

**WEST COAST LUMBER INSPECTION BUREAU  
GLUED LUMBER CERTIFICATION AND  
QUALITY CONTROL MANUAL**



**Portland, Oregon  
December 21, 2018**

## **PART I**

### **GENERAL SPECIFICATIONS**

#### **1. GENERAL:**

The West Coast Lumber Inspection Bureau (WCLIB) shall initially certify plants to produce Structural Glued lumber of the Stress-Rated boards, Light Framing, Structural Light Framing, Joists and Planks, Decking, Machine Stress-Rated Lumber, Posts & Timbers, and Beams & Stringers grades and shall maintain continuing quality control as prescribed in the standard. A grade stamp for glued lumber may be issued and used only if the material complies with all the applicable sections of this manual, current edition of WCLIB Rules No. 17 (3), and the "Glued Lumber Policy" (1) of the American Lumber Standard Committee (ALSC).

#### **2. PRODUCT GRADING PROVISIONS**

- 2.1 Glued lumber shall be considered as a solid piece and shall be graded under the rules which apply to solid sawn lumber. It shall be ordered, acknowledged, and invoiced as glued material. End jointed lumber qualified under this standard may be qualified as either a "Certified End Joint" or "Stud Use Only." End joints qualifying as "Certified End Joints" shall meet all applicable requirements for joint strength of the ALSC "Glued Lumber Policy" (1), the WCLIB Standard Grading Rules No. 17, paragraph 210 (see Appendix C), and this standard. Adhesives used in "Certified End Joint" lumber shall meet the requirements of ASTM D2559 (2). End joints qualifying as "Stud Use Only" shall meet all appropriate sections of this standard. Face or edge bonded lumber and timbers, with or without end joints, qualified under this standard shall be designated as "Certified Glued Lumber" and shall meet all applicable requirements of the ALSC "Glued Lumber Policy" (1). End joints in "Certified Glued Lumber" shall meet the requirements for "Certified End Joint."

#### **2.2 LUMBER SURFACING**

- 2.2.1 Gluing surfaces shall be surfaced smooth and, except for minor local occurrences, shall be free of raised grain, torn grain, skips, burns, glazing, or other deviations that might interfere with glue spread, proper mating of the end joint or with the proper penetration or adhesion of the glue.
- 2.2.2 All gluing surfaces shall at the time of gluing be free from dust or other foreign matter, including any exudation or surface damage which would be detrimental to satisfactory gluing.

#### **2.3 CERTIFIED GLUED LUMBER**

- 2.3.1 Face or edge bonded lumber qualified as "Certified Glued Lumber" shall be manufactured in accordance with all applicable requirements of the ALSC "Glued Lumber Policy" and Part II of this Standard.

- 2.3.2 Certified Glued Lumber may be qualified for grade stamping as Stress-Rated boards, Light Framing, Structural Light Framing, Joist and Planks, Machine Stress-Rated Lumber, Decking, Beams & Stringers, Posts & Timbers.
- 2.3.3 Adhesives used for "Certified Glued Lumber" shall meet the performance requirements of the ALSC "Glued Lumber Policy" (1) and ASTM D2559 (2).
- 2.3.4 The maximum allowable end-joint offsets are specified in Part I, Section 2.6.
- 2.3.5 The maximum allowable tip gap for end-joints, which is the distance from the tip of the finger in the joint area to the base of the matching profile of that finger shall not exceed an average of 1/16".
- 2.3.6 Each piece of "Certified Glued Lumber" shall be marked with the words "Certified Glued Lumber." The wording may be part of the grade stamp or a separate WCLIB- issued stamp.

## **2.4 CERTIFIED END JOINT**

- 2.4.1 Lumber qualified as "Certified End Joint" may be grade stamping as Stress-Rated boards; Light Framing, Structural Light Framing, Stud, Joist and Planks, Decking, and Machine Stress-Rated Lumber Grades; and Beams & Stingers and Post & Timber grades.
- 2.4.2 End joints qualifying as "Certified End Joints" shall meet all applicable requirements of the ALSC "Glued Lumber Policy" and this standard structural end joints.
- 2.4.3 Lumber stamped as "Certified End Joint" shall limit the size of knots and holes in the joint area as specified in Section 2.7.
- 2.4.4 Adhesives used for "Certified End Joints" shall meet the performance requirements of ASTM D2559 (2).
- 2.4.5 The maximum allowable end-joint offsets are limited as specified in Section 2.6.
- 2.4.6 The maximum allowable tip gap, which is the distance from the tip of the finger in the joint area to the base of the matching profile of that finger shall not exceed an average of 1/16".
- 2.4.7 Each piece of "Certified End Joint" lumber shall be marked with the words "Certified End Joint." The wording may be part of the grade stamp or a separate WCLIB-issued stamp. End joints combined with face or edge bonds shall be identified as "Certified Glued Lumber."

## **2.5 STUD USE ONLY**

- 2.5.1 Lumber qualified as "Stud Use Only" may be grade stamped as Stress-Rated boards, Light Framing, Structural Light Framing, Stud, and Joist and Plank grades 6" and smaller.

- 2.5.2 End joints qualifying for "Stud Use Only" shall meet all applicable requirements of the ALSC "Glued Lumber Policy" for structural end joints, except as specifically listed in this standard.
- 2.5.3 "Stud Use Only" end jointed lumber shall be in dimension sizes 2 x 6 and smaller only, and lengths not to exceed 12 feet.
- 2.5.4 An adhesive shall meet the requirements of ASTM D2559 with the exception of the test for "Resistance to Deformation Under Static Loading". Adhesive verification tests using ASTM D2559 shall be carried out using either Douglas fir, western hemlock, southern yellow pine, western larch or other ALSC approved species that meet the requirements of Table 1 in ASTM D2559.
- 2.5.5 The maximum allowable End Joint offsets are specified in Section 2.6.
- 2.5.6 Each piece of "Stud Use Only" lumber shall be marked with the words "Stud Use Only." The wording may be part of the grade stamp or a separate WCLIB-issued stamp.
- 2.5.7 Lumber stamped as "Stud Use Only" shall limit the size of knots and holes in the joint area as specified in Section 2.7.

## **2.6 OFFSETS IN GLUED LUMBER**

- 2.6.1 Offsets in end joints are permitted equivalent to the skip permitted in the grade provided the offset on the opposite edge is no greater than 1/32".

## 2.7 ALLOWABLE KNOTS IN VICINITY OF END JOINT

2.7.1 Knots or holes in the joint area are permitted in sizes not to exceed the following, or equivalent displacement:

Maximum Permitted Knot Size in End-Joint Area

Nominal Width	STUD USE ONLY (Para. 210c.)			CERTIFIED GLUED LUMBER (Para. 210a) CERTIFIED END JOINTS (Para. 210b.)			
	Select Structural	No. 1, No. 2, Construction	Stud, No. 3, Standard, Utility	Select Structural	No. 1	No. 2	Construction Standard, Utility, Stud, No. 3
2"	1/4"	1/4"	3/8"	3/16"	1/4"	1/4"	3/8"
3"	3/8"	1/2"	3/4"	1/4"	3/8"	1/2"	5/8"
4"	1/2"	5/8"	1"	3/8"	1/2"	3/4"	7/8"
5"	5/8"	3/4"	1 1/4"	1/2"	5/8"	7/8"	1 1/8"
6"	3/4"	7/8"	1 1/2"	5/8"	3/4"	1"	1 3/8"
8"				3/4"	1"	1 1/8"	1 5/8"
10"				1"	1 1/8"	1 3/8"	1 7/8"
12"				1 1/4"	1 1/4"	1 1/2"	2"

2.7.2 Knots or holes exceeding displacements listed above are limited under the provisions of the grade being produced, and shall be positioned so that neither the knot(s), nor the grain distortion associated with the knot(s) extend into the joint area.

## 3. ADHESIVES

- 3.1 Adhesives used in "Certified End Joint" lumber shall meet the requirements of ASTM D2559 (2).
- 3.2 It is permitted to use an adhesive in structural end jointed lumber labeled as "Stud Use Only" that meets the requirements of ASTM D 2559 (2) with the exception of the test for "Resistance to Creep Under Static Loading".
- 3.3 When the adhesives used in end jointed lumber meet the requirements of ALSC "Glued Lumber Policy" (1), section 1.4.2 the grade stamp may include the designations "Heat Resistant Adhesive" or "HRA".
- 3.4 The Designation "Non-HRA" shall be included on grade stamps that do not meet the provisions of section 1.4.2.

## **4. MILL CERTIFICATION**

- 4.1 Upon application for certification, the Bureau shall determine whether the producing mill has adequate facilities for machining accurate joints, properly mixing and applying adhesives, and proper assembly of the joints. The Bureau shall also determine that the Quality Control program employed by the mill is adequate to maintain the quality level required under this standard. A qualification report for the plant facilities and equipment shall be completed by the Bureau and made part of the permanent record.

## **4.2 PROCEDURES MANUAL**

The producing mill shall fully describe, in a manual, the production procedures and quality control program employed. The manual shall include a description of production check points, visual inspections and physical testing procedures used. The manual shall be reviewed and approved by the Bureau prior to implementation. This standard shall serve as a testing and quality control manual for the mill if a mill does not wish to develop one as part of its procedures manual.

- 4.2.1 All substantive changes made to the mill quality control manual shall be reviewed and approved by the Bureau prior to implementation at the plant.

## **4.3 QUALITY CONTROL EQUIPMENT**

All quality control equipment shall be well maintained, located at the manufacturing facility, and available at all times. The following equipment is recommended:

- 4.3.1 Standard gauges for measuring cross sectional dimensions of stock.
- 4.3.2 Moisture meter properly calibrated for monitoring the moisture content of the stock.
- 4.3.3 Feeler gauges or other suitable probes for examining completed finger joints.
- 4.3.4 Magnifying lens or other suitable device for measuring and monitoring the finished glue line thickness.
- 4.3.5 Equipment suitable for tests for strength and wood failure of completed structural finger joints.
- 4.3.6 Equipment suitable for performing Cyclic Delamination Tests.

## **4.4 QUALITY CONTROL PERSONNEL**

It shall be the responsibility of the quality control personnel to inspect the production operation and to perform visual inspections and tests. They shall certify to the performance of equipment, procedures, and maintain records in accordance with the requirements of this standard. The quality control personnel shall cooperate fully with WCLIB and with the WCLIB delegated representatives. Instances of nonconformance with this standard shall be brought to the immediate attention of the plant manager.

## **5. TEST RECORDS**

### **5.1 ADHESIVE QUALIFICATION RECORDS**

Written records shall be maintained of the delamination, strength, and wood failure results obtained from qualification test of each lot of adhesive.

### **5.2 DAILY QUALITY CONTROL RECORDS**

All daily quality control test results shall be recorded in a form for permanent record. They shall include the strength, wood failure, delamination, visual test and inspection results, and the current status of the quality control process for joint strength.

- 5.3 A daily check list shall be maintained which contains a summary of the results of any adhesive qualification tests, and all daily quality control tests, including visual checks on equipment and procedures.
- 5.4 Quality control records shall include all pertinent data such as the date, time, test identification, minimum test requirement, test result, corrective action taken if necessary, and name of quality control person performing the test or inspection.

## **6. PERIODIC QUALITY CONTROL TESTS**

- 6.1 Each new lot of adhesive shall be tested with the tests utilized for daily quality control. Samples for this testing shall be made up separately prior to use of the adhesive in the production or taken from the first production run.
  - 6.1.1 A minimum of five joints shall be tested according to the Full-Size Tension Test, see Appendix B, for the adhesive used in end-jointed lumber. The test results shall meet the requirement of the daily quality control tests.
  - 6.1.2 A minimum of ten pieces shall be tested according to the Shear Test, see Appendix B, along the glue lines for the adhesive used in face and edge bonded material. The test results shall meet the requirement of the daily quality control tests.
  - 6.1.3 A minimum of one joint shall undergo a Cyclic Delamination test, see Appendix B for the adhesive. The test results shall meet the requirement of the daily quality control tests.
- 6.2 Additional quality control tests shall be performed any time there is reason to believe that the product is not conforming to specifications

## **7. BUREAU SUPERVISION**

- 7.1 The Bureau will periodically evaluate the plant operation, products, quality control procedures, and records to assure that quality standards are maintained. At least 12 times per year, approximately monthly, the Bureau supervisor will check and report on the record of the plant's daily quality control tests. Prompt evaluation by the Bureau shall follow the appropriate quality control requirements of this standard.
- 7.2 The Bureau supervisor shall make a written report of their findings under Section 7.1. The report shall also include the results of a visual inspection of the plant facilities and test equipment, listing any deficiencies noted, and corrective action taken. The report shall also include a listing of any production stoppages due to non-conformance of the product to the requirements of this standard since the last inspection visit. Include a description of appropriate corrective action taken by the mill.

Note: The periodic inspections of the plant production by the WCLIB District Supervisor is not intended to be considered a substitute for adequate plant quality control. Production of continuously high-quality lumber remains the responsibility of the plant management.

- 7.3 At least annually, the Bureau shall check the calibration of the quality control test equipment at the plant to ensure that the equipment is properly calibrated and maintained. The supervisor shall include a report of the findings with the monthly inspection report. The report shall include a description of any corrective action necessary to repair and/or re-calibrate the equipment.

## **8. NON-COMPLIANCE**

- 8.1 When any of the daily quality control tests indicate that the glued joints do not meet the requirements of this standard, the plant quality control manager and WCLIB staff shall be notified immediately. Corrective actions shall be taken prior to resumption of production.
- 8.1.1 All glued lumber products determined by test to be noncomplying shall have the grade stamps obliterated and the use of the grade stamps shall be discontinued until the cause of the production problem has been identified and corrected. The use of the grade stamp can be resumed after the product has been re-qualified per the qualification requirements in Part II, III or IV, whichever is applicable.
- 8.2 Continuing noncompliance of a mill to any sections of this standard shall result in withdrawal of grade marking privileges by the Bureau.



**PART II**  
**CERTIFIED GLUED LUMBER**  
**QUALIFICATION AND QUALITY CONTROL**  
**PROCEDURES**

**1. GENERAL:**

Material produced as "Certified Glued Lumber" shall comply with the appropriate provisions of Part I of this standard. Certified Glued lumber may be qualified for grade stamping as Stress-rated boards, Light Framing, Structural Light Framing, Joists and Planks, Machine Stress-rated lumber, Decking, Beams and Stringers, and Posts and Timbers.

- 1.1** All combinations of wood components used in producing a given "Certified Glued Lumber" product shall be approved by WCLIB.

**2. QUALIFICATION TESTS:**

The following tests shall be performed when qualifying material as "Certified Glued Lumber," see Figure No. 1.

**2.1 CYCLIC DELAMINATION TEST - SEE APPENDIX B:**

- 2.1.1** A minimum of five finger joints (if applicable) and five face and/or edge bonds shall be tested.
- 2.1.2** Samples shall be evaluated for delamination in accordance with the procedures specified in the Cyclic Delamination Test, see Appendix B. Delamination after one complete cycle shall not exceed 5 percent. If the delamination is more than 5 percent, the sample may be subjected to a second complete cycle. The delamination after the second cycle shall not exceed 10 percent.

**2.2 FULL-SIZE END JOINT TENSION TEST (IF APPLICABLE) - SEE APPENDIX B**

- 2.2.1** A minimum of 53 end joints shall be tested.
- 2.2.2** The fifth percentile non-parametric tolerance limit 75% confidence (5<sup>th</sup> Percentile), tensile stress value of the qualification sample shall equal or exceed the adjusted tensile stress parallel to the grain as determined according to section 6.1 of the Full-Size Tension Test in Appendix B.
- 2.2.2.1** The minimum failure tensile stress of all test specimens shall equal at least the adjusted tensile stress parallel to the grain as determined according to section 6.1 of the Full-Size Tension Test in Appendix B.
- 2.2.3** The percent wood failure shall meet the requirements of Section 2.3.3

- 2.2.4 The failure mode type, see Appendix B, Table D, shall be recorded at the time of testing. Any piece failing below the established strength criteria in mode type six may be discarded and replaced with another piece.
- 2.2.5 Whenever possible, end jointed lumber shall be tested full width. If finger jointed lumber must be ripped, testing shall be in accordance with section 5.0 of the Full-Size End Joint Tension Test, see Appendix B.
- 2.2.6 The highest grade for which qualification of a joint configuration is sought shall be tested.
- 2.2.7 Lumber widths shall be qualified in one of two ways; (1) every width to be produced may be qualified by test, or (2) certification of the widest width of lumber produced by the plant also certifies the narrower widths. Option 2 shall be used only if the end joint configuration and adhesive are the same for all widths to be qualified.
- 2.3 SHEAR TEST - SEE APPENDIX B:**
- 2.3.1 A minimum of 20 specimens of face or edge bonded material shall be tested along the glue lines. No more than two specimens shall be taken from the same piece of lumber.
- 2.3.2 Samples shall be evaluated for shear strength and wood failure. The minimum shear strength of the specimens tested shall equal or exceed 2.1 times the published horizontal shear stress for the species.
- 2.3.3 The average percent wood failure of the test specimens shall equal or exceed 80% for wet-use adhesives used with softwoods.
- 2.4 QUALIFICATION**
- 2.4.1 Qualification is considered successful after all the required qualification tests are successful. For example, to qualify as Glued Lumber, the qualification test samples shall pass the Full-Size End Joint Tension (if there are end joints), Cyclic Delamination, and Shear Tests.
- 2.4.2 If any qualification tests fail, the problem(s) shall be identified, and corrected prior to further qualification testing.
- 2.4.3 Unsuccessful qualification tests may be repeated once. For example, if the Full-Size End Joint Tension tests and Cyclic Delamination Tests pass, but the Shear Test fails, only the Shear Test would need to be repeated.
- 2.4.3.1 If the second qualification test fails, the qualification is considered unsuccessful and the problem(s) shall be identified and corrected prior to further qualification testing. All required qualification tests shall be repeated.

### **3. DAILY QUALITY CONTROL TESTS**

The following tests shall be performed as part of a daily quality control program.

#### **3.1 CYCLIC DELAMINATION - SEE APPENDIX B:**

- 3.1.1 A minimum of 1 specimen per production shift shall be sampled and tested. Separate tests shall be performed on face or edge joints and end joints (if applicable).
- 3.1.2 Samples shall be evaluated for delamination in accordance with the procedures specified in the Cyclic Delamination Test, see Appendix B. Delamination after one complete cycle shall not exceed 5 percent. If the delamination is more than 5 percent, the sample may be subjected to a second complete cycle. The delamination after the second cycle shall not exceed 10 percent, see Figure 3.
- 3.1.3 If the delamination of the sample exceeds 10% after the second complete cycle, production shall be stopped until the problem is identified and corrected.
  - 3.1.3.1 Normal production shall continue once a qualification sample has been collected, tested, and qualified in accordance with Section 2.1.
  - 3.1.3.2 All production manufactured between the last passing test and the stoppage of production shall be held and reworked.
  - 3.1.3.3 If the held lumber can be segmented into lots based on time of production, individual lots may be tested and qualified.
  - 3.1.3.4 The test shall consist of a minimum of five randomly selected samples collected from the lot.
  - 3.1.3.5 The acceptance of individual lots shall be based on Section 2.1.2 and 3.1.3.3.

#### **3.2 FULL-SIZE END JOINT TENSION OR BENDING TEST - SEE APPENDIX B**

- 3.2.1 A minimum of one end joint per hour of production (eight per shift) with no fewer than five end joints per partial shift of production shall be sampled and tested.
- 3.2.2 All pieces shall equal or exceed the minimum end joint tensile or bending stress value as specified in section 2.2.2.1. If a piece fails below the minimum tensile or bending stress, production shall be stopped until the problem is identified and corrected and WCLIB shall be immediately notified.
- 3.2.3 If a quality control test value falls below the 5<sup>th</sup> percentile value as determined according to section 2.2.2, but not less than the minimum end joint strength value, the test values of at least 27 of the next 28 pieces shall equal or exceed the 5<sup>th</sup> percentile tensile or bending stress value. WCLIB shall be immediately notified.
- 3.2.4 When finger jointed lumber must be ripped prior to test, testing shall be in accordance with the

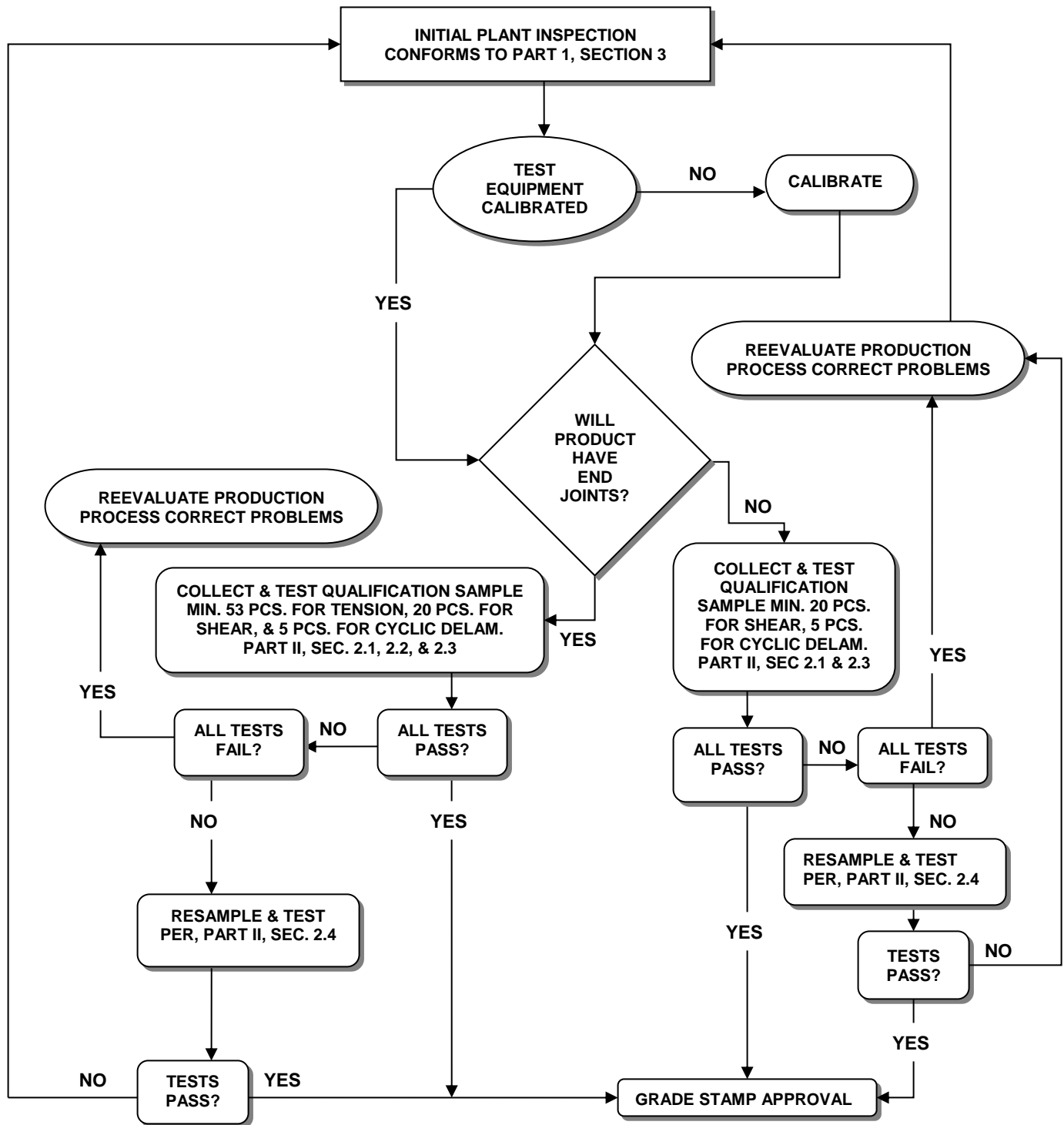
Full-Size End Joint Strength Test, see Appendix B.

- 3.2.5 If testing reveals that production is out of compliance by failing to meet the requirements of sections 3.2.2 or 3.2.3, the non-compliance provisions of Part I, section 8.1.1 shall be applied.

**3.3 SHEAR TEST - SEE APPENDIX B:**

- 3.3.1 A minimum of 10 specimens per shift of face or edge bonded material shall be tested. No more than two (2) specimens shall be collected from the same piece of lumber.
- 3.3.2 The minimum shear strength for all test specimens shall be greater than the assigned horizontal shear strength for that species multiplied by a factor of 2.1.
- 3.3.3 The average percent wood failure of the test specimens shall equal or exceed 80% for wet-use adhesives used with softwoods.
- 3.3.4 If testing reveals that production is out of compliance by failing to meet the requirements of sections 3.3.2 or 3.3.3, the non-compliance provisions of Part I, section 8.1.1 shall be applied.

**FIGURE No. 1  
QUALIFICATION FLOW DIAGRAM  
CERTIFIED GLUED LUMBER**



**PART III**  
**CERTIFIED END JOINTS**  
**QUALIFICATION AND QUALITY CONTROL**  
**PROCEDURES**

**1. GENERAL:**

Material produced as "Certified End Joints" shall comply with the appropriate provisions of Part I of this standard. Certified End Joints may be qualified for grade stamping as Stress-Rated Boards, Light Framing, Structural Light Framing, Joists and Planks, Decking, Structural Laminations, and Machine Stress Rated grades.

**2. QUALIFICATION TESTS:**

The following tests shall be performed when qualifying material as Certified End Joints, see Figure No. 2.

**2.1 CYCLIC DELAMINATION - SEE APPENDIX B:**

2.1.1 A minimum of five finger joints shall be tested.

2.1.2 Samples shall be evaluated for delamination in accordance with the procedures specified in Appendix B. Delamination after one complete cycle shall not exceed 5 percent. If the delamination is more than 5 percent, the sample may be subjected to a second complete cycle. The delamination after the second cycle shall not exceed 10 percent.

**2.2 FULL-SIZE END JOINT TENSION TEST - SEE APPENDIX B**

2.2.1 A minimum of 53 end joints shall be tested.

2.2.2 The 5<sup>th</sup> percentile non-parametric tolerance limit 75% confidence (5<sup>th</sup> Percentile) tensile stress value of the qualification sample shall equal or exceed the adjusted tensile stress parallel to the grain as determined according to section 6.1 of the Full-Size End Joint Tension Test in Appendix B.

2.2.2.1 The minimum failure tensile stress of all test specimens shall equal or exceed the adjusted tensile stress parallel to the grain as determined according to section 6.1 of the Full-Size End Joint Tension Test in Appendix B.

2.2.3 The average percent wood failure of the test specimens shall equal or exceed 80% for wet-use adhesives used with softwoods.

- 2.2.4 The failure mode type, see Appendix B, Table D, shall be recorded at the time of testing. Any piece failing below the established strength criteria in mode type six may be discarded and replaced with another piece.
- 2.2.5 Whenever possible, end jointed lumber samples shall be tested full width. If finger jointed lumber samples must be ripped, testing shall be in accordance with the Full-Size End Joint Tension Test, see Appendix B.
- 2.2.6 The highest grade to be produced with the end joint configuration being qualified shall be used for joint qualification.
- 2.2.7 Lumber widths shall be qualified in one of two ways; (1) every width to be produced may be qualified by test, or (2) certification of the widest width of lumber produced by the plant also certifies the narrower widths. Option 2 shall be used only if the end joint configuration and adhesive are the same for all widths to be qualified.

### **2.3 QUALIFICATION**

- 2.3.1 Qualification is considered successful after all the required qualification tests are successful. To qualify for grade marking as "Certified End Joint," samples shall pass the Full-Size End Joint Tension and Cyclic Delamination Tests.
- 2.3.2 If any qualification tests fail, the problem(s) shall be identified, and corrected prior to further qualification testing.
- 2.3.3 Unsuccessful qualification tests may be repeated once. For example, if the Full-Size End Joint Tension test passes and Cyclic Delamination Test fails, only the Cyclic Delamination Test would need to be repeated.
  - 2.3.3.1 If the second qualification test fails, the qualification is considered unsuccessful and the problem(s) shall be identified and corrected prior to further qualification testing. Both the Full-Size End Joint Tension and Cyclic Delamination Tests shall be repeated.

## **3. DAILY QUALITY CONTROL TESTS**

The following tests shall be performed as part of a daily quality control program.

### **3.1 CYCLIC DELAMINATION - SEE APPENDIX B.**

- 3.1.1 A minimum of 1 specimen per production shift shall be collected and tested.
- 3.1.2 Samples shall be evaluated for delamination in accordance with the procedures specified in the Cyclic Delamination Test, see Appendix B. Delamination after one complete cycle shall not exceed 5 percent. If the delamination is in excess of 5 percent, the sample may be subjected to a second complete cycle. The delamination after the second cycle shall not exceed 10 percent, see Figure 3.

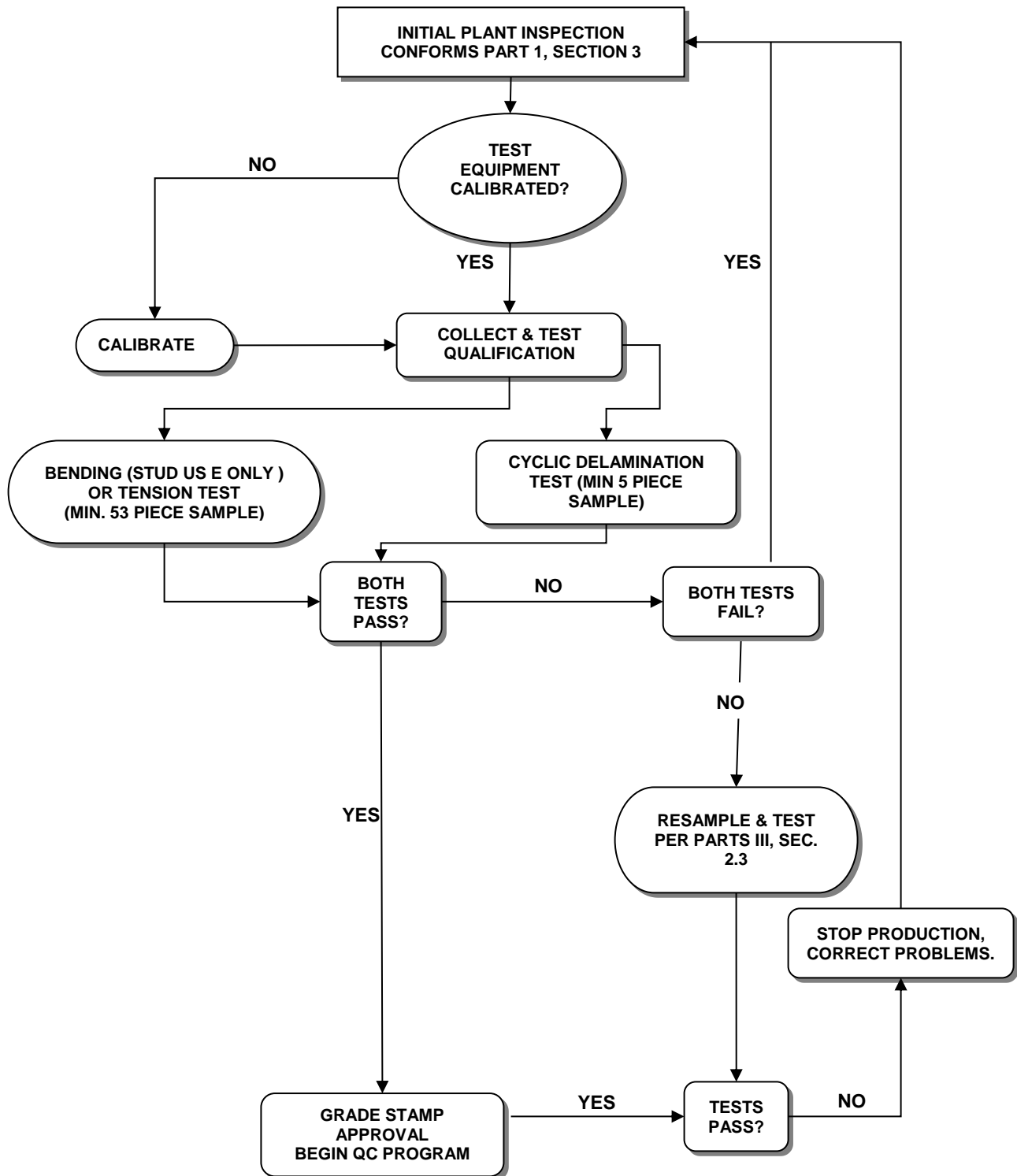
- 3.1.3 If the delamination of the sample exceeds 10% after the second complete cycle, production shall be stopped until the problem is identified and corrected.
- 3.1.3.1 Normal production shall continue once a qualification sample has been collected, tested, and qualified in accordance with Section 2.1.
- 3.1.3.2 All production manufactured between the last passing test and the stoppage of production shall be held and reworked.
- 3.1.3.3 If the held lumber can be segmented into lots based on time of production, individual lots may be tested and qualified.
- 3.1.3.4 The test shall consist of a minimum of five randomly selected samples collected from the lot.
- 3.1.3.5 The acceptance of individual lots shall be based on Section 2.1.2.

### **3.2 FULL-SIZE END JOINT TENSION TEST - SEE APPENDIX B.**

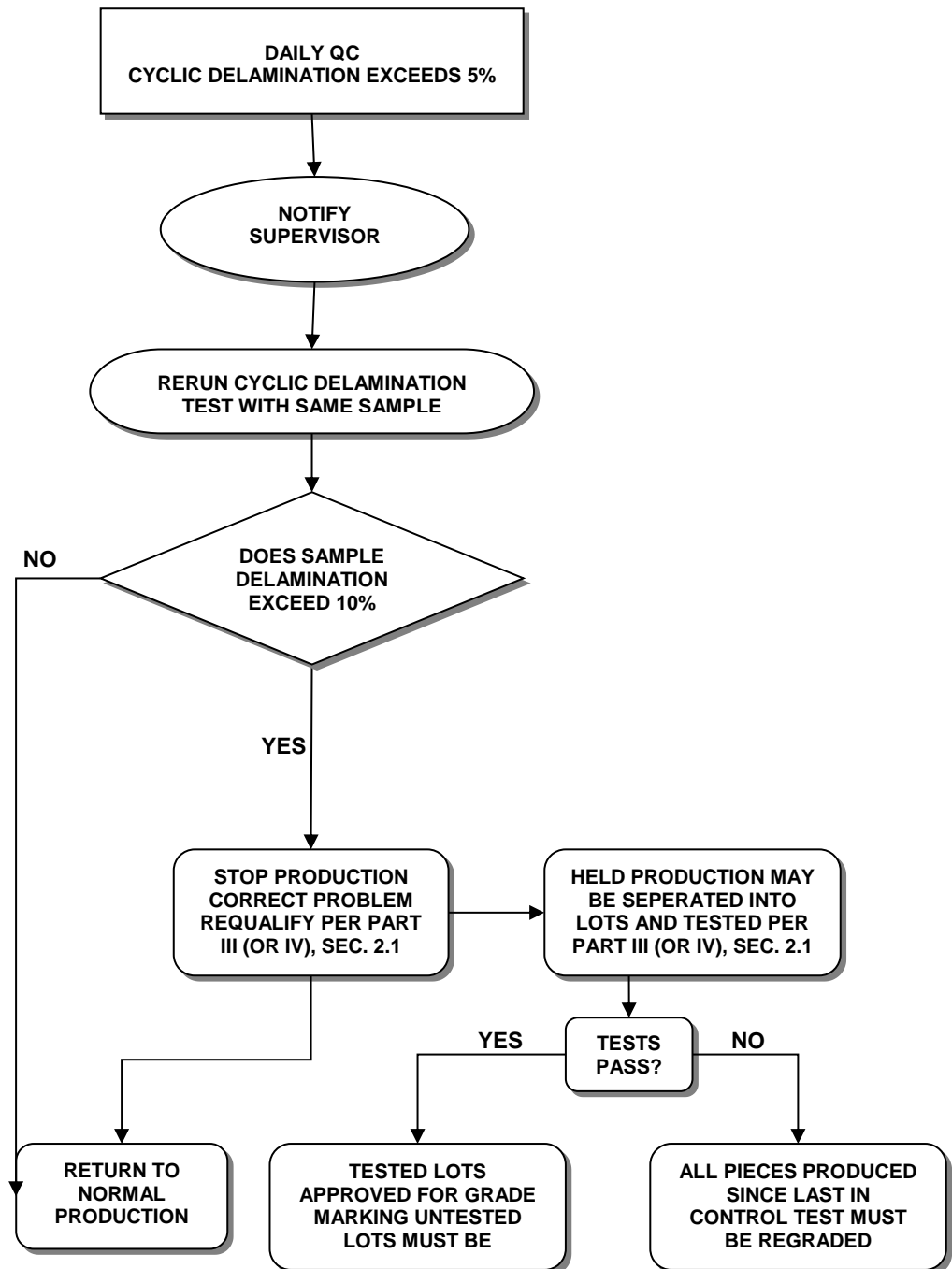
- 3.2.1 A minimum of one end joint per hour of production (eight per shift) with no fewer than five end joints per partial shift of production shall be sampled and tested.
- 3.2.2 All pieces shall equal or exceed the minimum end joint tensile stress value as specified in section 2.2.2.1. If a piece fails below the minimum tensile stress, production shall be stopped until the problem is identified and corrected and WCLIB shall be immediately notified.
- 3.2.3 If a quality control test value falls below the 5<sup>th</sup> percentile value as determined according to section 2.2.2, but not less than the minimum end joint strength value, the test values of at least 27 of the next 28 pieces shall equal or exceed the 5<sup>th</sup> percentile tensile stress value. WCLIB shall be immediately notified.
- 3.2.4 Finger jointed lumber samples, which must be ripped prior to test, shall be prepared and tested in accordance with the Full-Size End Joint Tension Test, see Appendix B.
- 3.2.5 If testing reveals that production is out of compliance by failing to meet the requirements of sections 3.2.2 or 3.2.3, the non-compliance provisions of Part I, section 8.1.1 shall be applied.



**FIGURE No. 2  
QUALIFICATION FLOW DIAGRAM  
CERTIFIED END JOINT & “STUD USE ONLY”**



**FIGURE No. 3  
REQUALIFICATION FLOW DIAGRAM  
FOR EXCESSIVE CYCLIC DELAMINATION**



**IV**

**STUD USE ONLY**

**QUALIFICATION AND QUALITY CONTROL**

**PROCEDURES**

**1. GENERAL:**

Material produced as "Stud Use Only" lumber shall comply with the appropriate provisions of Part I of this standard.

**2. QUALIFICATION TESTS:**

The test 2.1 Cyclic Delamination shall be performed for the qualification of "Stud Use Only" material. Also, either 2.2 End Joint Tension Test or 2.3 Full-Size End Joint Bending Test shall be performed when qualifying material as "Stud Use Only," see Figure No. 2 (Part III).

**2.1 CYCLIC DELAMINATION - SEE APPENDIX B.**

2.1.1 A minimum of five finger joints shall be tested.

2.1.2 Samples shall be evaluated for delamination in accordance with the procedures specified in Appendix B. Delamination after one complete cycle shall not exceed 5 percent. If the delamination is more than 5 percent, the sample may be subjected to a second complete cycle. The delamination after the second cycle shall not exceed 10 percent.

**2.2 FULL SIZE END JOINT TENSION TEST - SEE APPENDIX B.**

2.2.1 A minimum of 53 end joints shall be tested.

2.2.2 The fifth percentile non-parametric tolerance limit 75% confidence (5<sup>th</sup> Percentile) tensile stress value of the qualification sample shall equal or exceed the adjusted tensile stress parallel to the grain as determined according to section 6.1 of the Full-Size Tension Test in Appendix B.

2.2.2.1 The minimum failure tensile stress of all test specimens shall equal or exceed the adjusted tensile stress parallel to the grain as determined according to section 6.1 of the Full-Size Tension Test in Appendix B.

2.2.3 The average percent wood failure of the test specimens shall equal or exceed 80% for wet-use adhesives used with softwoods.

2.2.4 Lumber widths shall be qualified in one of two ways; (1) every width to be produced shall be qualified by test, or (2) 2 x 6 shall be used to qualify 2 x 6 and narrower. Option 2 shall be used

only if the end joint configuration and adhesive are the same for all widths to be qualified.

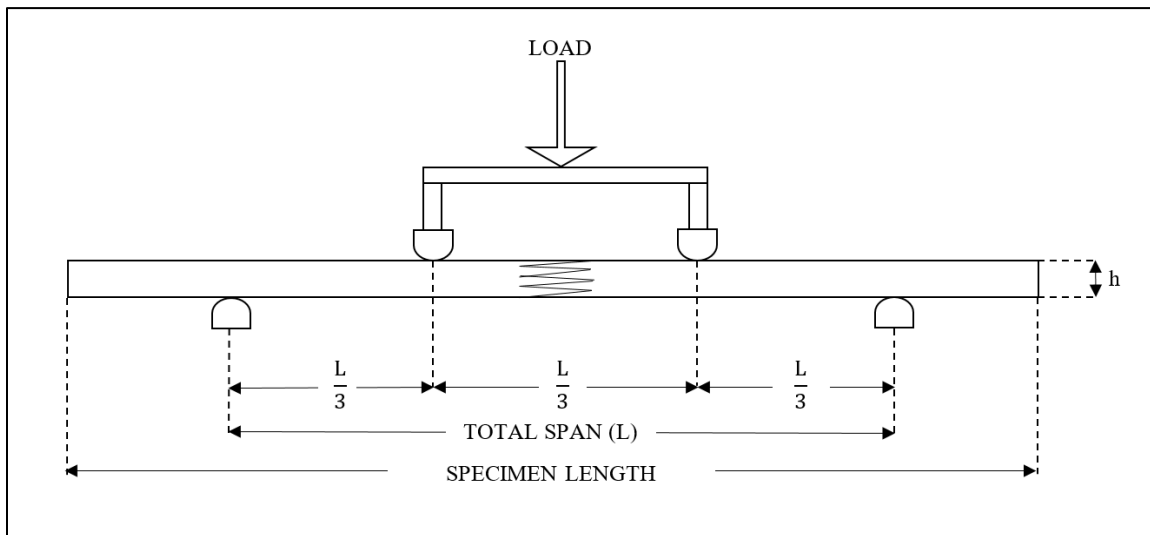
## 2.3 FULL-SIZE END JOINT BENDING TEST

2.3.1 A minimum of 53 end joints shall be tested.

2.3.2 A specimen for the determination of bending strength shall consist of a full-size piece in accordance with ASTM D4761 of fingerjoined lumber containing at least one fingerjoint positioned in such a way that when the specimen is tested in bending, the fingerjoint is located at mid-span.

2.3.2.1 The minimum failure bending stress of all test specimens shall equal or exceed the adjusted bending stress as determined according to section 5.1 of the Full-Size End Joint Bending Test in Appendix B.

2.3.3 Third-point loading shall be used, with the two loading points symmetrically placed on either side of the finger joint. The loading points shall be placed adjacent to and spanning the fingerjoint, approximately 2" from the joint area. See image below:



2.3.4 The load shall be applied at uniform rate of movement not to exceed 5" of crosshead movement per minute. The test loading rate must not exceed the ability of the load measuring device on the testing machine to respond accurately.

2.3.5 The specimen shall be tested with a shear span to depth ratio between 15 and 21, where depth is the dimension of the specimen under test in the direction in which the loading force is applied.

2.3.6 95% of the tests shall equal or exceed the 5<sup>th</sup> percentile bending strength values

## **2.4 QUALIFICATION**

- 2.4.1 Qualification is considered successful after all the required qualification tests are successful. To qualify for grade marking as "Stud Use Only," samples shall either pass the Full-Size End Joint Tension or Bending and Cyclic Delamination Tests.
- 2.4.2 If any qualification tests fail, the problem(s) shall be identified, and corrected prior to further qualification testing.
- 2.4.3 Unsuccessful qualification tests may be repeated once. For example, if the Full-Size End Joint Tension pass or the Full-Size End Joint Bending test passes and Cyclic Delamination Test fails, only the Cyclic Delamination Test would need to be repeated.
- 2.4.3.1 If the second qualification test fails, the qualification is considered unsuccessful and the problem(s) shall be identified and corrected prior to further qualification testing. The Full-Size End Joint Tension or Bending and Cyclic Delamination Tests shall be repeated

## **3. DAILY QUALITY CONTROL TESTS**

The test 3.1 Cyclic Delamination shall be performed as part of a daily quality control program. Also, either 3.2 Full-Size End Joint Tension Test or 3.3 Full-Size End Joint Bending Test shall be performed as part of a daily quality control program.

### **3.1 CYCLIC DELAMINATION - SEE APPENDIX B.**

- 3.1.1 A minimum of 1 specimen per production shift shall be sampled and tested.
- 3.1.2 Samples shall be evaluated for delamination in accordance with the procedures specified in the Cyclic Delamination Test, see Appendix B. Delamination after one complete cycle shall not exceed 5 percent. If the delamination is more than 5 percent, the sample may be subjected to a second complete cycle. The delamination after the second cycle shall not exceed 10 percent, see Figure 3.
- 3.1.3 If the delamination of the sample exceeds 10% after the second complete cycle, production shall be stopped until the problem is identified and corrected.
- 3.1.3.1 Normal production shall continue once a qualification sample has been collected, tested, and qualified in accordance with Section 2.1.
- 3.1.3.2 All production manufactured between the last passing test and the stoppage of production shall be held and reworked.
- 3.1.3.3 If the held lumber can be segmented into lots based on time of production, individual lots may be tested and qualified.
- 3.1.3.4 The test shall consist of a minimum of five randomly selected samples collected from the lot.

3.1.3.5 The acceptance of individual lots shall be based on Section 3.1.2.

### **3.2 FULL-SIZE END JOINT TENSION TEST - SEE APPENDIX B.**

3.2.1 A minimum of one end joint per hour of production (eight per shift) with no fewer than five end joints per partial shift of production shall be sampled and tested.

3.2.2 All pieces shall equal or exceed the minimum end joint tensile stress value as specified in section 2.2.2.1. If a piece fails below the minimum tensile stress, production shall be stopped until the problem is identified and corrected and WCLIB shall be immediately notified.

3.2.3 If a quality control test value falls below the 5<sup>th</sup> percentile value as determined according to section 2.2.2, but not less than the minimum end joint strength value, the test values of at least 27 of the next 28 pieces shall equal or exceed the 5<sup>th</sup> percentile tensile stress value. WCLIB shall be immediately notified.

3.2.4 If testing reveals that production is out of compliance by failing to meet the requirements of sections 3.2.2 or 3.2.3, the non-compliance provisions of Part I, section 8.1.1 shall be applied.

### **3.3 FULL-SIZE END JOINT BENDING TEST**

3.3.1 A minimum of one end joint per hour of production (eight per shift) with no fewer than five end joints per partial shift of production shall be sampled and tested.

3.3.2 All pieces shall equal or exceed the minimum end joint bending stress value as specified in section 2.3.2.1. If a piece fails below the minimum bending stress, production shall be stopped until the problem is identified and corrected and WCLIB shall be immediately notified.

3.3.3 If a quality control test value falls below the 5<sup>th</sup> percentile value as determined according to section 2.3.2.1, but not less than the minimum end joint strength value, the test values of at least 27 of the next 28 pieces shall equal or exceed the 5<sup>th</sup> percentile tensile stress value. WCLIB shall be immediately notified.

3.3.4 If testing reveals that production is out of compliance by failing to meet the requirements of sections 3.3.2 or 3.3.3, the non-compliance provisions of Part I, section 8.1.1 shall be applied.

## REFERENCES

1. American Lumber Standard Committee (ALSC) P.O. Box 210  
Germantown, MD 20875-210
  - a. ALSC, Incorporated, Glued Lumber Policy, November 8, 2013.
2. ASTM International, Inc. 2017. Annual Book of ASTM Standards, Volume 15.06, Adhesives, ASTM International, Inc. 100 Barr Harbor Dr. West Conshohocken, PA. 19428-2959
  - a. D 2559-12a Standard Specification for Adhesives for Bonded Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions
3. West Coast Lumber Inspection Bureau (WCLIB), P.O. Box 2316, Portland OR 97281
  - a. Standard No. 17, Grading Rules for West Coast Lumber, 2015.

## **Appendix A**

### **Testing Forms**





**SUPERVISORS MONTHLY REPORT  
END-JOINTED LUMBER (CERT. END JOINT & STUD USE ONLY)  
OR STRUCTURAL GLUED LUMBER (IF END-JOINTED)**

**PART I.**

Mill Name:		Test Date:	
Mill Location:		WCLIB Supervisor:	
Species:		Lumber Size:	
Grades Produced:		Finger Length:	
Test Sample Production Date:		Shift:	

**PART II.**

Adhesive Application:		Excessive		Adequate		Insufficient
Squeeze Out:		Excessive		Adequate		Insufficient
Adhesive Batch Test Results:		Good		Fair		Poor
Finished Joint Appearance:		Good		Fair		Poor
Positioning & Alignment:		Good		Fair		Poor
Explain any Fair or Poor findings along with corrective actions taken:						

**PART III.**

Are daily test records available?		Yes		No
If No, explain				
Latest Test Results:		In Compliance		Not in Compliance

**QC STRENGTH TESTING RESULTS**

Strength (Tension or Bending)	#1:	#2:	#3:	#4:
	#5:	#6:	#7:	#8:
Required Joint Strength:	Pounds:		Psi:	

**CYCLIC DELMINATION RESULTS**

Cycle No.1		%	Cycle No.2 (if required)		%
------------	--	---	--------------------------	--	---

**PART IV.**

Deficiencies noted & corrective actions taken:	



## SUPERVISORS MONTHLY REPORT STRUCTURAL GLUED LUMBER (SHEAR TESTS ONLY)

### PART I.

Mill Name:		Test Date:	
Mill Location:		WCLIB Supervisor:	
Species:		Grades Produced:	
Test Sample Production Date:		Shift:	

### PART II.

Adhesive Application:		Excessive		Adequate		Insufficient
Adhesive Batch Test Results:		Good		Fair		Poor
Explain any Fair or Poor findings along with corrective actions taken:						

### PART III.

Are daily test records available?	Yes:		No:	
If No, explain				
Latest Test Results:	In Compliance		Not in Compliance	

### QC SHEAR TEST RESULTS

Strength:	#1		#2		#3		#4		#5	
	#6		#7		#8		#9		#10	
Wood Failure, %:	#1		#2		#3		#4		#5	
	#6		#7		#8		#9		#10	
Required Shear	Pounds:		psi:							

### CYCLIC DELMINATION RESULTS

Cycle No.1		%	Cycle No.2 (if required)		%
------------	--	---	--------------------------	--	---

### PART IV.

Deficiencies noted & corrective actions taken:	



**END-JOINT QUALITY CONTROL FORM  
WEST COAST LUMBER INSPECTION BUREAU  
TENSION TESTS**

Mill:		Ft Value (psi)	
Species:		Ft * 2.1 (psi)	
Grade:		Ft * 1.25 * 2.1 (psi)	
Size:		Tested By	

**TENSION TEST**

Days/Shift <sup>1</sup>						
Test Value <sup>2,3,4</sup>	UTS	UTS	UTS	UTS	UTS	UTS
Piece No. 1						
Piece No. 2						
Piece No. 3						
Piece No. 4						
Piece No. 5						
Piece No. 6						
Piece No. 7						
Piece No. 8						
# of pieces < 5 <sup>th</sup> %tle F-t						
# of pieces < Min. F-t						

- <sup>1</sup> A minimum of one (1) end-joint per hour per shift (8 hours) with not fewer than five (5) end-joints collected during any production shift of less than five (5) hours.
- <sup>2</sup> If an Ultimate Tensile Stress (UTS) value is less than the 5<sup>th</sup> %tle Ft (as determined at the time of qualification) and greater than the minimum Ft as (determined at the time of qualification), the UTS values for the next 27 pieces must exceed the 5<sup>th</sup> %tle Ft. Contact the appropriate WCLIB personnel.
- <sup>3</sup> If a UTS test value is less than the minimum Ft, the process is out of control, contact appropriate WCLIB personnel.
- <sup>4</sup> UTS = ultimate tension load/ (thickness of the piece x width of the piece)

GLUED LUMBER DAILY QUALITY CONTROL FORM  
WEST COAST LUMBER INSPECTION BUREAU  
SHEAR TEST

MILL		SPECIES		SIZE		TEST DATE	
LOCATION		GRADE		GLUE		TEST BY	
AVERAGE REQUIRED SHEAR STRESS (PSI)		AVERAGE REQUIRED WOOD FAILURE		WCLIB PROJECT NO.			

DATE/SHIFT												
	Shear Stress, psi	% Wood Failure	Shear Stress, psi	% Wood Failure	Shear Stress, psi	% Wood Failure	Shear Stress, psi	% Wood Failure	Shear Stress, psi	% Wood Failure	Shear Stress, psi	% Wood Failure
Piece No 1												
No. 2												
No. 2												
No. 2												
No. 2												
No. 2												
No. 2												
No. 2												
No. 2												
No. 2												
Sum of Test Values												
Average (Sum/10)												

1. FOR THE MINIMUM REQUIRED AVERAGE SHEAR STRENGTH, SEE SHEAR TEST IN WCLIB GLUED LUMBER STANDARD, APPENDIX B.
2. THE AVERAGE PERCENT WOOD FAILURE SHALL EUQAL OR EXCEED 70% FOR SOFTWOODS AND NON-DENSE HARDWOODS AND 50 % FOR HARDWOODS.
3. IF TEST AVERAGE IS LESS THAN THE MINIMUM REQUIRED SHEAR STRENGTH VALUE, THE PROCESS IS OUT OF CONTROL. GO TO REQUALIFICATION.

West Coast Lumber Inspection Bureau  
Portland, Oregon  
End-Jointed Lumber Tension Testing Qualification Form

Page \_\_\_ of \_\_\_

Client:		Species:		Grade:		WCLIB No:	
Location:		Size:		End-Joint Length:		Test Date:	
Min Req'd Stress (psi):		Min Req'd Load (psi):		Adhesive:		Test By:	

Piece No.	Thickness, (In)	Width, inches	Max. Gauge Pressure, psi	Max. Load, lbs	Max Lumber Tensile Stress, psi	Failure Mode	MC No. 1, %	MC No. 2, %	# of Joints between grips	Wood Failure, %	Comments

5 <sup>th</sup> Percentile Grade/Size/Species Tensile Stress = (Ft *1.25*2.1)		Min. Required Grade/Size/Species Tensile Stress = (Ft*2.1)	
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## **Appendix B**

### **Test Procedures**

## **Cyclic Delamination Test**

December 21<sup>st</sup>, 2018

### **1 Scope**

- 1.1 This test method provides a procedure for assessing the ability of an adhesive bond to resist separation after repeated exposure to wetting and drying.

### **2 Summary of Test Method**

- 2.1 The end-grain surfaces of a bonded wood cross-section are exposed to a vacuum-pressure soak cycle at room temperature. The specimen is then dried to  $\pm 15\%$  of the original test specimen weight prior to visual evaluation.
- 2.2 This test method conforms with Test Method B of ASTM D 1101-97a (Reapproved 2013), “Standard Test Methods for Integrity of Adhesive Joints in Structural Laminated Wood Products for Exterior Use” as published by ASTM International, Incorporated and can be found in the 2018 Annual Book of Standards, Volume 15.06.

### **3 Test Equipment**

- 3.1 Autoclave - An autoclave or pressure vessel capable of safely withstanding a minimum pressure of 75 pounds per square inch (psi) and drawing and holding a vacuum of 25 inches mercury (at sea level).
- 3.2 Drying oven - a drying oven capable of maintaining a minimum temperature of 160° F (71 °C) and an air flow of 500 feet/minute,  $\pm 45$ -50 air changes per minute) when oven is empty.
- 3.3 Scale (recommended) - A weight-measuring scale for determining if the test samples have been adequately dried.
- 3.4 Optical equipment (recommended) - A magnifying glass with a minimum of 3X magnification capacity to visually examine the samples.

### **4 Specimens and Conditioning**

- 4.1 Specimen dimensions
  - 4.1.1 End Joints - The test specimens shall be prepared from a full cross-section piece measuring approximately 6 inches long with an end-joint in the center of the piece.

- 4.1.1.1 Specimen preparation - The test specimen shall be crosscut through the center of the end-joint so the adhesive bond-lines on the end-grain are exposed and yields two pieces, approximately 3 inches long, see Figure No. B2.
- 4.1.2 Face Bond - Each test specimen shall be a minimum of 6 inches deep, or the full depth of the member section if less than 6 inches deep. The length of each specimen shall be 3 inches, see Figure No. B1.

## **5 Procedure**

- 5.1 The test specimens shall be placed in the pressure vessel and weighted down (if necessary). Sufficient water shall be admitted into the vessel so that the test specimens are submerged. The water temperature shall be 65 to 80 °F (18 to 27 °C).
- 5.2 Apply a vacuum of 20 to 25 inches of mercury (at sea level) and hold for 30 minutes.
- 5.3 Release the vacuum and apply a pressure of  $75 \pm 5$  psi for 2 hours.
- 5.4 Remove the test samples from the vessel and dry them in the oven until within 12 - 15 % of their original weight.

## **6 Measurements and Calculations**

- 6.1 At the end of the drying period, the crosscut surface of the specimens shall be examined immediately for separation for delamination (separation of the bond-lines). Indeterminate areas may be probed with a 0.004-inch feeler gauge.
- 6.2 The portions of the adhesive bond-lines that are delaminated are measured to the nearest 1/16 inch and are reported as a percentage of the total of bond line lengths on both faces of the sample block.
- 6.3 It is permitted to ignore the following:
  - 6.3.1 Delamination in the bond-lines adjacent to the outer fingers.
  - 6.3.2 Delamination less than 0.1 inches long.
  - 6.3.3 Delamination within knot boundaries.

## **7 Performance Requirements**

- 7.1 If the delamination observed after one cycle exceeds 5% the test specimen will be subjected to a second vacuum-pressure-drying cycle. If the observed delamination of the test specimen at the end of the second cycle exceeds 10%, the test sample has failed the test.



## **8 Report**

8.1 The report shall include the following:

- a.) The weights before and after the conditioning shall be recorded.
- b.) The temperature of the oven, relative humidity, and time to final delamination reading shall be recorded.
- c.) The percentage of delamination shall be recorded for each specimen tested.
- d.) Corrective actions shall be documented in the daily records any time test results show delamination greater than 5%.

FIGURE NO. B1 - FACE BOND CYCLIC DELAMINATION TEST

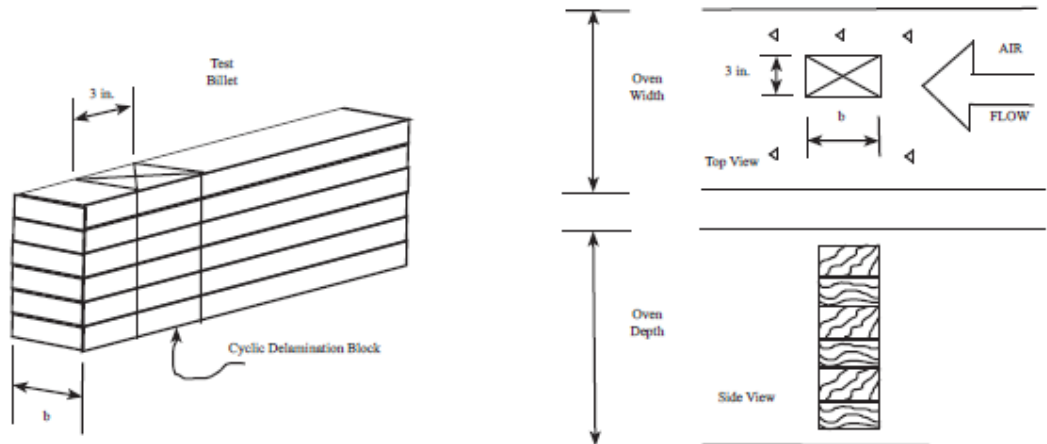
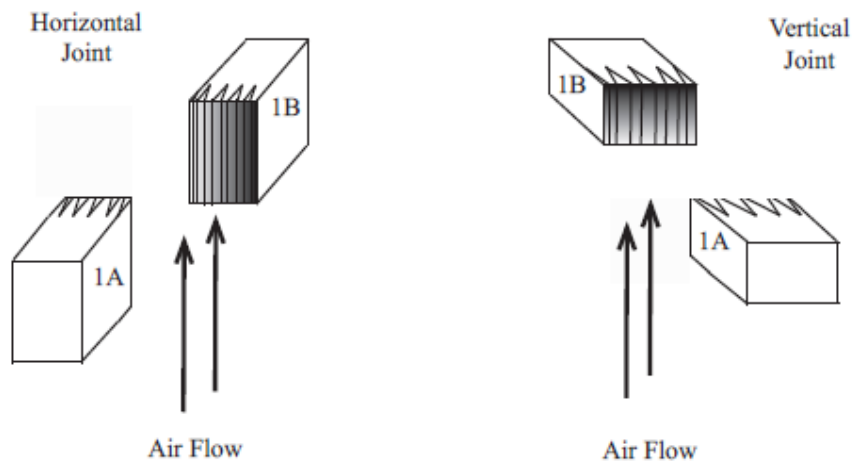


FIGURE NO. B2 - END-JOINT CYCLIC DELAMINATION TEST SPECIMEN



NOTE: Adapted from American Institute of Timber Construction (AITC)  
Standard AITC 200-2004.

## **Full-Size End Joint Tension Test**

December 21<sup>st</sup>, 2018

1. Scope
  - 1.1 This test method provides procedures for the determination of axial tensile capacity of full-size end-joints.
  - 1.2 Applications of this test method include: end-joint qualification and daily quality control of production.
2. Summary of the Test Method
  - 2.1 The test specimen shall be subjected to an axial tension load. The length of the specimen shall be short enough to help ensure that failures occur primarily at the end-joint, but long enough that the stresses at the end-joint are not affected by the grips. It is recommended that the distance between the grips be a minimum of 24-inches.
  - 2.2 Except as specified, the specimens shall either be tested according to ASTM D4761 (1).
3. Tension Test Machine
  - 3.1 Test Machine Capacity - The tension test equipment shall be capable of testing the widest single piece of end-jointed lumber produced at the mill of full-width lumber may be ripped if the appropriate calculations are used to adjust the resulting test data.
  - 3.2 Distance Between the Grips - The grips of the tension test machine shall be designed so that the piece is not crushed in a manner that will lead to lower test values. It is recommended that the grips not be spaced closer than 24-inches.
  - 3.3 Accuracy - The force-measuring equipment shall be calibrated so that the error of the load measurements does not exceed  $\pm 2.0\%$ .
4. Test Procedure
  - 4.1 Specimen Measurements - The following data shall be recorded at the time of the test.
    - 4.1.1 Cross-Sectional Dimensions - The thickness and width of the test specimens shall be measured to the nearest 0.01 inches (0.25 mm).
    - 4.1.2 Moisture Content - Unless otherwise specified by the durability conditioning protocol, the moisture content of the test specimens shall be measured on each side of the joint according to ASTM D 4442 (1) or ASTM D4444 (1).

- 4.1.3 Maximum Tension Failure or Proof Load - The maximum tension load shall be recorded.
- 4.1.4 Percent Wood Failure - The percent wood failure shall be reported as a percentage of adhesive surface area.
- 4.1.5 Failure Code - The mode of failure shall be recorded by referencing the failure mode found in Table D of Appendix B.
- 4.2 Test Set-up - As close as possible, the end-joint shall be centered between the grips. The test specimen shall be positioned in such a way that longitudinal axis of the specimen coincides with the direction of the load application.
- 4.3 Speed of Testing - The test rate shall be such that the sample target load would be achieved in approximately one minute. The failure load should not be reached in less than 10 seconds or more than 10 minutes.
- 5.0 Ripped Lumber - It is strongly recommended that the tension tests be performed on full-size pieces of lumber. However, if the pieces in the test samples are ripped so that the test specimens are of equal width to represent a smaller nominal size, the maximum failure or proof-load shall be multiplied by the following adjustment factors.

Nominal Test Specimen Width, inches	Ripped Lumber Adjustment Factor	Nominal Product Width, inches
4	0.90	8
5	0.87	10
6	0.84	12

## 6. Analysis of test data

- 6.1 The minimum required ultimate tensile stress (UTS) for the sample is as follows:

$$UTS = 2.1 * F_t * C_{1t} * C_{2t} * C_3 \quad (1)$$

Where:

UTS = adjusted tension strength requirement

$F_t$  = assigned  $F_t$  for the species/species group, size and grade tested

$C_{1t}$  = finger-jointing factor of 1.25 for the fifth percentile estimates, and 1.00 for the base joint strength

$C_{2t}$  = finger-joint profile tension factors as shown in Table 4

$C_3$  = reduced finger-joint width factor. For unreduced width (full board width) test

specimen, use 1. Otherwise, use the value in Table 2 for reduced width (ripped) test specimen.

<b>C<sub>2t</sub> TABLE 1</b> Values of Finger-Joint Profile Tension Factors	
Specimen Type	Fifth Percentile or Minimum Joint Strength
Full Cross-section	1.00
Rectangular Fraction Section <sup>-1</sup>	1.15

<sup>1</sup> Fractional section shall be at least 3/4" in thickness

<b>C<sub>3</sub> TABLE 2</b> Values of C <sub>3</sub> Factors for Finger-Joint Specimen Reduced in Width (Ripped) for Testing					
Reduced specimen width (actual)	Original (un-ripped) Lumber Board Width (nominal)				
	2X4	2X6	2X8	2X10	2X12
1.5 inches by original thickness (e.g. reduced to nominal 2" width)	1.05	1.11	1.17	1.24	1.33
2.5 inches by original thickness (e.g. reduced to nominal 3" width)	1.03	1.08	1.14	1.21	1.29
Half of original product width less saw kerf	1.05	1.08	1.11	1.15	1.19
<i>Note to C<sub>3</sub> Table: <math>C_3 = \frac{7270-177h_1}{7270-177h_2}</math></i> <i>Where: <math>h_1</math> = Reduced width specimen dimension in the direction of the applied test load</i> <i><math>h_2</math> = Full Board width specimen dimension</i>					

<b>"k" Value TABLE 3</b>	
Joint Profile	k
Vertical	0.50
Horizontal	0.60

- 6.1.2 When the ratio of Ft/Fb assigned to the highest grade level qualified is less than the value of 0.50 for vertical end-joints or 0.60 for horizontal end-joints, and no bending qualification tests are conducted, the following factors shall be substituted in equation No. 1 in section 6.1:

Ft = use the assigned Fb for the size and grade tested.

$C_{1t} = 1.575$  for the 5<sup>th</sup> percentile tolerance limit (75% confidence) and 1.26 for the minimum joint strength.

## 6.2 Test Sample Size and Determination of Non-Parametric Order Statistics

Sample Size	Pieces Permitted < Required Min. Joint Strength	Order Statistic Equal to 5 <sup>th</sup> %tle Non-parametric TL, 75% Confidence <sub>1</sub>
53	0	2
78	0	3
102	1	4
125	1	5
148	2	6

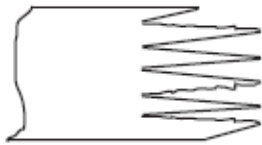
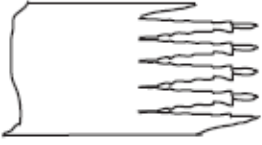
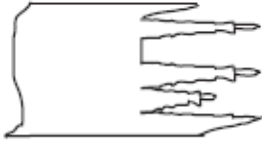

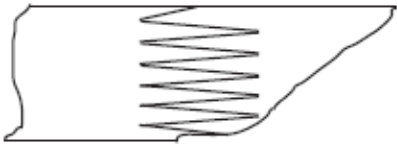
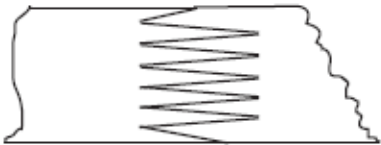
<sub>1</sub> Sample sizes and order statistics from ASTM D 2915, Table 2 (1).

## REFERENCES

1. ASTM International Inc. 2017. Annual Book of Standards, Volume 04.10, Wood, ASTM International, Inc. 100 Barr Harbor Dr. West Conshohocken, PA 19428-2959
  - a. D 2915- 10 Standard Practice for Evaluating Allowable Properties for Grades of Structural Lumber.
  - b. D 4442 16 Standard Test Methods for Direct Moisture Content Measurement of Lumber and Wood-Base Materials.
  - c. D 4444 -13 Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters.
  - d. D 4761 - 13 Standard Test Method for Mechanical Properties of Lumber and Wood-Base Materials.
2. ASTM International, Inc. 2017. Annual Book of Standards, Volume 15.06, Adhesives, ASTM International, Inc. 100 Barr Harbor Dr. West Conshohocken, PA. 19428-2959
  - a. D4688 -14 Standard Test Method for Evaluating Structural Adhesives for Finger Jointing Lumber.

## FAILURE MODE CLASSIFICATIONS OF TESTED SPECIMENTS

TABLE D. Adapted from ASTM D 4688, Figure A 1-1. The types of failure that occur in finger jointed specimens due to tension loading may be roughly classified into six modes. Determine the failure mode of each specimen based on the written and graphical description given in A1.1.

<u>Mode</u>	<u>Description</u>	<u>Example</u>
1.)	Failure mostly along the bondline surfaces of the joint profile with poor wood failure of an kind. (wood failure < 70%).	
2.)	Failure mostly along the bondline surfaces of the joint profile with good wood shear failure (wood failure > 70%).	
3.)	Failure mostly along the joint profile but with some failure at the finger roots or scarf tips. Good overall wood shear failure along the joint profile surfaces.	
4.)	Mostly tensile wood failure at the fingerjoint roots or scarf tips and with high overall wood failure. Little failure of any kind along the joint profile.	
5.)	Failure beginning at the joint (possibly due to a stress riser) and progressing away from the joint. Essentially 100% wood failure	
6.)	Failure away from the joint (not influenced by the joint) -- all wood failure.	

Note: Test specimens exhibiting Mode 6 type failure may be excluded from the test results if the test strength value is below the required strength value for the species/grade/size combination.



## **Shear Test**

December 21<sup>st</sup>, 2018

### **1. Scope**

- 1.1 This test method provides procedures for the determination of comparative shear strengths of adhesive bonds used for bonding wood when tested on a standard specimen under specified conditions, conditioning, and loaded in compression. The shear test shall be in conformance with ASTM D 905 (4), Section 14 (Resistance to Shear by Compression Loading), or the American Institute of Timber Construction (AITC) Test, T107, Shear Test (1).
- 1.2 Applications of this test method include: evaluation of new adhesives, face-bond qualification, and quality control of production.

### **2. Summary of the Test Method**

- 2.1 The test specimen shall be prepared from production and sheared parallel to the grain along the face bond lines. The strength of the bond line is compared to the assigned shear strength for the species. The estimated wood failure is also evaluated.
- 2.2 Except as specified, the specimens shall be tested according to ASTM D 2559 (2), or the AITC Test T107 (1). An example of a block-shear test apparatus can be found in ASTM D 905 (2).
- 2.3 Qualification Sample Size - A minimum of 20 test specimen shall be selected for qualification testing.

### **3 Shear Test Machine**

- 3.1 Test Machine Capacity - The shear test equipment shall be capable of applying opposing loads parallel to the wood grain along the face bond line. An example of a test machine can be found in ASTM D 905 (2).
- 3.2 Accuracy - At least annually, the accuracy of the test equipment shall be conducted to insure the integrity of the force-measuring device. The test equipment shall be calibrated so that the error of the load measurements does not exceed  $\pm 2.0\%$ . The test equipment shall be calibrated more frequently if it is suspected that the current calibration is no longer valid or if there have been substantial modifications made to the test equipment.

## **4 Test Sampling**

Test samples shall be obtained from standard production

### **4.1 Test Specimen Types**

#### **4.1.1 Stepped Block**

4.1.1.1 The stepped block is the standard test specimen configuration, see Figure No. B3.

4.1.2 Core Type - The shear test may be performed on a cylindrical 1-inch diameter core sample. Prior to using this test sample configuration, a correlation the shear test values of a minimum of 20 stepped block and 20 core test samples shall be tested. Matching specimens shall be obtained by cutting the test specimen from the same piece of glued lumber. The core samples shall be taken as close to the block shear samples as cutting conditions permit. The ratio of average shear strength value of the core sample to the block shear test shall be determined. The correlation obtained from this procedure shall be used to adjust the test values of the core test specimens to an equivalent block shear test value, but in no case shall the correlation factor be greater than 1.0 be used.

4.1.3 Straight Block - A straight block test sample configuration may be used in place of a stepped block configuration if it is correlated with the standard stepped block. The same procedure for comparing the stepped block to the core type test specimen in section 4.1.2 shall be used. The dimensions of the face bond area should be approximately the same as the area for the stepped block test samples, see Figure No. B3.

## **5 Test Procedure**

5.1 Specimen Measurements - The following information shall be recorded for each test specimen.

5.1.1 Cross-section Measurements - The cross-section measurements shall be measured and recorded to the nearest 0.01 inches prior to testing.

5.1.2 Maximum Shear Load - The test specimens shall be loaded to failure in shear. The maximum shear load for each test specimen shall be recorded.

5.1.3 Wood Failure - The percent wood failure ( $\pm 5\%$ ) shall be estimated and recorded.

5.1.4 Shear Stress - The shear stress shall be determined by dividing the maximum shear load by the product of the cross-section measurements.

5.2 Speed of Testing - The rate of motion of the testing machine shall be capable of applying a maximum rate of loading not to exceed 0.50 inches per minute.

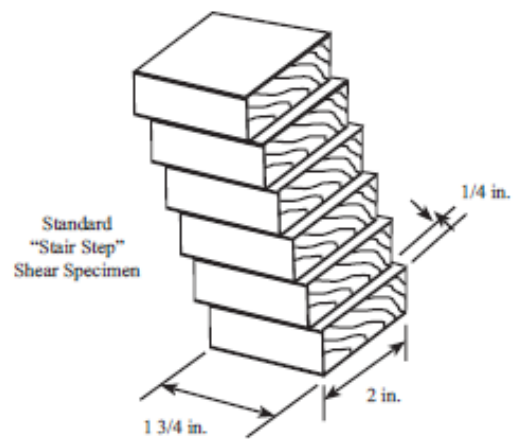
5.3 Performance Requirements

- 5.3.1 Shear Strength - The minimum shear failure for each specimen in the test sample shall equal or exceed 2.1 times the published horizontal shear stress for the species.
- 5.3.2 Wood Failure - The minimum average percent wood failure for the qualification sample shall equal or exceed 80%.
- 5.3.3 Excluded Test Specimen - Test specimen with low shear stress values that are less than the average shear stress for the species and have an estimate wood failure that is less than 75% may be excluded for the test results. When a test specimen is excluded, additional samples shall be selected meet the sample size requirements. A maximum of two specimen per qualification sample may be excluded.

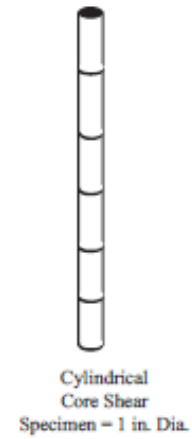
## REFERENCES

1. American Institute of Timber Construction 6960 SW Varns St., Tigard, OR 97223-8281
  - a: Inspection Manual for Structural Glued Laminated Timber, AITC 200-2004
2. ASTM International, Inc. 2018. Annual Book of Standards, Volume 15.06, Adhesives, ASTM International, Inc. 100 Barr Harbor Dr. West Conshohocken, PA. 19428-2959
  - a. D 905-08 (2013) Standard Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading.
  - b. D 2559 -12a Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions.

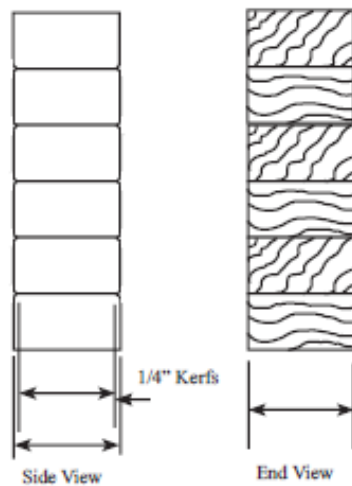
### A. Standard Bloc Specimen



### B. Standard Core Specimen



### C. Alternate Block Design



### D. Other Alternates to Block Shown in C include:

- (1) Alternating the Saw Kerf to Opposite Sides of the Glue Line ---



- (2) No Saw Kerfs at All;  
A Straight 1 1/2 in. x 2 in. Block



Figure No. B3 - Shear Test Specimen Alternatives  
Note: Adapted from AITC 200-2004.

**Appendix C**  
**WCLIB NO. 17, PARAGRAPH 210, STRUCTURAL GLUED LUMBER**

**WCLIB STANDARD No. 17, REVISED SEPTEMBER 1<sup>st</sup>, 2018**

**PARAGRAPH 210. STRUCTURAL GLUED LUMBER**

**210. STRUCTURAL GLUED LUMBER** (All Species)

210. Glued lumber identified as structural glued lumber shall meet both the grade specifications of the grade rule under which lumber is graded, and the glue bond requirements of this paragraph and the WCLIB Glued Lumber Certification and Quality Control Manual. Structural glued lumber identified by a Bureau structural glued quality mark shall be considered as a solid piece. Grade specifications and limitations for structural glued lumber are the same as those for lumber without glued joints. The quality of the joints is considered a separate factor. Structural glued lumber shall be ordered, acknowledged, and invoiced as structural glued lumber.

210a. **“CERTIFIED GLUED LUMBER”**. All structural glued lumber identified by the Bureau Certification of Structural Glue Joint mark shall meet all the requirements of the rules under which it is graded and all applicable requirements for end, face, and/or edge joints for exterior adhesives of American National Standard **ANSI A190.1 2017** for Structural Glued Laminated Timber. Adhesives shall meet the requirements of **ASTM D 2559-12a**.

210b. **“CERTIFIED END JOINT”**. All end jointed material identified by the Bureau Certification of End Joint mark shall meet the applicable requirements for end joints using exterior adhesives of American National Standards **ANSI A190.1 2017** for Structural Glued Laminated Timber.

210c. **“STUD USE ONLY”**. End jointed lumber manufactured with adhesives meeting all of the provisions of **ASTM 2559-12a** for exterior adhesives with the exception of creep (section 16) may be stamped with **“STUD USE ONLY”** end joint stamps. **“STUD USE ONLY”** end jointed lumber is limited to 6” and less in nominal width and 12 feet and shorter length.

Maximum Permitted Knot Size in End-Joint Area

Nominal Width	CERTIFIED END JOINT			
	Select Structural	No. 1	No. 2	No. 3 And Light Framing Grades
2"	3/16"	1/4"	1/4"	3/8"
3"	1/4"	3/8"	1/2"	5/8"
4"	3/8"	1/2"	3/4"	7/8"
5"	1/2"	5/8"	7/8"	1-1/8"
6"	5/8"	3/4"	1"	1-3/8"
8"	3/4"	1"	1-1/8"	1-5/8"
10"	1"	1-1/8"	1-3/8"	1-7/8"
12"	1-1/4"	1-1/4"	1-1/2"	2"

\* Light Framing grades are 4"nominal and less.

Maximum Permitted Knot Size in End-Joint Area

Nom. Width	STUD USE ONLY		
	Select Structural	No.1, No. 2, Const.	Stud, No. 3. Stand., Utility
2"	1/4"	1/4"	3/8"
3"	3/8"	1/2"	3/4"
4"	1/2"	5/8"	1"
5"	5/8"	3/4"	1-1/4"
6"	3/4"	7/8"	1-1/2"