

101.15
C/QC Procedures

Glued Products

Procedures for Mill Certification and Quality Control

Western Wood Products Association



PART A. PRODUCT SPECIFICATIONS

These procedures for Glued Products Mill Certification and Quality Control were approved by the WWPA Quality Standards and Technical Committees.

These grade rules and reinspection portions (Part A) of these procedures were excerpted from Section 1.70 of WWPA Western Lumber Grading Rules.

GRADE RULES

A number of manufacturers produce glued products such as finger-jointed lumber, millwork and mouldings, end and edge-glued boards and laminated products. In all products, the grade limiting characteristics are the same as are imposed on a solid piece of the same grade. The joint shall also be tight and of good appearance. Glued products shall be ordered, acknowledged and invoiced as such.

WWPA Glued Products Certification and Quality Control Procedures are applicable to gradestamped glued products of the species and grades in these rules and conform to the American Lumber Standard Committee Glued Lumber Policy. The Board of Review of the American Lumber Standard Committee monitors compliance to the procedures.

In finger-jointed lumber for which design values are published, the length of individual sections between joints shall be no less than 4". The distance shall be measured as the length of the section that does not contain the joint profile. Sections at ends of the piece are not restricted by length. The joint area shall be free of (1) unsound wood and (2) local grain slope exceeding slope of grain requirements of the grade being furnished.

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

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

White speck or firm honeycomb is permitted in the joint area of finger-jointed VERTICAL USE ONLY material, if the grade permits, when an adhesive is used that conforms to ASTM D2559, with the exception of creep resistance. If an adhesive is used that conforms to all the requirements of ASTM D2559, then the material may be marked "CERT EXT JNTS." In either case, white speck or firm honeycomb is permitted in only one piece of the joint and the joint area shall be free of other strength-reducing characteristics.

VERTICAL USE ONLY finger-jointed lumber shall be in sizes 2x2 through 2x6 only, and in lengths not to exceed 12 feet.

Offsets in Finger-Jointed Lumber

In Dimension lumber marked VERTICAL USE ONLY, offsets of 1/16" are permitted on one edge, provided that offsets on the opposite edge do not exceed 1/32". In Dimension lumber marked CERTIFIED EXTERIOR JOINTS, offsets are permitted up to the allowable skip for the grade, provided that offsets on the opposite edge do not exceed 1/32". Offsets on wide faces are limited to the skip provision for the grade.

REINSPECTION

Any complaint on glued products involving grade, size, species, moisture or tally shall be governed by Section 5.00 of the Standard Grading Rules for Western Lumber of Western Wood Products Association in effect on the date of purchase of the product.

In the case of disputes arising over the strength of glued joints in structural lumber, a sample of the item complained of shall be submitted to a testing laboratory authorized by WWPA. The sample shall consist of 53 pieces selected from the lumber in question by a WWPA Lumber Inspector and shall be prepared, tested and evaluated in accordance with the appropriate section of the WWPA Certification and Quality Control Procedures.

When tests indicate an item does not meet minimum strength requirements, all reinspection and testing costs shall be borne by the seller and the entire item shall be the property of the seller. If more than one item in a shipment is involved in the complaint, reinspection and testing costs shall be prorated between buyer and seller, for that portion of the shipment upon which the complaint was registered, based on the ratio of the invoiced footage of the items found not in conformance to that found in conformance.

Nominal Width	VERTICAL USE ONLY			CERT EXT JNTS			
	Select Structural	No.1, No.2, Const.	Stud, No.3, Stand., Util.	Select Structural	No.1	No.2	Const., Stud, No.3, Stand., Util.
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"

ADHESIVE AND USE REQUIREMENTS

Stress-rated lumber gradestamped CERT EXT JNTS, CERTIFIED FACE GLUING or CERTIFIED EDGE GLUING must be assembled with an adhesive which conforms to ASTM D 2559.

Stress-rated lumber gradestamped with the notation "VERTICAL USE ONLY" and "CERT GLUED JNTS" must be assembled with an adhesive which conforms to:

- a. Type 1 as specified in ASTM D 4317,
- b. wet use requirements of ASTM D 5572, or
- c. ASTM D 2559, with the exception of the test for "Resistance to Deformation Under Static Loading."

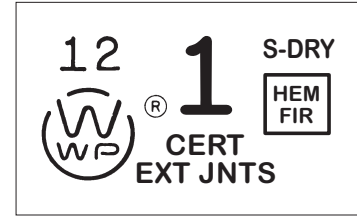
"VERTICAL USE ONLY" lumber assembled with adhesives conforming to the full requirements of ASTM D 2559 may be gradestamped "CERT EXT JNTS".

Finger-jointed lumber gradestamped with the notation "HRA" must be assembled with an adhesive which conforms to Section 1.4.2 of the American Lumber Standard Committee Glued Lumber Policy using ASTM D 7374 or ASTM D 7470.

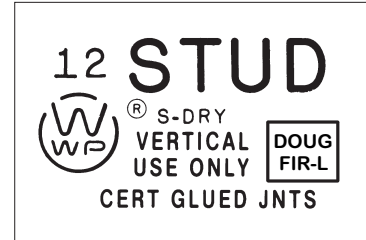
Glued lumber products not assigned design values may be gradestamped, provided adhesives meet requirements of ASTM D 5572.

Adhesive verification tests using ASTM standards must be performed using Douglas Fir and/or Western Larch species. If adhesive verification is for unseasoned lumber, then tests shall be performed on the species to be used in production and in the unseasoned state.

WWPA gradestamped Structural-glued dimension lumber according to these procedures is accepted for use under all U.S. model building codes and may be used interchangeably with solid sawn lumber of the same grade and species. "VERTICAL USE ONLY" is to be used as a vertical end-loaded member in compression where sustained bending or tension loading conditions are not present, and where the moisture content of the wood will not exceed 19 percent in use.



Grade Stamp Facsimile



Grade Stamp Facsimile



Grade Stamp Facsimile

**PART B.
PROCEDURES FOR CERTIFICATION AND QUALITY CONTROL**

Manufacturers producing stress-rated glued products may be certified to use WWPA grade stamps. Use of WWPA grade stamps is made contingent upon meeting the certification requirements set forth herein and subsequently meeting the in-plant quality control requirements specified under each product heading that follows. Certification and daily quality control are required for each product produced except when an adhesive has already been approved for a more-dense species, see Note 1. Each size and species (highest density) shall be certified per manufacturing equipment center.

Manufacturers must possess at each producing location, testing equipment capable of performing certification and subsequent plant quality control tests. WWPA shall calibrate and verify the accuracy of plant test equipment upon initial certification and at least annually thereafter. Calibration force measuring instruments for verifying testing machines shall be in accordance with ASTM E74.

Sample selection, preparation, testing and analysis for initial certification or recertification shall be conducted by, or under the direction of, WWPA. A WWPA technician will familiarize mill personnel with certification and in-plant quality control testing procedures and requirements. In-plant quality control shall be conducted by mill personnel, subject to monthly visual grade inspections by WWPA Lumber Inspectors and periodic review of plant procedures and recordkeeping by a WWPA technician. Records of test equipment calibrations, quality control tests, and production interruptions caused by out of control situations shall be maintained at each producing location, retained for at least one year, and shall be available to WWPA during normal working hours.

Except as noted below, each grade or product for which use of a WWPA grade stamp is authorized must meet certification requirements. Mills in continuous production (without production stoppages extending beyond one year) need only an original certification.

Recertification may be required upon:

- a. Significant modification of the adhesive formula, or change in adhesive curing methods,
- b. Change in finger-joint configuration, or significant change in finger-joint equipment,
- c. Nonproduction beyond one year.

Note: Density and wood structure affect gluing characteristics. Therefore, if a high-density species with its design values is certified, any less-dense species will also qualify for its design values. The following table indicates the relative densities of western species, with Douglas Fir-Larch species being most dense.

Table 1

DENSITY CLASSIFICATION

<u>Species</u>	<u>Specific Gravity</u>
Douglas Fir-Larch	0.50
Douglas Fir (South)	0.46
Hem-Fir	0.43
Spruce-Pine-Fir (South)	0.36
Western Cedars	0.36
Western Woods or White Woods	0.36
<i>(any western species, singly or in combination, except Redwood)</i>	

**FINGER-JOINTED LUMBER
CERTIFIED EXTERIOR JOINTS**

1.0 TEST EQUIPMENT

1.1 General

Each producing plant must possess the following equipment capable of testing samples from production:

- 1.1.1 Tension-testing equipment capable of testing full-size specimens.
- 1.1.2 A pressure vessel and a drying oven, adequately sized and equipped to perform the Cyclic Delamination test described in Appendix A.

2.0 CERTIFICATION

2.1 Qualification

In order to qualify for use of WWPA grade stamps, tension tests of 53-piece samples and delamination tests of 20-piece samples from production are required. Additional tension samples may be tested to qualify when in accordance with the *Sample Size and Statistic Table for Joint Strength* in Section 2.4.

2.2 Sample Selection and Preparation

2.2.1 Tension-test specimens shall be selected from normal production by a WWPA Lumber Inspector, and be of a length to minimize failure at the grip and provide a gauge length of at least four times the nominal specimen width. Specimens shall be full-size with the joint centered in the length, and of a quality consistent with the grade for

which certification is desired. In instances where test equipment would not permit full-size testing, pieces may be ripped through the wide face and tested in accordance with Section 2.3.1.

2.2.2 Delamination-test specimens shall be selected from normal production by a WWPA Lumber Inspector. Each specimen shall be the full depth of the member and three inches long with the joint centered. The specimen shall be crosscut through the joint, exposing all fingers.

2.3 Testing

2.3.1 For the tension tests, finger joints shall be centered between the grips spaced no closer than four times the nominal specimen width. Each piece shall be tested at a maximum load rate of 4,000 psi per minute. When test apparatus limitations require ripping the wide widths into two pieces of equal width, the two test values shall be averaged and adjusted per Table 2 to represent the stress of the wide piece. The maximum load, calculated stress and percent wood failure (for those failed) shall be recorded for each specimen.

2.3.2 Delamination-test specimens shall be subjected to the vacuum-pressure-drying cycle as described in Appendix A.

2.4 Test Analysis

2.4.1 The highest allowable design value and corresponding grade for which CERT EXT JNTS grade stamps may be issued shall be determined by the adjusted lowest base and fifth percentile tensile strength values calculated from the test results. The tensile strength values for qualifying to a particular design level must meet requirements according to *Sample Size and Statistic Table for Joint Strength*. When certification or daily quality control specimens are ripped from the product being manufactured, the test data shall be adjusted by the width effect factors shown in Table 2.

Sample Size and Statistic Table for Joint Strength*

Sample Size	Base Joint Strength	5th Percentile Joint Strength
	Pieces Permitted < Required	Order Statistic
53	0	2
78	0	3
102	1	4
125	1	5
148	2	6

*Sample sizes selected from ASTM D 2915, Table 2. Sample sizes which have whole number order statistics for the 5% Nonparametric Tolerance Limit, 75% confidence.

The required tensile joint strength for both the adjusted base joint strength and fifth percentile tolerance limit (75% confidence) shall be computed in accordance with the following equation:

$$UTS = 2.1 * F_t * C_{1t} * C_{2t} * C_3$$

where:

- UTS = adjusted tensile strength requirement, psi
- F_t = assigned F_t for size and grade tested, psi
- C_{1t} = finger-joint factor: 1.00 for the base joint strength, and 1.25 for the fifth percentile estimate
- C_{2t} = finger-joint profile factor: 1.00 for full-cross-section specimens and 1.15 for rectangular fractional section specimens
- C₃ = reduced finger-joint width factor, for full-cross-section use 1.00 and for ripped specimens use C₃ in Table 2

When the ratio of F_t/F_b assigned to the highest grade level to be qualified is less than 0.50 for a vertical joint profile or 0.60 for a horizontal joint profile, the following factors shall be substituted in the above equation:

- F_t = use assigned F_b for size and grade tested
- C_{1t} = use 0.60 for the minimum joint strength, and 0.75 for the fifth percentile estimate

Note: Full cross-section tests are in accordance with AITC test T119. Fractional section specimens shall be at least 0.75" in thickness. The test span for fractional section specimens shall be of sufficient length to minimize extraneous influences in the joint area resulting from gripping the test specimen.

Table 2

REDUCED FINGER-JOINT WIDTH EFFECT FACTORS, C₃

To adjust the calculated average stress of the two smaller ripped specimens of equal width to represent the nominal product size, multiply by the appropriate 1/C₃ factor:

Nominal Specimen Width	C ₃	1/C ₃ Factor	Nominal Product Width
2"	1.05	0.95	4"
3"	1.08	0.92	6"
4"	1.11	0.90	8"
5"	1.15	0.87	10"
6"	1.19	0.84	12"

- 2.4.2 Delamination specimens shall exhibit delamination not to exceed 5 percent.
- 2.4.3 Adjustments to strength test data for moisture content shall be in accordance with ASTM D 1990, Annex A1 or D 2915, section 4.2 or other recognized consensus standard.

3.0 PLANT QUALITY CONTROL

3.1 Sample Selection and Preparation

- 3.1.1 One piece from production for each test (tension, delamination) shall be selected each hour to verify conformance to certification levels with not fewer than five (5) specimens collected during any production shift of less than five (5) hours. (For the first five shifts of production following initial certification, pieces shall be selected every half-hour of production.)

When all structural glued lumber production is subjected to a proof load of at least 1.3 times the assigned allowable stress the sampling frequency may be reduced to one (1) specimen per four (4) hours per shift (8 hours) with not fewer than two (2) specimens collected during any production shift of less than eight (8) hours.

When rough lumber is glued and intended to be surfaced, sample selection shall occur after material has been planed or profiled. Sample selection shall represent hourly production rate of finger-joint manufacturing equipment center.

- 3.1.2 Specimens shall be prepared in accordance with Section 2.2.

3.2 Testing

- 3.2.1 Tension-test specimens shall be loaded per Section 2.3 to the adjusted fifth percentile joint strength required for the applicable tension design value as calculated per Section 2.4. The maximum load, calculated stress and percent wood failure (for those failed) shall be recorded for each specimen.
- 3.2.2 Cyclic Delamination-test specimens shall be subjected to the vacuum-pressure-drying cycle as described in Appendix A. The percent of delamination shall be recorded for each specimen.

3.3 Test Analysis

- 3.3.1 If test results of each tension test specimen equal or exceed the adjusted base joint strength for the Ft design value assigned the highest grade being produced, the process is considered *in control* and all lumber represented by the sample is satisfactory for shipment..
- 3.3.2 If a tension test value falls below the adjusted fifth percentile strength value, but not below the adjusted base joint strength value, the item shall be monitored so that at least 27 of the next 28 pieces equal or exceed the adjusted fifth percentile strength value.
- 3.3.3 Should a specimen fail away from the end joint and below adjusted base or fifth percentile strength requirements, a substitute piece may be selected from the same production run and tested.
- 3.3.4 If the delamination-test specimens exhibit delamination of 5 percent or less the process is considered *in control* and all lumber represented by the sample is satisfactory for shipment.
- 3.3.5 If a sample does not meet the requirements of Section 3.3.1, 3.3.2 and 3.3.4, the process is considered *out of control* and all lumber represented by the sample shall be held pending confirmation tests outlined in Section 10.

**FINGER-JOINTED LUMBER
VERTICAL USE ONLY**

4.0 TEST EQUIPMENT

4.1 General

Each producing plant must possess the following equipment capable of testing samples from production:

- 4.1.1 Bending-test equipment capable of testing grades and sizes produced.
- 4.1.2 A pressure vessel and a drying oven adequately sized and equipped to perform the Durability Cycle described in Appendix B.

5.0 CERTIFICATION

5.1 Qualification

In order to qualify for use of WWPA grade stamps, bending tests of a 53-piece sample from production are required. Additional bending samples may be tested to qualify when in accordance with the *Sample Size and Statistic Table for Joint Strength* in Section 5.4.

5.2 Sample Selection and Preparation

- 5.2.1 Samples shall be selected from normal production by a WWPA Lumber Inspector. Specimens shall be of as clear wood as possible with a finger-joint centered in the length.
- 5.2.2 A 1½" square test specimen (± 1/32") shall be obtained from each piece by ripping lengthwise through the wide face. (When specimen dimensions cannot be maintained within the prescribed tolerances, actual measurements shall be taken and used in the stress calculations.) Specimens shall be subjected to the Durability Cycle described in Appendix B prior to bending test.

5.3 Testing

- 5.3.1 Each joint shall be centered in a bending-test span not to exceed 21 times the depth of the specimen. The specimens shall be tested to failure in static bending with equal loads applied at the third points to a face containing the joint profile. The bending test load shall be applied at a rate not to exceed 5" of crosshead movement per minute.
- 5.3.2 The failure load, calculated stress, percent of wood failure and moisture content "before" and "after" the Durability Cycle shall be recorded for each specimen.

5.4 Test Analysis

- 5.4.1 The highest allowable design value and corresponding visual grade for which VERTICAL USE ONLY grade stamps may be issued shall be determined on the adjusted lowest base and fifth percentile bending strength values calculated from the test results. Adjusted bending strength values for qualifying to a particular design level must meet requirements according to *Sample Size and Statistic Table for Joint Strength*.

**Sample Size and Statistic Table
for Joint Strength***

Sample Size	Base Joint Strength	5th Percentile Joint Strength
	Pieces Permitted < Required	Order Statistic
53	0	2
78	0	3
102	1	4
125	1	5
148	2	6

*Sample sizes selected from ASTM D 2915, Table 2. Sample sizes which have whole number order statistics for the 5% Nonparametric Tolerance Limit, 75% confidence.

The required bending joint strength for both the adjusted base joint strength and fifth percentile tolerance limit (75% confidence) shall be computed in accordance with the following equation:

$$MOR = 2.1 * F_b * C_{1b} * C_{2b} * C_3$$

where:

- MOR = adjusted bending strength requirement, psi
- F_b = assigned F_b for size and grade tested, psi
- C_{1b} = finger-joint factor: 1.00 for the base joint strength, and 1.15 (1.10 for 2x3) for the fifth percentile estimate
- C_{2b} = 0.75 for horizontal joint profile and 0.80 for vertical joint profile
- C₃ = reduced finger-joint width factor, for full cross-section use 1.00 and for ripped specimens use C₃ in Table 3

Notes to C_{2b}: Joint profile refers to the orientation of the joint fingers relative to the cross section of the board. If the profile of the fingers is visible on the wider face of the board, the profile is considered vertical. If the profile of the fingers is visible on the narrower face of the board, the profile is considered horizontal.

When the ratio of Ft/Fb assigned to the highest grade level to be qualified exceeds 0.50 for a vertical joint profile or 0.60 for a horizontal joint profile, the following factors shall be substituted in the above equation:

- F_b = use assigned F_t for size and grade tested
- C_{1b} = use 1.6 for the base joint strength, and 1.84 (1.76 for 2x3) for the fifth percentile estimate.

Table 3

REDUCED FINGER-JOINT WIDTH FACTORS, C₃

To adjust the for the reduced product width for specimens ripped to 1½" x 1½", multiply by the appropriate C₃ factor:

Nominal Product Size	C ₃	Net Specimen Size
2x3	1.05	1½" x 1½"
2x4	1.08	1½" x 1½"
2x6	1.11	1½" x 1½"

- 5.4.2 Specimens containing characteristics that do not permit a fair evaluation of bond quality need not be included in the analysis of test results. Additional specimens shall be substituted to maintain the established sample size.
- 5.4.3 Adjustments to strength test data for moisture content shall be in accordance with ASTM D 1990, Annex A1 or D 2915, section 4.2 or other recognized consensus standard.

6.0 PLANT QUALITY CONTROL

6.1 Sample Selection and Preparation

- 6.1.1 One piece from production shall be selected each hour to verify conformance to certification levels with not fewer than five (5) specimens collected during any production shift of less than five (5) hours. (For the first five shifts of production following initial certification, one piece shall be selected every half-hour of production.)

When all structural glued lumber production is subjected to a proof load of at least 1.3 times the assigned allowable stress the sampling frequency may be reduced to one (1) specimen per four (4) hours per shift (8 hours) with not fewer than two (2) specimens collected during any production shift of less than eight (8) hours.

When rough lumber is glued and intended to be surfaced, sample selection shall occur after material has been planed or profiled. Sample selection shall represent hourly pro-

duction rate of finger-joint equipment.

- 6.1.2 Pieces selected shall be of as clear wood as possible with a joint centered in the length.
- 6.1.3 A 1½" square test specimen (± ½") shall be obtained from each piece by ripping lengthwise through the wide face of the piece. Specimens shall be subjected to the Durability Cycle described in Appendix B prior to bending test.

6.2 Testing

- 6.2.1 Specimens shall be loaded per Section 5.3 to the adjusted fifth percentile joint strength required for the applicable bending design stress as calculated per Section 5.4. The maximum load, calculated stress, percent wood failure (for those failed) and moisture content "before" and "after" the Durability Cycle shall be recorded for each specimen.

6.3 Test Analysis

- 6.3.1 If test results of each specimen equal or exceed the adjusted base joint strength for the F_b design value applicable to the highest grade being produced, the process is considered *in control* and all lumber represented by the sample is satisfactory for shipment.
- 6.3.2 If a bending test value falls below the adjusted fifth percentile strength value, but not below the adjusted base joint strength value, the item shall be monitored so that at least 27 of the next 28 pieces equal or exceed the adjusted fifth percentile strength value.
- 6.3.3 Should a specimen fail away from the end joint and below adjusted base or fifth percentile strength requirements, a substitute piece may be selected from the same production run and tested.
- 6.3.4 If the sample does not meet the requirements of Section 6.3.1 and 6.3.2, the process is considered *out of control* and all lumber represented by the sample shall be held pending confirmation tests outlined in Section 10.

FACE-OR EDGE-GLUED LUMBER

7.0 TEST EQUIPMENT

7.1 General

Each producing plant must possess the following equipment capable of testing samples from production:

- 7.1.1 Equipment capable of performing shear tests in accordance with ASTM D 905 modified as described in Appendix C.
- 7.1.2 A pressure vessel and a drying oven adequately sized and equipped to perform the Durability Cycle described in Appendix B.

8.0 CERTIFICATION

8.1 Qualification

In order to qualify for use of WWPA grade stamps, shear tests of samples from production are required.

8.2 Sample Selection and Preparation

- 8.2.1 Fifty-Three pieces shall be selected from normal production by a WWPA Lumber Inspector. Block shear-test specimens shall be sawn from pieces of clear wood with no apparent strength-reducing characteristics.
- 8.2.2 The specimens shall be prepared as specified in ASTM D 905 or, alternatively, as described in Section 7.6.5.3 of the AITC/WCLIB 200-2009 Inspection Manual, Test T107. After preparation, specimens shall be subjected to the Durability Cycle described in Appendix B.

8.3 Testing

- 8.3.1 Each specimen shall be tested in accordance with ASTM D 905 modified as described in Appendix C.
- 8.3.2 The failure load, calculated shear stress, and percent of wood failure shall be recorded for each glue line.

8.4 Test Analysis

- 8.4.1 The highest allowable horizontal shear design value for which CERTIFIED FACE GLUING or CERTIFIED EDGE GLUING grade stamps may be issued shall be based on the fifth percentile tolerance limit (75% confidence) horizontal shear strength calculated from the test results divided by 2.1.

- 8.4.2 Specimens containing characteristics that do not permit a fair evaluation of bond quality need not be included in analysis of test results. Additional specimens shall be substituted to maintain the established sample size.

9.0 PLANT QUALITY CONTROL

9.1 Sample Selection and Preparation

- 9.1.1 One piece from production shall be selected each hour to verify conformance to certification levels with not fewer than five (5) specimens collected during any production shift of less than five (5) hours. (For the first five shifts of production following initial certification, pieces shall be selected every half-hour of production.) Each piece selected shall be of clear wood with no apparent strength-reducing characteristics.
- 9.1.2 A block shear-test specimen shall be prepared from each piece as specified in ASTM D 905 or, alternatively, as described in Section 7.6.5.3 of the AITC/WCLIB 200-2009 Inspection Manual, Test T107. After preparation, the specimen shall be subjected to the Durability Cycle described in Appendix B.

9.2 Testing

- 9.2.1 Specimens shall be loaded per Section 8.3 to 2.1 times the applicable horizontal shear design value. The maximum load, calculated stress and percent wood failure (for those failed) shall be recorded for each specimen.

9.3 Test Analysis

- 9.3.1 If test results of each specimen equal or exceed 2.1 times the Fv design value applicable to the species being produced, the process is considered *in control* and all lumber represented by the sample is satisfactory for shipment.
- 9.3.2 Should a specimen fail away from the glue line and below 2.1 times the applicable design value, a substitute piece shall be selected from the same production run and tested.
- 9.3.3 If a specimen does not meet the requirements of Section 9.3.1, an additional five specimens may be sampled from production closely related by proximity to the deficient specimen(s) and tested to failure. If the average of the original specimen plus the five subsequent specimens still does not meet the appropriate criterion, the process

is considered *out of control* and all lumber represented by the sample shall be held pending confirmation tests outlined in Section 10.

OUT OF CONTROL

10.0 PROCEDURES

If a sample tested in accordance with hourly quality control fails the requirements of Section 3.3, 6.3 or 9.3, whichever is applicable, all the volume produced since the previous quality control sample shall be held pending completion of additional tests.

A 53-piece sample representative of the production being held shall be prepared and tested in accordance with the applicable daily quality control procedures. If all pieces meet the requirements of Section 3.3, 6.3 or 9.3, whichever is applicable, the production volume held may be released for shipment.

If the sample fails to meet requirements, (1) all grade stamps on the production being held shall be obliterated, and (2) use of grade stamps shall be discontinued until the cause is identified and corrected. Use of grade stamps may be resumed after a subsequent 53-piece sample is found to comply with requirements of Section 3.3, 6.3 or 9.3, whichever is applicable.

Note: An additional 49 pieces may be tested and combined with the results of the 53-piece sample. Under this condition no more than one failure in 102 is permissible to remain in control. Additional samples may be tested; where no more than 2 failures in 148 are permissible.

UNSEASONED LUMBER

11.0 GENERAL

Manufacturers may produce glued lumber with unseasoned (green) material provided certification and plant quality control requirements of the applicable sections in these procedures are met. Each species or species combination shall be certified. In addition, the following criteria are required:

11.1 Adhesive

11.1.1 The adhesive manufacturer shall provide WWPA and the producing mill pertinent criteria and instructions essential for use of adhesive to be qualified. Each plant shall have a written plant standard, outlining quality control procedures including the additional instructions. This standard must be followed to retain certification.

11.1.2 Prior to initial certification, 60 pieces shall be tested in bending or tension to determine percentage of wood failure. Specimens shall average at least 70 percent wood failure and no individual specimen less than 30 percent. Wood failure tests shall be conducted at a moisture content of 19 percent or less on air-dried or kiln-dried specimens, whichever is applicable to the product shipped.

11.2 Testing for Lumber Shipped Unseasoned

11.2.1 Tests shall be conducted prior to initial certification to determine minimum curing time at which adjusted base and fifth percentile strength values required for the highest grade design value being produced is achieved. To establish minimum curing time, 30 pieces at 12-hour intervals are tested until each joint equals or exceeds the applicable property target value. For daily quality control, one piece from production each hour shall be selected to verify conformance to certified strength levels and minimum curing time. Unseasoned glued lumber shall not be shipped prior to the established minimum curing time.

11.2.2 Accelerated drying of test samples for plant daily quality control may be performed provided test values are correlated to air-dried samples. At least 30 air-dried specimens at a moisture content of 19 percent or less and an equal number of accelerated-dried specimens shall be tested for strength according to appropriate sections in this standard. The ratio of the average stresses of the air-dried samples to the accelerated-dried samples shall be used to adjust the accelerated-dried specimens stresses during certification and daily quality control. In no case shall a correlation factor greater than 1.0 be used.

11.2.3 During certification and daily quality control, lumber used for cyclic delamination or durability cycle must be dried to 19% moisture content or less before testing.

11.3 Testing for Lumber Shipped Dry

11.3.1 If unseasoned glued lumber is to be subjected to air-drying or kiln-drying prior to shipment, sample selection for certification and plant quality control tests shall occur after the drying process.

APPENDIX A

CYCLIC DELAMINATION TEST

Specimens shall be subjected to the following Cyclic Delamination Test, which is a modification of Method B of ASTM D 1101.

Procedures

Weigh and record to the nearest gram the weight of each test specimen. Place test specimens in an autoclave or pressure vessel and weight them down. Add water at a temperature of 65° to 85°F in sufficient quantity to completely submerge the specimens. Separate the test specimens by stickers, wire screens, or other means in such a manner that all end-grain surfaces are freely exposed to the water. Apply a vacuum of 20" to 25" of mercury (at sea level) and hold it for 30 minutes. Then release the vacuum and apply a pressure of 75 psi, plus or minus 5 psi, for 2 hours. Dry the test specimens for a period of approximately 10 hours in air at 160°F and a relative humidity of 8 to 10 percent (70°F wet bulb depression) which is circulating at a rate of 500 ft/minute plus or minus 50 ft/minute. (Where the flow rate cannot be accurately measured, specimens shall be dried to within 12 to 15 percent of their original weight within 10 to 15 hours with the temperature held to 160°F.)

The test specimens shall be placed at least 2" apart during drying with end-grain surfaces parallel to the stream of air. The actual time in the drying oven is controlled by the change in weight of the test specimens. When the weight has returned to within 12 to 15 percent of the original test specimen weight, the specimens are removed from the oven and delamination is then observed. The delamination is measured along the glue lines and is reported as a percentage of the sum of the glue line lengths on both sections of a single end joint that has been sawn in two parts prior to testing. Areas of poor bond associated with knots or other grade characteristics should be recorded, but should not be included in the computation for percentage of delamination. Test blocks may be chiseled apart at the glue lines to further evaluate the glue line quality. Signs of poor glue line pressure and dry-out may be characterized by a glossy appearance of the glue surface.

APPENDIX B

DURABILITY CYCLE

Specimens shall be subjected to the following Durability Cycle, which is a modification of Method B of ASTM D 1101.

Procedures

Record the moisture content of each specimen. Place specimens in an autoclave or pressure vessel and weight down. Add enough water at a temperature of 65° to 85°F to completely submerge the specimens. Separate the specimens by stickers, wire screens, or other means so that all end-grain surfaces are exposed to the water. Draw a vacuum of 20" to 25" of mercury and hold it for 30 minutes. Release the vacuum and apply a pressure of 75 psi, plus or minus 5 psi, for 2 hours. Place specimens in a drying oven to return them to their original moisture content. Usually an air temperature of about 160°F and a relative humidity of 8 to 10 percent (70°F wet bulb depression), with air circulating at a rate of 500 ft. per minute, will achieve this goal. During drying, place the test specimens approximately 2" apart with the end-grain surfaces parallel to the stream of air. When specimen moisture content is no more than 2 percent greater than the original moisture content, the specimens are ready for testing.

APPENDIX C

SHEAR TEST

Specimens shall be subjected to Shear Test specified in ASTM D 905, modified as follows:

- a. Specimens are to be obtained from pieces selected from normal production.
- b. Specimens shall be tested at a moisture content normal to production.
- c. The shearing tool shall be capable of approximating a uniform rate of loading not to exceed 0.50 inches of crosshead movement per minute.

The following is a list of publications referenced in this standard:

- AITC/WCLIB 200-2009 Inspection Manual, Test T107
- AITC/WCLIB 200-2009 Inspection Manual, Test T119
- ASTM D 905 Standard Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading
- ASTM D 1101 Standard Test Methods for Integrity of Glue Joints in Structural Laminated Wood Products for Exterior Use
- ASTM D 1990 Standard Practice for Establishing Allowable Properties for Visually Graded Dimension Lumber from In-Grade Tests of Full-Size Specimens
- ASTM D 2559 Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions
- ASTM D 2915 Standard Practice for Establishing Allowable Properties for Grades of Structural Lumber
- ASTM D 4317 Standard Specification for Polyvinyl Acetate-Based Emulsion Adhesives
- ASTM D 5572 Standard Specification for Adhesives Used in Nonstructural Lumber Products
- ASTM E 74 Standard Practice for Calibration of Force-Measuring Instruments for Verifying the Force Indication of Testing Machines
- Western Lumber Grading Rules 2011, Western Wood Products Association.

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