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Specifications for adhesives used for finger joints in non-structural lumber products

Spécifications pour des adhésifs utilisés pour des aboutages dans des produits en bois non structuraux

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 17087 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

Based with permission of ASTM, on ASTM D 5572, *Standard Specification for Adhesives Used for Finger Joints in Nonstructural Lumber Products*.

Specifications for adhesives used for finger joints in non-structural lumber products

1 Scope

This International Standard specifies 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 intended to be used to evaluate adhesives as well as the adhesive bonds in the finger joints.

2 Normative references

The following referenced documents are indispensable for the application of this International Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

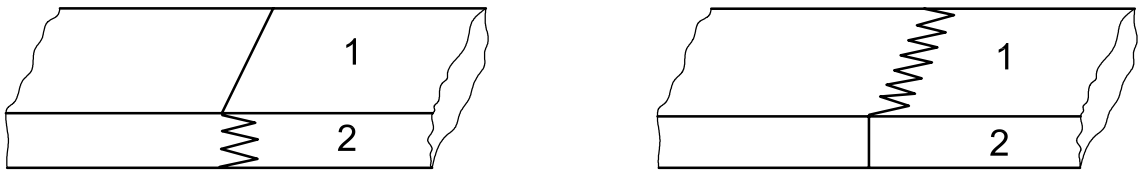
ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
bond
union between materials produced using adhesives

3.2
finger joint
joint formed by bonding two precut members shaped like fingers (see Figure 1)



a) Horizontal joint **b) Vertical joint**

Key
1 face
2 edge

Figure 1 — Finger joint

3.3
dry-use nonstructural adhesive
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 %

3.4
wet-use nonstructural adhesive
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

3.5
equilibrium moisture content
EMC
moisture content at which wood neither gains nor loses moisture to the surrounding air

NOTE Adapted from ASTM D 9.

3.6
moisture content
MC
amount of water contained in the wood, usually expressed as a percentage of the mass of the oven-dry wood

NOTE Adapted from ASTM D 9.

4 General principles

4.1 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 104 °C.

NOTE This specification reflects results obtained with laboratory-made specimens compared to those obtained with industrially manufactured specimens. 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. Such 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. Figure 2 depicts a typical finger joint configuration.

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

4.3 An industrially made finger joint assembly should preferably be evaluated using the requirements for compliance with this specification. When this specification is used to evaluate specimens made from laboratory-made assemblies, the results may not compare favourably with those obtained with specimens made from industrially made assemblies.

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

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

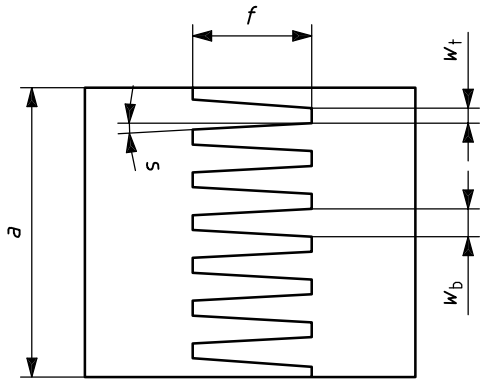
4.6 The 104 °C test is a more severe test designed to evaluate the product after exposure to short-term elevated-temperature conditions. This test is intended to simulate conditions that might be experienced in transit, during further processing or in service conditions.

NOTE Service conditions could typically include stress and time under stress, as well as elevated temperature.

4.7 Procedures are described in sufficient detail to permit duplication in different test laboratories.

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

Before beginning the full testing process, the test laboratory should preferably take a representative sample and check the dry strength first, in order to ensure that the product basically conforms to the dry-strength performance level certified by the adhesive manufacturer.



Key

a	height of joint	33 mm
f	length of finger	6 mm
w_t	width of finger tip	1 mm
w_b	width of finger base	2 mm
s	slope of finger	5°

NOTE The dimensions given are examples for a typical horizontal finger joint.

Figure 2 — Example of cross-section of finger joint test specimen

5 Apparatus and materials

5.1 Tensile-testing machine, capable of maintaining a pre-determined constant crosshead rate. The machine shall be capable of determining a maximum load. The measured strength shall be between 15 % and 85 % of the capacity of the machine. The machine shall permit the measurement and recording of the applied force with an uncertainty of ± 1 % or better.

The machine shall have a capacity of not less than 9 800 N in compression, shall be equipped for one-third-span, two-point loading for the flexure test as described in 9.1 and shown in Figure 3, shall be equipped with grips of sufficient length to hold the specimen firmly, preferably with a minimum length of 63 mm and minimum width of 19 mm, and shall be located in an atmosphere such that the moisture content of the specimen is not noticeably altered during testing.

The equipment shall be calibrated regularly in accordance with ISO 7500-1.

It is recommended that the machine be autographic, giving a chart that can be read in terms of millimetres of crosshead movement as one coordinate and applied force as the other coordinate. It is also recommended that inertialess equipment be used.

The finger joint specimens to be broken in tension are shorter than those to be broken in flexure. Accommodation shall be made in the equipment for handling the larger flexure specimen.

5.2 Environmental chamber, capable of conditioning specimens at (23 ± 2) °C and (65 ± 5) % relative humidity, having a capacity for at least 20 specimens well spaced and supported on racks to allow free air flow.

5.3 Oven(s), with sufficient air circulation to remove moisture from the oven chamber, capable of meeting all the following temperature requirements: (41 ± 2) °C (see 10.2.3), (65 ± 2) °C (see 10.2.6 and 10.3.3), (104 ± 2) °C (see 10.2.4, 10.2.5 and 10.3.4) and (110 ± 2) °C (see 10.2.4).

5.4 Specimen-soaking tank, having a capacity meeting the requirements of 10.2.3, so that all of the specimens are at least 50 mm below the water level for the duration of the soak cycles.

5.5 Specimen-boiling tank, having a capacity meeting the requirements of 10.3.3, so that all of the specimens are at least 50 mm below the water level for the duration of the boil cycles.

5.6 Vacuum/pressure vessel, having a capacity meeting the requirements of 10.3.5, so that all of the specimens are at least 50 mm below the water level for the duration of the vacuum/pressure cycles.

5.7 PVDC wrap: poly(vinylidene chloride) film for wrapping test specimens.

6 Requirements

6.1 To demonstrate compliance with this specification, the test adhesive shall be tested for performance in accordance with Clauses 9 and 10, and it shall meet the requirements in Table 1 for the selected test mode and performance classification.

6.2 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 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 group 3 and 4 hardwoods in Table 2.

6.3 The wood-failure requirements listed in Table 1 are given for softwoods and hardwoods.

6.4 An industrially manufactured finger joint may be used to evaluate the adhesive, provided its construction meets the requirements set forth in Clauses 7 to 10, and the joint is tested against the requirements in Table 1.

7 Test specimens

7.1 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 Use lumber that conforms to the following requirements: maximum slope of grain of 7 % (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 and splits or checks.

Recommended minimum specific gravities are given in Table 3. Finger joints shall be cut on the day the assemblies are to be made. See Clause 6 for species compliance rules relative to testing, and Table 2 for information on the bondability of some species of wood.

7.3 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.

7.4 For each exposure condition within the unique performance classification, a test group shall consist of 20 specimens representing at least four different assemblies with no more than five specimens for each assembly.

Table 1 — Minimum test requirements

Performance classification and exposure conditions [a]	Subclause number for exposure description	Test mode: tension [b]					Test mode: flexure
		Strength [c] MPa	Wood failure [d]				Stress at rupture [c] (min. [g]) MPa
			Group average [e] %		Individual minimum [f] %		
			Soft-wood	Hard-wood [h]	Soft-wood	Hard-wood [h]	
Dry use:							
Cured (dry)	10.2.2	13,8	60	30	30	15	13,8
Three-cycle soak	10.2.3	6,9	30	15	15	—	6,9
Elevated-temperature test method 1 (104 °C)	10.2.4	6,9	—	—	—	—	—
Elevated-temperature test method 2 (104 °C)	10.2.5	6,9	—	—	—	—	—
Temperature/humidity (65 °C, 16 % EMC)	10.2.6	5,2	—	—	—	—	—
Wet use:							
Cured (dry)	10.3.2	13,8	60	30	30	15	13,8
Boil	10.3.3	11,0	50	25	25	—	9,7
Elevated temperature (104 °C)	10.3.4	6,9	—	—	—	—	—
Vacuum/pressure	10.3.5	11,0	50	25	25	—	9,7

a Twenty specimens required for each classification and exposure.

b Parallel to the grain.

c Tension and flexure results may vary with the species. To be acceptable, a wood shall produce joints able to meet these requirements.

d The wood-failure requirements are given for softwoods and hardwoods. Group 3 and 4 hardwoods are listed at 50 % of the softwood value, with no wood-failure requirement if the calculated value is 15 % or less.

e For total group of specimens tested.

f 90 % of the specimens tested shall meet or exceed the minimum wood-failure percentages shown. If a zero value is obtained for any of the specimens, the specimen shall meet the strength requirement.

g For any individual specimen.

h See recommended minimum specific gravity in Table 3.

Table 2 — Bondability groupings of commonly used wood

Group [a]	Hardwoods	Softwoods	Other	
Group 1 [b] Bond easily	Alder Aspen Basswood Chestnut, American Cottonwood Magnolia Willow, Black	Cedar, Incense Fir, Grand Fir, Noble Fir, Pacific Fir, White Pine, Eastern white Pine, Western white Redcedar, Western Redwood Spruce, Sitka	Balsa Cativo Courbaril Determa [c]	Hura Purpleheart Roble
Group 2 [d] Bond well	Butternut Elm, American Elm, Rock Hackberry Maple, Soft Sweetgum Sycamore Tupelo Walnut, Black Yellow-poplar	Fir, Douglas Larch, Western [e] Pine, Ponderosa Pine, Sugar Redcedar, Eastern	Afrormosia Andiroba Angelique Avodire Banak Cedar, Spanish Iroko Jarrah Limba Mahogany, African Mahogany, True	Meranti (Lauan), Light red Meranti (Lauan), White Meranti (Lauan), Yellow Obeche Okoume Opepe Peroba rosa Sapele Sucupira Wallaba
Group 3 [f] Bond satisfactorily	Ash, White Beech, American Birch, Sweet Birch, Yellow Cherry Hickory, Pecan Hickory, True Madrone Maple, Hard Oak, Red [c] Oak, White [c]	Cedar, Alaska Cedar, Port Orford Pine, Southern	Angelin Azobe Benge Bubinga Karri	Meranti (Lauan), Dark red Pau marfim Pine, Caribbean Pine, Parana Pine, Radiata Ramin
Group 4 [g] Bond with difficulty	Orange, Osage Persimmon		Balata Balau Greenheart Kaneelhart Kapur	Keruing Lapacho Lignumvitae Rosewood Teak

[a] It is recognized that more modern adhesives might lead to different species groupings in regard to difficulty of bonding.

[b] Bond very easily with adhesives having a wide range of properties and under a wide range of bonding conditions.

[c] Difficult to bond with phenol-formaldehyde adhesives.

[d] Bond well with a fairly wide range of adhesives under a moderately wide range of bonding conditions.

[e] Wood from butt logs with a high extractive content is difficult to bond.

[f] Bond satisfactorily with good-quality adhesives under well-controlled bonding conditions.

[g] Satisfactory results require careful selection of adhesives and very close control of bonding conditions; may require special surface treatment.

Table 3 — Recommended minimum specific gravities by species

Species	Specific gravity [a] g/cm^3
Cedar, Alaska	0,44
Fir, Douglas (East)	0,48
Fir, Douglas (interior South)	0,46
Fir, White	0,39
Hemlock, Western	0,45
Larch, Western	0,52
Pine, Lodgepole	0,41
Pine, Loblolly	0,51
Pine, Ponderosa	0,40

[a] Values are averages based on oven-dry mass and volume at 10 % to 12 % moisture content.

8 Moisture content and 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 have to be dried to a given MC before testing.

Select lumber within the range from 10 % to 12 % MC before bonding (see 7.2). Determine the MC by use of an electronic moisture meter. After bonding the assemblies in the field, control the MC of the specimens throughout the testing process.

If needed, condition the assemblies to the original MC ± 1 % by use of an environmental chamber prior to cutting the specimens.

8.2 Specimen conditioning during the testing process

The allowable variation in MC at the completion of a drying cycle or before testing dry is ± 1 %. 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 10.2.2 and 10.3.2, where the specimens have never left the dry state. Wood failure may be read on these test specimens following the strength testing, with no further conditioning to reduce MC.

9 Test procedures — Flexure and tension

9.1 Testing in flexure

Specimens shall be conditioned in accordance with Clause 8.

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 Figure 3, and with a distance between the reaction points of 24 times the depth d. Allow at least 25 mm at both ends of the specimen outside the reaction points (see dimension e in Figure 3).