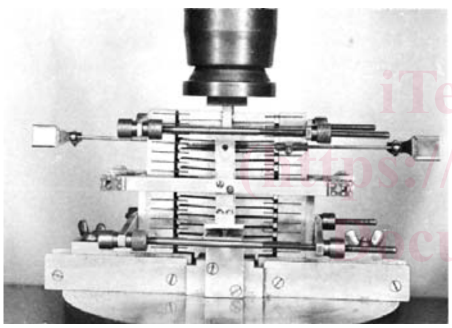


FIG. 7 Assembly for Compression Parallel to Surface Test of a Laterally Supported Specimen

Marten's Mirror Compressometer on a laterally supported specimen. Use these or equally accurate instruments for measuring deformation. Choose increments in loading so that not less than 12 and preferably at least 15 readings are obtained before proportional limit. Read deformation to the nearest 0.0001 in. (0.002 mm). Attach compressometers over the central portion of the length; points of attachment (gage points) shall be at least 1 in. (25 mm) from the ends of specimens.

39. Moisture Content and Specific Gravity

39.1 Use the entire compression parallel to surface specimen for moisture content determination except when the capacity of the drying oven is too small for convenient drying of the number of specimens being evaluated, when it will be permissible to dry short lengths. Weigh the specimen immediately before test and determine the moisture content and specific gravity for each specimen in accordance with Section 9.

40. Calculation and Report

40.1 The report shall indicate which procedure (laminated, laterally supported, or short column) was used. Calculate the values of modulus of elasticity, stress at proportional limit, and maximum crushing strength by using the measured cross-sectional dimensions of each specimen. Describe the type of failure.

LATERAL NAIL RESISTANCE TEST

41. Scope

41.1 Nail-holding tests shall be made to measure the resistance of a nail to lateral movement through a board. One half of the specimens shall be selected and positioned in test so that the movement of the nail will be perpendicular to the long dimension of the board for evaluation of directional properties. When general information is desired the sixpenny common nail or its equivalent should be used. For special applications, however, this procedure is adaptable to other sizes and types of fasteners.

NOTE 17—If this test is performed on some boards, the nail may bend and pull out of the stirrup. If this happens, the maximum load will be an apparent and not the true resistance of the board, and will only indicate that the resistance is some figure higher than the apparent value. When this happens it shall be noted.

NOTE 18—Values obtained from this test are dependent on the thickness of the specimen. Values, however, are not directly proportional to the thickness. For this reason values obtained from tests of different boards can only be compared exactly if the thicknesses are equal.

42. Test Specimen

42.1 Each specimen shall be 3 in. (76 mm) in width and of convenient length, and shall have a nail 0.113 in. (2.80 mm) in diameter (or as near thereto as possible) (Note 19) driven at right angles to the face of the board so that about an equal length of nail projects from each face. The nail shall be centered on the width and located ¼ , ⅜ , ½ , or ¾ in. (6, 9, 12, or 18 mm) (Note 20) from one end. Tests shall be made for all three edge distances for each material tested. The thickness of each specimen shall be measured to an accuracy of not less than ±0.3 %.

NOTE 19—A sixpenny common wire nail meets this requirement. In certain instances it may be more desirable to use a pointed steel pin of known hardness than the nail. The type of nail or pin used shall be described in the report.

NOTE 20—The edge distance is the distance from the center of the nail or other fastener to the edge of the board.

43. Specimens Soaked Before Test

43.1 Specimens to be tested in the soaked condition shall be prepared in accordance with Section 13, and the nails shall be driven before the specimens are soaked.

44. Method of Loading

44.1 Clamp the end of the specimen opposite to the end with the nail in a position parallel to the movement of the testing machine. Grip such as are suitable for tension tests parallel to the plane of the board are suitable. Engage the nail by the stirrup, and connect in turn to one platen of the testing machine by a rod. A typical test assembly for measuring the resistance of a nail in the lateral direction is shown in Fig. 8. The stirrup and connections are detailed in Fig. 9. For other types of fasteners, such as staples, modification of the stirrup may be necessary.

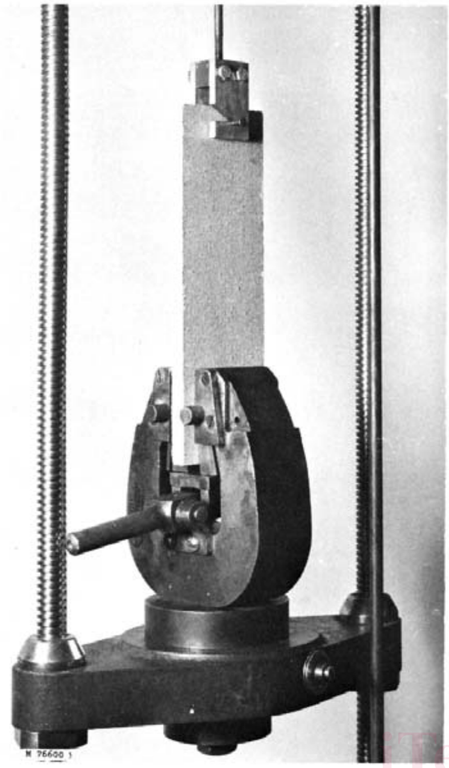


FIG. 8 Test Assembly for Measuring the Resistance of Nails to Lateral Movement

45. Speed of Testing

45.1 Load the specimen continuously throughout the test by separation of the heads of the testing machine at a uniform rate of crosshead speed of 0.25 in./min (6 mm/min) (see Note 8).

46. Test Data and Report

46.1 The load required to move the nail to the edge of the specimen shall be the measure of the lateral resistance. The maximum load and the nature of failure shall be included in the report.

NAIL WITHDRAWAL TEST

47. Scope

47.1 Nail-holding tests shall be made on nails driven through the specimen from face to face to measure the resistance to withdrawal in a plane normal to the face. When general information is desired the sixpenny common nail or its equivalent should be used. For special applications, however, this procedure is adaptable to other sizes and types of fasteners.

48. Test Specimen

48.1 The test specimen shall be of convenient size (at least 3 in. (76 mm) in width and 6 in. (152 mm) in length). Nails 0.113 in. (2.80 mm) in diameter shall be driven through the board at right angles to the face, and at least ½ in. (12 mm) of the shank portion shall project above the surface of the material. The thickness of each specimen shall be measured to an accuracy of not less than ±0.3 %.

NOTE 21—A sixpenny common wire nail meets this requirement. In certain instances it may be more desirable to use a pointed steel pin of known hardness than the nail. A head or other suitable end shall then be provided to engage the load-applying fixture and the nail or pin used shall be described in the report.

NOTE 22—Where the use of a particular nail or fastener requires less than ½ in. of shank projecting above the surface, then only sufficient length shall be left to permit engagement in the testing assembly.

49. Specimens Tested in the Dry Condition

49.1 When the tests are made in the dry state, the withdrawals shall be made immediately after the nails have been driven.

50. Specimens Soaked Before Test

50.1 Specimens to be tested in the soaked conditions shall be prepared in accordance with Section 13, and the nails shall be driven before the specimens are soaked.

51. Method of Loading

51.1 The assembly for the direct-withdrawal test is shown in Fig. 10. Attach the specimen-holding fixture to the lower platen of the testing machine. Insert the specimen in the fixture with the heads of the nails up, as shown. Engage the heads of the nails by the load-applying fixture equipped with a slot for easy attachment. This loading fixture shall be attached to the upper platen of the testing machine. Loads shall be applied by separation of the platens of the testing machine. The fitting is detailed in Fig. 11. For other types of fasteners, such as staples, modification of the loading fixture may be necessary.

52. Speed of Testing

52.1 Apply the load to the specimen throughout the test by a uniform motion of the movable head of the testing machine at a rate of 0.06 in./min (1.5 mm/min) (see Note 8).

53. Test Data and Report

53.1 The maximum load required to withdraw the nail shall be the measure of resistance of the material to direct nail withdrawal, and shall be included in the report.

NAIL-HEAD PULL-THROUGH TEST

54. Scope

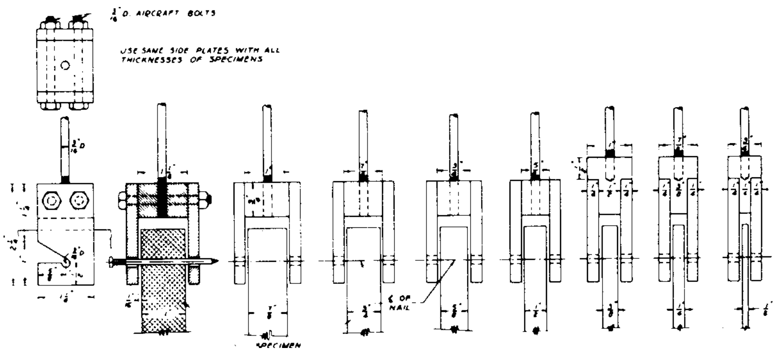
54.1 Nail-head pull-through tests shall be made to measure the resistance of a panel to having the head of a nail or other fastener pulled through the board. This test is to simulate the condition encountered with forces that tend to pull paneling or sheathing from a wall.

55. Test Specimen

55.1 The test specimen shall be of convenient size (at least 3 in. (76 mm) in width by 6 in. (152 mm) in length). Common wire nails 0.113 in. (2.80 mm) in diameter shall be driven through the board at right angles to the face with the nail head flush with the surface of the board (Note 23 and Note 24). The thickness of each specimen shall be measured to an accuracy of not less than ±0.3 %.

NOTE 23—A sixpenny common wire nail meets this requirement.

NOTE 24—For interior applications, the resistance to pull-through of a finishing nail may be preferred. For other applications, some special



Metric Equivalents

in.	1⁄16	1⁄8	3⁄16	3⁄8	1⁄2	5⁄8	3⁄4	7⁄8	1	1 1⁄8	1 1⁄4	2 1⁄4
mm	1.5	3	4.5	9	12.7	15	19	21	25.4	28	32	57

FIG. 9 Detail of Stirrups and Connections for Measuring the Resistance of Nails to Lateral Movement

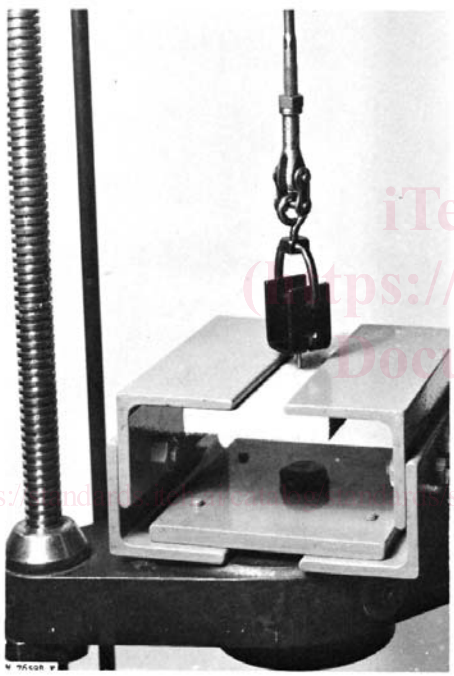
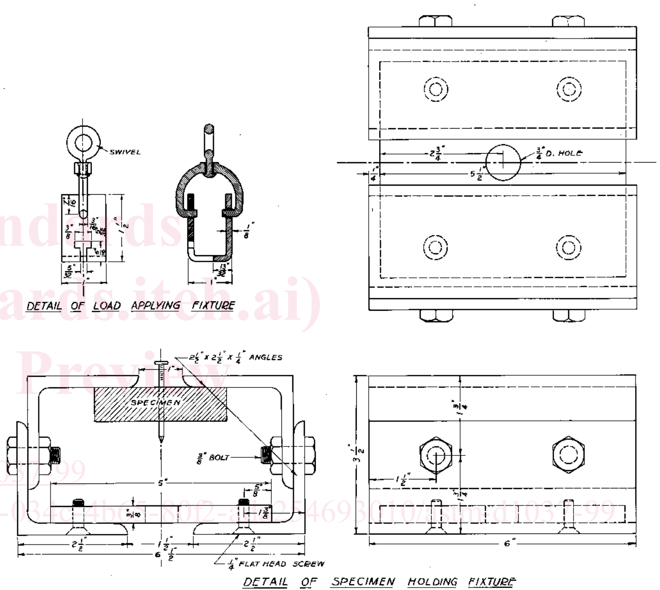


FIG. 10 Test Assembly for Measuring the Resistance of Nails to Direct Withdrawal



NOTE 1—1 in. = 25.4 mm.

FIG. 11 Details of Testing Equipment for Measuring the Resistance of Nails to Direct Withdrawal

fastener like a staple or roofing nail may be desired instead of a common nail. If for any reason a different fastener than the common nail is used, the report of the test shall describe the fastener actually used.

56. Specimens Tested in the Dry Conditions

56.1 When the tests are made in the dry state, the pullthrough shall be made immediately after the nails have been driven.

57. Specimens Soaked Before Test

57.1 Specimens to be tested in the soaked condition shall be prepared in accordance with Section 13, and the nails shall be driven before the specimens are soaked.

58. Method of Loading

58.1 Modify the assembly for the direct withdrawal test detailed in Fig. 11 by replacing the top pair of angles in the specimen-holding fixture with a 6-in. (152-mm) length of 6 by 2 1⁄4-in. (152 by 57-mm) American standard channel. The web of the channel shall have a 3-in. (76-mm) diameter opening centered in the web. The edge of this opening provides the support to the specimen during test. Center the specimen-holding fixture and attach it to the lower platen of the testing machine. Insert the specimen in the holding fixture with the point of the nail up. Grip the pointed end of the nail with a tension grip or "Jacob's-type drill chuck" which is attached to the upper platen of the testing machine with a universal joint or toggle linkage, to provide for automatic aligning. Apply loads by separation of the platens of the testing machine. For other types of fasteners than nails, it may be necessary to modify the chuck or tension-grip type of loading fixture.

59. Speed of Testing

59.1 Apply the load to the specimen throughout the test by a uniform motion of the movable head of the testing machine at a rate of 0.06 in./min (1.5 mm/min) (see Note 8).

60. Test Data and Report

60.1 The maximum load required to pull the head of the nail or other fastener through the board shall be the measure of resistance of the material to nail-head pull-through, and shall be included in the report. The report shall describe the type of fastener used and the failure.

DIRECT SCREW WITHDRAWAL TEST

61. Scope

61.1 Screw-holding tests shall be made on screws threaded into the board to measure the resistance to withdrawal in a plane normal to the face. For numerous applications, the withdrawal resistance of screws from the edge of the board is desired. When that value is required the screw withdrawal resistance in the plane parallel to the face shall be determined. When general information is desired for comparing the screw withdrawal resistance of a board with another board or material, the No. 10, 1-in. (25-mm) Type AB sheet metal screw (Note 25) shall be used. For special applications, however, this procedure is adaptable to other sizes and types of screws.

62. Test Specimen

62.1 *Withdrawal Perpendicular to the Plane of the Board*—The test specimen shall be at least 3 in. (76 mm) in width by 4 in. (102 mm) in length. The thickness of the specimen shall be at least 1 in. (25 mm) unless other considerations make it desirable to test with the thickness as manufactured because local bending of the board at withdrawal may affect test results. If necessary, glue up two or more thicknesses of the board to arrive at the 1-in. minimum thickness. One-inch, No. 10 Type AB sheet metal screws (Note 25) shall be threaded into the specimen ⅔ in. (17 mm). Lead holes shall be predrilled using a drill 0.125 in. (3.2 mm) in diameter (Note 27).

62.2 *Withdrawal from the Edge of the Board*—The test specimen shall be 3 in. (76 mm) in width by at least 6 in. (152 mm) in length and the thickness of the board as manufactured (Note 26). One half of the test specimens shall be prepared with the long dimension parallel and the other half with the long dimension perpendicular to the long dimension of the board in order to evaluate directional properties. A 1-in., No. 10 Type AB sheet metal screw (Note 25) shall be threaded into the edge of the board at midthickness ⅔ in. (17 mm). Lead holes shall be predrilled using a drill 0.125 in. (3.2 mm) in diameter (Note 27).

NOTE 25—Number 10 Type AB screws should have a root diameter 0.138 $\pm$ 0.003 in. (3.51 $\pm$ 0.1 mm) and a pitch of 16 threads per inch.

NOTE 26—In some applications where several thicknesses of hardboard or the thinner particle board are laminated together, it may be desirable to obtain the edge withdrawal resistance of a laminated board. When this is done, the specimen shall be laminated from an odd number of thicknesses and the screws shall be located at the midthickness of the center laminate.

NOTE 27—It is recognized that some other lead hole diameter may give higher withdrawal resistance values for some densities and kinds of board. Departures from this size of lead hole are permitted, but diameter used shall be reported.

63. Specimens Tested in the Dry Condition

63.1 When the tests are made in the dry state, the withdrawals shall be made immediately after the screws have been embedded.

64. Specimens Soaked Before Test

64.1 Specimens to be tested in the soaked condition shall be prepared in accordance with Section 13, and the screws shall be embedded before the specimens are soaked.

65. Method of Loading

65.1 The assembly for the direct screw withdrawal is the same as shown for direct nail withdrawal in Fig. 10. Attach the specimen-holding fixture to the lower platen of the test machine. Insert the specimen in the fixture with the heads of the screws up as shown. Engage the heads of the screws by the load-applying fixture equipped with a slot for easy attachment. Attach this loading fixture to the upper platen of the testing machine. Apply loads by separation of the platens of the testing machine.

66. Speed of Testing

66.1 Apply the load to the specimen throughout the test by a uniform motion of the movable head of the testing machine at a rate of 0.6 in./min (15 mm/min) (see Note 8).

67. Report

67.1 The report shall include the following:

67.1.1 Diameter of lead hole actually used, indicating both type and size of screw,

67.1.2 Any departures for other size of fastener,

67.1.3 Type of withdrawal, differentiated as surface (withdrawal perpendicular to the plane of the board) or edge (withdrawal parallel to the plane of the board) resistance,

67.1.4 Thickness of the board as actually tested, and

67.1.5 If the screw is broken rather than withdrawn, it shall be noted and the test value shall not be included in those values presented in the reports as values of withdrawal.

HARDNESS TEST

68. Scope

68.1 The modified Janka ball test shall be used for determining hardness.

69. Test Specimen

69.1 Each specimen shall be nominally 3 in. (75 mm) in width and 6 in. (150 mm) in length and at least 1 in. (25 mm) thick. Because most boards are manufactured in thicknesses of less than 1 in. (25 mm), the specimen for test shall be made by bonding together several layers of the panel to make the required thickness. A rubber cement or other suitable flexible adhesive shall be used. The finished specimen shall be trimmed