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# Standard Specification for Adhesives Used for Finger Joints in Nonstructural Lumber Products<sup>1</sup>

This standard is issued under the fixed designation D5572; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification establishes performance levels for adhesives to be used in finger joints in nonstructural bonded-lumber products. Such products include, but are not limited to, interior and exterior mouldings, window and door components or parts, and bonded-lumber panels. Adhesives that meet the requirements of the various performance classes are considered capable of providing an adequate bond for use under the conditions described for the class. This specification is to be used to evaluate adhesives as well as the adhesive bonds in the finger joints. See Section 5, Significance and Use, for limitations when using this specification to evaluate industrially manufactured finger joints.

NOTE 1—This specification supersedes the finger-joint portion of the 1990 edition of Specification D3110.

1.2 The following index is provided as a guide to the test methods in this specification:

	Section
Apparatus	6
Equipment, Material, and Preparation of Assemblies and Specimens	7
Conditioning for Factory-Manufactured Assemblies, Laboratory-Made Assemblies, and Test Specimens	8
Testing in Flexure	9
Testing in Tension	10
Exposure Conditions and Treatments	11
1. Dry Use Tests: Dry, 3-cycle Soak, Elevated Temperature, and Temperature-Humidity	11.1
2. Wet Use Tests: Dry, Boil, Elevated Temperature, and Vacuum-Pressure	11.2

NOTE 2—The conditioning needed for various stages in the preparation of both types of specimens and for the exposure tests are given.

NOTE 3—Specific guidelines for specimen size, exposure conditions, testing, calculation, and reporting are given for flexure specimens in Sections 9 and 11, and for tension specimens in Sections 10 and 11.

1.3 For the definitions of *dry use* and *wet use*, see 3.2.1.1 and 3.2.1.2.

1.4 The values stated in inch-pound units are to be regarded as standard. The SI units given in parentheses are for information only.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D14 on Adhesives and is the direct responsibility of Subcommittee D14.30 on Wood Adhesives.

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1.5 The following precautionary caveat pertains only to the apparatus and test methods portions, Sections 6-11 of this specification: *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:<sup>2</sup>

- D143 Test Methods for Small Clear Specimens of Timber
- D907 Terminology of Adhesives
- D2016 Methods of Test for Moisture Content of Wood (Withdrawn 1987)<sup>3</sup>
- D3110 Specification for Adhesives Used in Laminate Joints for Nonstructural Glued Lumber Products (Withdrawn 1996)<sup>3</sup>
- D4688 Test Method for Evaluating Structural Adhesives for Finger Jointing Lumber
- D5266 Practice for Estimating the Percentage of Wood Failure in Adhesive Bonded Joints
- E4 Practices for Force Verification of Testing Machines
- E6 Terminology Relating to Methods of Mechanical Testing
- E41 Terminology Relating To Conditioning
- E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
- E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

## 3. Terminology

### 3.1 Definitions:

- 3.1.1 Many terms in this specification are defined in Terminology D907 and Terminology E41.
- 3.1.2 *bond, n*—the union of materials by adhesives.
- 3.1.3 *finger joint, n*—a joint formed by bonding two precut members shaped like fingers. (See Figs. 1 and 2.)

<sup>2</sup> 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.

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

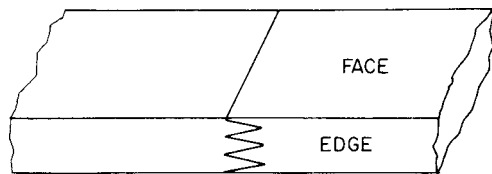


FIG. 1 Horizontal Joint

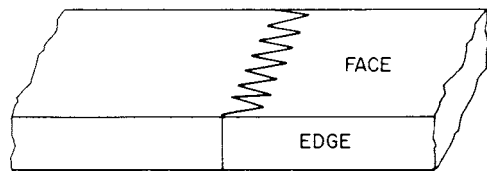


FIG. 2 Vertical Joint

3.2 Definitions of Terms Specific to This Standard:

3.2.1 nonstructural adhesive:

3.2.1.1 dry use nonstructural adhesive, *n*—an adhesive capable of producing sufficient strength and durability to make the bonded lumber product serviceable in nonstructural use, under conditions in which the equilibrium moisture content (EMC) of the wood does not exceed 16 %.

3.2.1.2 wet use nonstructural adhesive, *n*—an adhesive capable of producing sufficient strength and durability to make the bonded lumber product serviceable in nonstructural use, under conditions in which the EMC of the wood may be 16 % or greater.

3.3 Abbreviations:

3.3.1 EMC—equilibrium moisture content.

3.3.2 MC—moisture content.

4. Test Requirements

4.1 Adhesives:

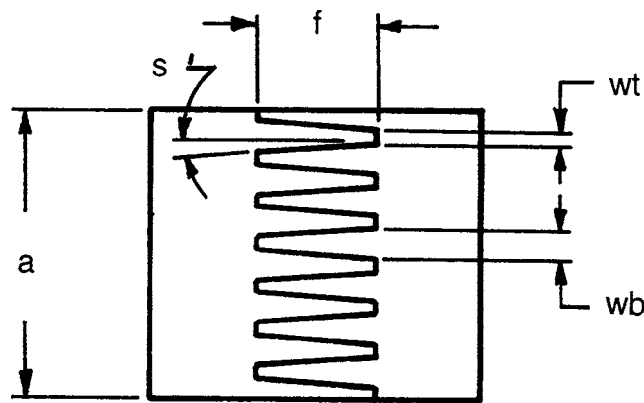
4.1.1 To comply with this specification the test adhesive shall be tested for performance in accordance with Sections 8.1.1-11, and it shall meet the requirements in Table 1 for the selected testing mode and performance classification.

4.1.2 Compliance with this specification shall warrant certification of the adhesive for use on the species of wood that is used for the tests, or for use on a designated group of species when tested and found to be in compliance for any one member of said group of species. The designated species groupings for commonly used domestic and imported woods, as accepted in this specification, are given in Table 2. In the event that the user or supplier of the adhesive, or both, cannot accept the designated groupings in Table 2, either party shall have the option of requesting a test on an individual species. Furthermore, the user and supplier may agree to change any of the wood-failure requirements of Table 1 when applied to tests on Groups 3 and 4 hardwoods from Table 2. For wood-property information on imported woods, see the *Wood Handbook*.<sup>4</sup>

4.1.2.1 The wood-failure requirements listed in Table 1 are given for softwoods and hardwoods. Table 1 shows that the

wood-failure requirements for hardwood are 50 % of the requirements for softwoods.

4.2 Industrially Manufactured Finger Joint—An industrially manufactured finger joint may be used to evaluate the adhesive, provided its construction meets the requirements set forth in Sections 7-10, and the joint is tested against the requirements in Table 1.



Example Dimensions for Fig. 3 Test Standard Finger Joint:

Code	Dimensions, in. (mm) <sup>A</sup>	Degrees
a	1.312 (33.32)	...
f	0.250 (6.25)	...
wt	0.047 (1.19)	...
wb	0.092 (2.34)	...
s (Slope)		5°

<sup>A</sup> The dimensions given are for a typical horizontal finger joint and are examples only.

FIG. 3 Test Standard Finger-Joint Form

5. Significance and Use

5.1 Adhesives are classified as dry use or wet use. Each classification includes consideration of short-term in-transit exposure conditions at elevated temperatures up to 220°F (104°C).

5.2 The initial development of Specification D3110 was based on finger-joint assemblies made under controlled laboratory conditions. In the development of this revised specification the results obtained with laboratory-made specimens (see 12.1.2) were compared to those obtained with industrially manufactured specimens (see 12.1.1). These finger joints were prepared using previously certified adhesives in cooperation with a manufacturer or equipment supplier who had the necessary finger-joint cutter and assembly equipment. These finger joints may vary in geometry and length from manufacturer to manufacturer, and this variation could affect the performance of the bonded-finger-joint assembly.<sup>5</sup> (See 12.1, 12.4, and 12.5.) Fig. 3 depicts a sample finger-joint configuration.

5.2.1 When changes are made in the design of the industrially manufactured finger joint, the new design should be compared to a control design that has been used successfully.

<sup>4</sup> U.S. Department of Agriculture Forest Service; Agricultural Handbook, No. 72, *Wood Handbook*, Tables 3 and 4, 1987 edition, pp. 3-11.

<sup>5</sup> Selbo, M. L., "Effects of Joint Geometry on Tensile Strength of Finger Joints," *Forest Products Journal*, Vol 13, No. 9, September 1963, pp. 390-400.

**TABLE 1 Minimum Test Requirements**

Performance Classification and Exposure Conditions <sup>A</sup>	Subsection Number for Exposure Description	Testing Mode Tension <sup>B</sup>				Testing Mode Flexure	
		Strength, psi (MPa) <sup>C</sup>	Wood Failure <sup>D</sup>		Modulus of Rupture <sup>C</sup>		
			Group Average <sup>E</sup>			Individual Minimum <sup>F</sup>	
			%				Minimum psi (MPa) <sup>G</sup>
		Soft Wood	Hard Wood <sup>H</sup>	Soft Wood	Hard Wood <sup>H</sup>		
<b>Dry Use:</b>							
Cured (dry)	11.1.1	2000 (13.8)	60	30	30	15	2000 (13.8)
Three-cycle soak	11.1.2	1000 (6.9)	30	15	15	/	1000 (6.9)
Elevated Temperature ((220°F (104°C))	11.1.3	1000 (6.9)	/	/	/	/	/
Temperature-Humidity ((140°F (60°C), 16 % EMC))	11.1.4	750 (5.2)	/	/	/	/	/
<b>Wet Use:</b>							
Cured (dry)	11.2.1	2000 (13.8)	60	30	30	15	2000 (13.8)
Boil	11.2.2	1600 (11.0)	50	25	25	/	1400 (9.7)
Elevated Temperature ((220°F (104°C))	11.2.3	1000 (6.9)	/	/	/	/	/
Vacuum Pressure	11.2.4	1600 (11.0)	50	25	25	/	1400 (9.7)

<sup>A</sup> Twenty specimens required for each classification and exposure.

<sup>B</sup> Parallel to the grain.

<sup>C</sup> Tension and flexure results may vary with the species. Any acceptable wood should produce joints able to meet these requirements.

<sup>D</sup> The wood-failure requirements are given for softwoods and hardwoods. Groups 3 and 4 hardwoods are listed at 50 % of the softwood value, with no wood-failure requirement if the calculation is 15 % or less. (See 4.1.2.)

<sup>E</sup> For total group of specimens tested.

<sup>F</sup> For 90 % of the specimens tested, they shall meet or exceed these minimum wood-failure values shown. If a zero value is obtained for any of the specimens (the specimen must meet the strength requirement).

<sup>G</sup> For any individual specimen.

<sup>H</sup> See recommended minimum specific gravity in Table 2.

<sup>I</sup> No requirement.

5.3 An industrially manufactured finger joint should be evaluated using the requirements for compliance with this specification, in accordance with 4.1. When this specification is used to evaluate specimens made from field-manufactured assemblies, the results may not compare favorably with those run on specimens made from laboratory-made assemblies.

5.4 Test requirements are provided to determine if the adhesive is suitable for dry use or wet use.

5.5 The dry test and exposure conditions and treatments are to evaluate adhesives used in nonstructural finger joints for typical service conditions.

5.5.1 The 220°F (104°C) test, a more severe test, is designed to evaluate the product after exposure to short-term elevated-temperature conditions. This test is intended to simulate conditions that might be experienced in transit, further processing, or in-service conditions.

NOTE 4—These typical service conditions could include stress and time under stress, as well as elevated temperature.

5.6 Procedures are described in sufficient detail to permit duplication in different testing laboratories.

5.6.1 Record any deviations in these procedures on the report forms, Appendix X1, as it may have an impact on the results obtained. Test data are only valid for the length and design used. (See 12.4.)

5.7 To avoid potential problems that would be caused by interrupting the bonding process, the adhesive-performance level should be determined by the finger-joint manufacturer prior to handling and early shipment. Before beginning the full

testing process, the testing laboratory should pull a representative sample and check the dry strength first, in order to ensure that the product basically conforms with the performance level certified by the adhesive manufacturer.

## TEST METHODS

### 6. Apparatus

NOTE 5—The finger-joint specimens to be broken in tension are shorter than those to be broken in flexure. Accommodation must be made in the equipment for handling the larger flexure specimen.

6.1 *Environmental Chamber (For Moist-Heat Aging)*, capable of conditioning specimens at  $80 \pm 5^\circ\text{F}$  ( $27 \pm 3^\circ\text{C}$ ) and  $80 \pm 5\%$  relative humidity and capacity for at least 20 specimens well-spaced and supported on racks to allow free air flow.

6.2 *Oven(s)*, with sufficient air circulation to remove moisture from the chamber, and capable of meeting all the following temperature requirements:  $105 \pm 5^\circ\text{F}$  ( $41 \pm 3^\circ\text{C}$ ) (see 11.1.2);  $220$  and  $230 \pm 5^\circ\text{F}$  ( $104$  and  $110 \pm 3^\circ\text{C}$ ) (see 11.1.3 and 11.2.3);  $150 \pm 2^\circ\text{F}$  ( $65 \pm 1^\circ\text{C}$ ) (see 11.1.4); and  $145 \pm 5^\circ\text{F}$  ( $63 \pm 3^\circ\text{C}$ ) (see 11.2.2).

6.3 *Tank for Soaking*, capacity to meet the requirements of 11.1.2, so that all of the specimens are at least 2 in. (50.8 mm) below the water level for the duration of the soak cycles.

6.4 *Tank for Boiling*, capacity to meet the requirements of 11.2.2, so that all of the specimens are at least 2 in. (50.8 mm) below the water level for the duration of the boil cycles.

**TABLE 2 Bondability Groupings of Commonly Used Domestic and Imported Wood<sup>A</sup>**

U.S. Hardwoods	U.S. Softwoods	Imported Woods	
<b>Group 1—Bond Easily<sup>B</sup></b>			
Alder	Cedar, incense	Balsa	Hura
Aspen	Fir:	Cativo	Purpleheart
Basswood	White	Courbaril	Roble
Cottonwood	Grand	Determa <sup>C</sup>	
Chestnut, American	Noble		
Magnolia	Pacific		
Willow, black	Pine:		
	Eastern white		
	Western white		
	Redcedar, western		
	Redwood		
	Spruce, Sitka		
<b>Group 2—Bond Well<sup>D</sup></b>			
Butternut	Douglas-fir	Afrormosia	Meranti (lauan):
Elm:	Larch, western <sup>E</sup>	Andiroba	White
American	Pine:	Angelique	Light red
Rock	Sugar	Avodire	Yellow
Hackberry	Ponderosa	Banak	Obeche
Maple, soft	Redcedar, eastern	Iroko	Okoume
Sweetgum		Jarrah	Opepe
Sycamore		Limba	Peroba rosa
Tupelo		Mahogany:	Sapele
Walnut, black		African	Spanish-cedar
Yellow-poplar		True	Sucupira
			Wallaba
<b>Group 3—Bond Satisfactory<sup>F</sup></b>			
Ash, white	Alaska-cedar	Angelin	Meranti (lauan), dark red
Beech, American	Port-Orford-cedar	Azobe	Pau marfim
Birch:	Pine, southern	Benge	Parana-pine
Sweet		Bubinga	Pine:
Yellow		Karri	Caribbean
Cherry			Radiata
Hickory:			Ramin
Pecan			
True			
Madrone			
Maple, hard			
Oak:			
Red <sup>C</sup>			
White <sup>C</sup>			
<b>Group 4—Bond With Difficulty<sup>G</sup></b>			
Osage-orange		Balata	Keruing
Persimmon		Balau	Lapacho
		Greenheart	Lignumvitae
		Kaneelhart	Rosewood
		Kapur	Teak

<sup>A</sup> From *Wood Handbook*<sup>7</sup> Table 9-1 (with the species incense cedar added to Group 1) U.S. Forest Service, USDA, Washington, DC. Although this table is of historical significance, it is recognized that more modern adhesives might lead to different species groupings in regard to difficulty of bonding. The user is referred to 5.2.

<sup>B</sup> Bond very easily with adhesives of a wide range of properties and under a wide range of bonding conditions.

<sup>C</sup> Difficult to bond with phenol-formaldehyde adhesive.

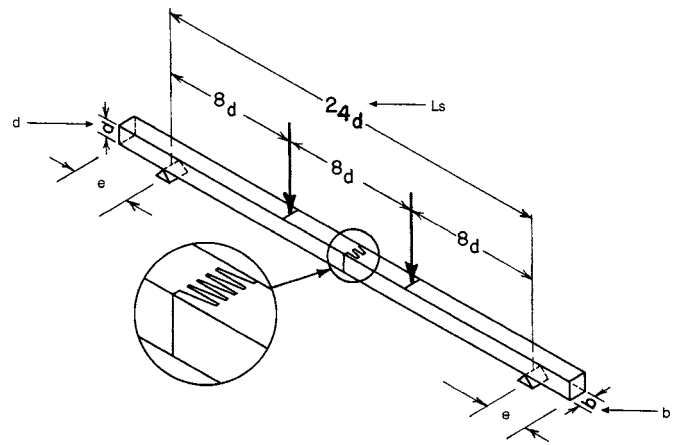
<sup>D</sup> Bond well with a fairly wide range of adhesives under a moderately wide range of bonding conditions.

<sup>E</sup> Wood from butt logs with high extractive content are difficult to bond.

<sup>F</sup> Bond satisfactorily with good-quality adhesives under well-controlled bonding conditions.

<sup>G</sup> Satisfactory results require careful selection of adhesives and very close control of bonding conditions; may require special surface treatment.

6.5 *Testing Machine for the Flexure Specimen*, capacity of not less than 2200 lbf (1000 kgf) in compression, equipped for one-third span, two-point loading as described in 9.5 and shown in Fig. 4, capable of maintaining a uniform rate of loading such that the load may be applied with a continuous



Example Dimensions for Fig. 4 Flexure Test Specimen:

Code	Dimension, in. (mm) <sup>A</sup>
Ls	12.0 (307.2)
b	0.75 (19.2)
d	0.5 (12.8)
e	(see 9.2.1)

<sup>A</sup> These dimensions are given as examples of a finger-joint assembly. Use the actual measurements of “b” and “d.” Code “b” may be the width of a vertical joint, or the thickness of a horizontal joint. Code “e” is the extended dimension of the length of the assembly that falls outside the reaction points.

FIG. 4 Flexure Test Form and Dimension

motion of the movable head to maximum at a rate of 0.5 in. (11.7 mm)/min with a permissible variation of ±10 %, and located in an atmosphere such that the moisture content of the specimens developed under the conditions prescribed in Section 11 is not noticeably altered during testing.

6.6 *Testing Machine for the Tension Specimen*, capable of applying a calibrated tensile force, equipped with grips of sufficient length to hold the specimen firmly, preferably a minimum length of 2.5 in. (63.5 mm) by a width of 0.75 in. (19 mm), and capacity of both test machine and grips of not less than 2200 lbf (1000 kgf).

NOTE 6—Depending on the design and adaptability, the same machine with a 2200-lbf (1000-kgf) capacity, described in 6.5 for the flexure testing, can be used for the tension test described in 6.6. (See Practices E4 and Terminology E6.)

6.7 *Vacuum-Pressure Vessel*, capable of meeting the requirements of 11.2.4, and capacity to meet the requirement that all of the specimens are at least 2 in. (50.8 mm) below the water level for the duration of the complete vacuum-pressure cycles.

## 7. Preparation of Finger Joint

7.1 *Equipment*—Prepare the finger-joint assemblies in cooperation with a wood-products manufacturer, an equipment manufacturer, or a laboratory having all of the proper equipment.

### 7.2 Preparation of Assemblies:

7.2.1 *Material*—Use lumber that conforms to the requirements: maximum slope of grain of 1 in 14 on any face or edge; EMC of 8 to 12 %, preferably brought to 10 to 12 % MC prior to cutting and bonding; free of knots and decay; free of machining defects such as chipped grain, feed-roll polish,

coarse knife marks, and feed-roll compression; free of drying effects, such as case hardening, collapse, or splits or checks. Recommended minimum specific gravities are given in **Table 3**. Finger joints are to be cut on the day the assemblies are to be made. See **4.1.2** for species compliance rules relative to testing, and **Table 2** for information on the bondability of some species of wood.

**7.2.2 Adhesive**—Follow the adhesive manufacturer’s instructions for conditions and procedures for preparing and applying the adhesive, as well as for assembling, pressing, and curing the assembly.

**7.2.3 Number of Specimens**—For each unique combination of specimen type, mode of testing, and exposure condition, a test group consists of 20 specimens, representing at least four different assemblies with no more than five specimens from each assembly.

**8. Conditioning**

**8.1 Measuring Moisture Content**—There are several stages in this test method where it is necessary to determine the MC as follows: on the lumber before bonding, on the assemblies before cutting into specimens, and on the specimens during several tests when they must be dried to a given MC before testing.

**8.1.1 Factory-Manufactured Assemblies**—When constructing the assemblies, select lumber within the range from 10 to 12 % MC before bonding, (see **7.2.1**). Determine the MC by use of an electronic moisture meter, in accordance with Test Method B in Methods **D2016**. After bonding the assemblies in the field, control the MC of the specimens throughout the testing process as shown in **8.1.2.1** and **8.1.3** for laboratory-made specimens.

**8.1.2 Laboratory-Made Assemblies**—Select lumber as described in **7.2.1**, except determine the MC of the lumber by Test Method A, Oven-Dry; or by Test Method B, Electronic Moisture Meter Method, of Methods **D2016**, when agreement within ±1 % MC with Test Method A has been determined.

**8.1.2.1** If needed, condition the assemblies to the original MC, ± 1 % MC, by use of an environmental chamber (see **6.1**) prior to cutting the specimens.

**8.1.3 Specimen Conditioning During the Testing Process**—The allowable variation in MC at the completion of a drying cycle or before testing dry is ±1 % MC. For example, if the MC of the specimen before exposure is 9 %, the acceptable range for testing is 8 to 10 %. Wood failure is estimated on

specimens after they have been conditioned to less than 8 %, except for the dry test described in **11.1.1** and **11.2.1**, where the specimens have never been taken from the dry state. Wood failure may be read on these test specimens following the strength testing, with no further conditioning to reduce MC.

**9. Testing in Flexure**

**9.1 Conditioning**—Follow instructions in Section **8**.

**9.2 Preparation of Test Specimen:**

**9.2.1 Form and Dimension**—From a finger-jointed assembly (see **7.2**), cut the flexure-test specimens with sufficient length for the joint to be centered at midspan as in **Fig. 4**, and with a distance between reaction points of 24 multiplied by the depth, *d*. Allow at least 1 in. (25 mm) at both ends of the specimen outside the reaction points. On each edge of the specimen, feather out the finger at the midpoint of the joint, adjusting the width of the specimen accordingly. (See **Fig. 5**.)

NOTE 7—In this application, “to feather” means to remove any portion extending beyond the normal surface of the outer finger so that the stress riser (butt joint effect) is not present on the surface. See **Fig. 5**.

**9.3 Exposure Conditions**—Subject the specimens to the tests for the selected wet-use or dry-use classification, or both, in accordance with the applicable conditions and treatments given in Section **11**. Consult **Table 1** for the tests required for each testing mode and performance classification.

**9.4 Testing Machine**—See **6.5**.

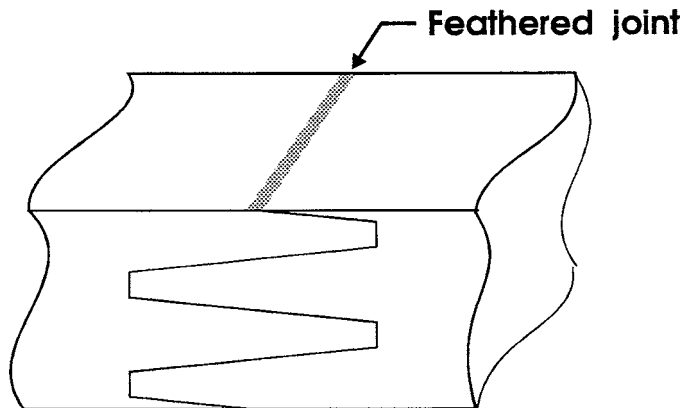
**9.5 Testing Procedure**—Apply the load with a continuous motion of the movable head at a rate of 0.5 in. (12.7 mm)/min (±10 %), testing the specimens by one-third span, two-point loading with the load applied perpendicular to the face showing the fingers, as shown in **Fig. 4**.

**9.6 Calculation**—Calculate the modulus of rupture in pounds-force per square inch or kilopascals as follows:

$$R = Pl/bd^2 \tag{1}$$

where:

- R* = modulus of rupture, psi (MPa),
- P* = maximum load, lbf (N),
- l* = length of span (24*d*), in. (mm),
- b* = breadth of specimen, in. (mm), and
- d* = depth of specimen, in. (mm).

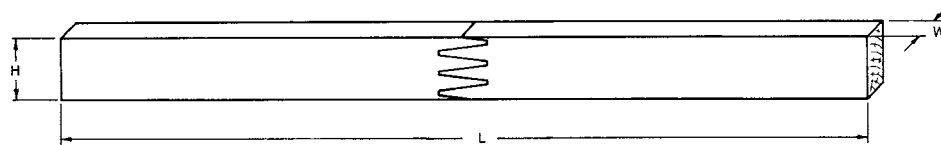


**FIG. 5 Feathered Finger Joint**

**TABLE 3 Recommended Minimum Specific Gravities by Species**

Species	Specific Gravity <sup>A,B</sup>
Douglas Fir, East	0.48
Douglas fir, Interior South	0.46
Cedar, Alaska	0.44
Fir, White	0.39
Hemlock, Western	0.45
Larch, Western	0.52
Pine, Lodgepole	0.41
Pine, Loblolly	0.51
Pine, Ponderosa	0.40

<sup>A</sup> Values have been taken from Table 4-2, *Wood Handbook*.<sup>7</sup>  
<sup>B</sup> Values are averages based on oven-dry weight and volume at 10 to 12 % moisture content.



Example Dimensions for Fig. 6:

(L)	10 in. (254.0 mm) <sup>A,B</sup>
(H)	0.75 in. (19.05 mm)
(W)	0.25 in. (6.35 mm)

<sup>A</sup> The dimensions are given as examples only.

<sup>B</sup> The recommended length is 10 in. Some testing machines cannot accommodate this length. See Note 7.

FIG. 6 Tension Test Multifinger Form and Dimension

9.7 *Report*—Report the modulus of rupture values on the form shown in Fig. X1.1 for dry use and wet use. Also, report the wood species used for testing, indicate whether it is classified as soft wood or hard wood, and report the slope of the finger in degrees. Report the measurements for *b* and *d*, to the nearest 0.01 in. (0.25 mm) for each specimen. Fig. X1.1 also includes spaces for the recording of several items of bonding information that, although not required for test reporting, have been found useful in product quality control.

## 10. Testing in Tension

10.1 *Conditioning*—Follow the instructions in Section 8.

10.2 *Preparation of Test Specimen:*

10.2.1 *Form and Dimensions*—From a finger-jointed assembly, cut the tension test specimens, with each measuring 0.25 by 0.75 ± 0.01 in. (6.35 by 19.05 ± 0.25 mm), with a recommended length of 10 in. (25.4 cm). Trim the outer fingers of the specimen as described in Note 7 and as shown in Fig. 5, a process known in this specification as “feathering.” (See 9.2.1 and Note 7.)

NOTE 8—Fig. 6 illustrates a sample finger-joint configuration. Ten inches (25.4 cm) is the preferred length, but shorter lengths may be necessary to accommodate certain testing machines. (See 5.5.1.)

10.3 *Exposure Conditions*—Follow the instructions in Section 11. See Table 1 for the tests required for each testing mode and performance classification.

10.4 *Testing Machine*—See 6.6.

10.5 *Testing*—Apply the load at a rate of 0.5 in. (12.7 mm)/min.

10.6 *Calculation*—Calculate the ultimate tensile stress in pounds-force per square inch or megapascals based on tensile breaking load and the cross-sectional area at the finger joint.

10.7 *Report*—Report the tensile-stress values together with the estimated percentages of wood failure on the form shown in X1.2 for dry use or X1.3 for wet use. Indicate whether the assemblies were field-manufactured or laboratory-made. Also, report the wood species and indicate whether it is classified as soft wood or hard wood. Report the slope of the finger in degrees and the dimensions to the nearest 0.01 in. (0.25 mm) for each specimen: length of the finger (*f*), width of the finger at the tip (*wt*), and width of the finger at the base (*wb*). See Fig. 3.

10.7.1 Estimate the wood failure on the finger joints by eye to the nearest 5 %. In addition, the mode and location of failure may be noted, that is, as wood failure away from the joint, through the tips, or following the fingers. See Appendixes X6 and X7 for guidelines on reading wood failure.

## 11. Exposure Conditions and Treatments

NOTE 9—Due to the number of specimens to be tested and the type of tests that must be run, there may not be sufficient time to run all the specimens at one time in the time allotted. So that the time schedule may be followed, before running the tests in 11.1.3, 11.2.2, 11.2.3, and 11.2.4, determine whether 1 h is enough time to test 20 specimens. If not, divide the specimens into smaller groups before running the exposure tests.

11.1 *Dry Use*—The exposure conditions and treatments used with each testing mode to meet the dry-use classification requirements are listed in Table 1. See 8.1.3 for information on allowable MC when testing the specimens. See 10.7.1 for instructions on reading wood failure. Details of the test methods are given as follows:

11.1.1 *Dry Test*—Following the prescribed curing period for the adhesive being tested, condition or dry one group of the specimens (see 7.2.2) to within the allowable range of ±1 % MC of the original MC (see 8.1.3), and test in accordance with the instructions in 9.5 or 10.5.

11.1.2 *Soak Test (Three Cycle)*—Place one group of the specimens (see 7.2.2) in the soak tank, separated by stickers, wire screens, or other means, in such a manner that all surfaces are freely exposed to the water. Weight down the specimens in water at 65 to 80°F (19 to 27°C) so that all specimens are at least 2 in. (50.8 mm) below the surface of the water. Keep the specimens immersed for a period of 4 h, followed by drying at a temperature of 105 ± 5°F (41 ± 3°C) for a period of 19 h, with sufficient air circulation to reduce the moisture content of specimens to within ±1 % MC of the original MC as described in 8.1.3. Repeat this procedure twice more for a total of three cycles. Following the third cycle, conduct the tests in the dry condition at 75 ± 5°F (24 ± 3°C). If needed before testing and reading wood failure, condition or dry to less than 8 % MC, in an environmental chamber. (See 8.1.3.) Use of an electronic moisture meter, as described in 8.1.1, is acceptable to determine MC.

11.1.3 *Elevated Temperature Test*—Use either of the following test methods:

11.1.3.1 *Test Method Number One*—Place one group of specimens (see 7.2.3) in an oven at 220 ± 5°F (104 ± 3°C) and