FST/2012/092 – Enhancing Value Added Wood Processing in Papua New Guinea

Testing gluing characteristics of the timbers for various wood product applications

Benoit Belleville, Ph.D.
This activity includes:

• Laboratory testing of glue-bond strength of various types of glues for PNG selected timber species;

• Laboratory testing of the performance of various types of glues and joints in various climatic conditions which will simulate conditions in potential market destinations.
Standard Specification for Adhesives Used for Laminate Joints in Nonstructural Lumber Products

1. Scope
1.1 This specification covers performance levels for adhesives to be used in laminate joints in nonstructural lumber products. Such products include, but are not limited to, interior and exterior moldings, window and door components or parts, and bonded lumber panels. This specification is to be used to evaluate adhesives as well as the adhesive bonds in nonstructural glued lumber products.

Norm 1—This specification applies to the laminate-joint portion of Specifications D3113.

Norm 2—See Section 2.2 for descriptions of a dry-use nonstructural adhesive and a wet-use nonstructural adhesive.

1.2 This specification applies to nonstructural adhesive joints made under both laboratory and field conditions. See Section 4 for limitations in using this specification to evaluate industrially manufactured laminate joints.

1.3 The following safety caveat applies only to the apparatus and test methods portions, Sections 6, 7, 8, and 9 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.

1.4 The values stated in inch-pound units are to be regarded as standard.

1.5 In this specification, laminate joint refers to both face and edge joints.

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

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2. Referenced Documents
2.1 ASTM Standards:
D905 Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading
D907 Terminology of Adhesives
D2016 Methods of Test for Moisture Content of Wood (Withdrawn 1997)
D2555 Practice for Establishing Clear Wood Strength Values
D3113 Specification for Adhesives Used in Laminate Joints for Nonstructural Glued Lumber Products (Withdrawn 1996)
D5268 Practice for Estimating the Percentage of Wood Failure in Adhesive Bonded Joints
E14 Practices for Force Verification of Testing Machines
E56 Terminology Relating to Methods of Metalworking
E64 Terminology Relating to Conditioning
E177 Practice for Use of the Precision and Bias in ASTM Test Methods
E949 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology
3.1 Definitions: Many terms in this specification are defined in Terminologies D907, E56, and E177.

3.1.1 bond, n—The union of materials by adhesives.

3.1.2 laminate joint, n—in wood bonding, a joint made by bonding layers of adhesives face-to-face or edge-to-edge to form thicker or wider stock.

3.1.3 edge joint, n—in wood bonding, a type of laminate joint made by bonding adherends edge-to-edge with grain directions parallel to form wider stock.

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*This specification is under the jurisdiction of ASTM Committee D3 on Adhesives and is the direct responsibility of Subcommittee D3.18 on Wood Adhesives.*


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.

The last approved version of this historical standard is referenced on www.astm.org.
Minimum shear strength requirements for teak laminated joint at 12% moisture content as per ASTM D5751

<table>
<thead>
<tr>
<th>Test</th>
<th>Average species strength (MPa)</th>
<th>Required average strength</th>
<th>Required average specimen strength (MPa)</th>
<th>Average species strength (MPa)</th>
<th>Required individual minimum strength (MPa)</th>
<th>Required individual minimum strength (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cured (dry)</td>
<td>11.92 X</td>
<td>60%</td>
<td>= 7.15</td>
<td>11.92 X</td>
<td>30%</td>
<td>= 3.58</td>
</tr>
<tr>
<td>Three-cycle soak</td>
<td>11.92 X</td>
<td>30%</td>
<td>= 3.58</td>
<td>11.92 X</td>
<td>15%</td>
<td>= 1.79</td>
</tr>
<tr>
<td>High temperature</td>
<td>11.92 X</td>
<td>40%</td>
<td>= 4.77</td>
<td>11.92 X</td>
<td>20%</td>
<td>= 2.38</td>
</tr>
<tr>
<td>Wet use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boil</td>
<td>11.92 X</td>
<td>50%</td>
<td>= 5.96</td>
<td>11.92 X</td>
<td>25%</td>
<td>= 2.98</td>
</tr>
</tbody>
</table>
Designation: D4988 - 99 (Reapproved 2005)

Standard Test Method for Evaluating Structural Adhesives for Finger Jutting Lumber

This standard is issued under the fixed designation D4988; 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 superceded date (x) indicates an editorial change since the last reapproval or reissue.

1. Scope

1.1 This test method is designed to evaluate adhesives for finger jutting lumber used in the manufacture of structural glued laminated timber. It tests the tensile strength of joints under the following conditions: dry with no treatment, wet after cure, vacuum pressure soak treatment, and wet after cyclic bed dry treatment.

1.2 The test results in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.3 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

D696 Terminology of Adhesives
D2599 Specification for Adhesives for Structured Wood Products for Use Under Exterior Exposure Conditions

3. Terminology

3.1 Definitions—Many terms in this test method are defined in Terminology D696.

3.1.1 adhesive—laminated veneer lumber (LVL), laminated strand lumber (LSL), oriented strand lumber (OSL), or parallel strand lumber (PSL) meeting the requirements of Specification D5054 or solid-wood lumber that is produced according to Practice D6970 and the grading rules of the applicable grading or inspection agency.

3.1.2 finger joint assembly—A short portion of two boards joined at the ends by a finger joint obtained from a finger joint production line for testing, frequently referred to as an assembly.

3.3.3.2 clamp—n—A group of finger joint assemblies obtained from a finger joint production line for statistical purposes.

3.3.3.3 determination—The laminate industry term sample is used for an individual finger joint assembly.

3.3.4 specimen—An individual strip, 1 by 1 in (25 by 25 mm), cut from a finger joint assembly for the tension test described in this test method.

4. Significance and Use

4.1 This test method is specifically designed to measure the performance of adhesives in finger joint manufactured under production line conditions.

4.2 The results of the test method may be used to certify an adhesive as suitable for finger jointing lumber under production-line conditions where the intended use of the finger jointed lumber will be in a structural glued laminated timber. When the test results are used for certification of an adhesive, use a standard wood species and a standard finger profile. Standard species may be found in Table 1 of Specification D5054. Two standard finger profiles commonly used in the manufacture of structural glued laminated timber industry are shown in Fig. 1 and 2.

4.3 This test method is not intended for quality control as the test assemblies are selected for their absence of defects usually found in run of the mill lumber and finger joint.

5. Apparatus

5.1 Test Machine, capable of applying a calibrated tensile force up to 23 kN (5000 lbf), equipped with templet (length of action of grips at 50 mm (2 in) by 3 in).
Material & Preparation of Specimens

Timber quality and surface

- Straight grain (max slope of grain of 1:14 on any face)
- EMC of 10 to 12%
- Free from all defects that may interfere with the bond strength determination (knots, decay, machining or drying defects)
- Surfaced on the day the assemblies are to be bonded

Equivalent to small clear sampling!
Bonding conditions

Usually specified by the manufacturer of the adhesive

- Recommended wood MC at the time of bonding;
- Mixing directions for the adhesive;
- Conditions for application (rate of spread, number of coats, one or both surfaces);
- Assembly conditions (pressing time and pressure).
Bonding conditions: Adhesive application
Preparation of specimens

**Boards dimensions:**
19 mm x 63.5 mm x 304 mm

- Thickness of each board shall not vary by more than 0.1 mm;
- Five specimens to be cut from each bonded boards;
- 8 boards or 4 bonded boards per species per exposure condition for a total of 20 specimens.
Test specimens (block shear)

**Number of specimens:**
20 per species per treatment or exposure condition

**Size of specimens:**
Bonded area 38 x 50.8 mm
Exposure condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Samples per test per species*</th>
<th>Type of test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Block shear</td>
</tr>
<tr>
<td>Cured (dry)</td>
<td>20</td>
<td>√</td>
</tr>
<tr>
<td>Elevated temperature</td>
<td>20</td>
<td>√</td>
</tr>
<tr>
<td>Three-cycle soak in water</td>
<td>20</td>
<td>√</td>
</tr>
<tr>
<td>Boil</td>
<td>20</td>
<td>√</td>
</tr>
<tr>
<td>Vacuum pressure</td>
<td>20</td>
<td>√</td>
</tr>
</tbody>
</table>

- Test 5 specimens from each of four different bonded boards
- 8 boards (dimensions: 19 mm x 63.5 mm x 304 mm) per species and exposure condition
Exposure conditions

Dry-use (no treatment)
Specimens are placed in a conditioning chamber at 20°C and 65% RH for 14 days (curing period) and tested.

Elevated temperature
Following the curing period specimens are placed in an oven at 104°C for 6 hours and then tested.

Three-cycle soak
Following the curing period specimens are placed in running water, separated by wire screens in such a manner that all surfaces are freely exposed to the water. The specimens are immersed for a period of 4 hours, followed by drying at a temperature of 41°C for 19 hours. This procedure is repeated twice more for a total of three cycles.

Boil
Following the curing period specimens are placed in a tank of boiling water, separated by wire screens so that all surfaces were freely exposed to the water. Samples are boiled for 4 hours, followed by drying for 20 hours at 63°C. Following a second 4-hour boil cycle, samples are removed and cooled in running water at 20°C for 1 hour.
Wood failure estimation

• Estimate wood failure % to the nearest 10%, with a maximum of 100 %

• A ruler or a scribed transparent template is often helpful.
Apparatus

- Balance (0.1 and 0.0001 g)
- Spreading equipment (roller spreader & pan)
- Equipment (press or clamps or Instron)
- Vernier calliper or micrometre
- Environmental chamber
- Oven (up to 110°C)
- Tank for soaking
- Tank for boiling
- Vacuum-pressure vessel (If possible)
- Instron
Action plan

- Species selection
- Adhesives selection
- Equipment required
- Preliminary trials
- Official test
I was reading this book today called the History of Glue

I couldn't put it down