SPS 3

Special Products Standard for Fingerjoined "Vertical Stud Use Only" Lumber

June 2025

SPS 3

SPECIAL PRODUCTS STANDARD

FOR

FINGERJOINED "VERTICAL STUD USE ONLY" LUMBER

EFFECTIVE: June 1, 2025

Supersedes All Previous Editions, Revisions, and Supplements

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PREFACE

The following is a chronological listing of **SPS 3** revisions.

a) Revised Sections Effective December 1, 2006

- Sections 6.2, 9.2.4, 15.4.2.2, Tables 2 to 5, APPENDIX VII

b) Revised Sections Effective April 4, 2007

- Sections 2, 2.2, 3.1.2, 3.1.3, 7.1.1, 7.1.4, 10.2 g)

c) Revised Section Effective July 14, 2010

- Section 13.8

d) Revised Sections Effective November 1, 2010

- Replace all references "NLGA SPS Annex B – Elevated-Temperature Adhesive Qualification Procedure" - in HRA & Non HRA Definitions, Section 3.1.3.1, Sections 2.2 and 7.1.4 with "*ASTM D7374 - 08 - Practice for Evaluating Elevated Temperature Performance of Adhesives Used in End-Jointed Lumber*"
- Sections 2.2, 12.3.2

e) Revised Sections Effective April 2011

- Revised the Flat Bending 5th%ile strength test values in Tables 2 to 5 inclusive
- Added "The test values apply only to fingerjoints using a horizontal profile" to the Notes under Tables 2-5

f) Revised Sections Effective February 2013

- Revised Section 9.1.1.2 - Added 2 new Tables and revised Table numbers accordingly
- Section 13.2 - added (To be performed by the Facility) to the section title
- Section 13.3 - added (To be performed by the Agency) to the section title
- Replaced "Calibration" in the Table 8 heading with "Spot-Check" to now read: "Table 8 - Test Equipment Spot-Check Frequency"

g) Revised Sections Effective March 2014

- Section 2.2 Updated publication reference dates and Section 6.2.1.3, corrected the 2x2 knot and hole size to ¼" instead of 3"

h) Revised Sections Effective November 2014

- Updated Section 2.2 – Referenced Publications
- Revised Section 9.1.1.2 to comply with the ALSC GLP
- Replaced Tables 3 & 4 with a new Table 3 and renumbered all the Tables forward
- Revised Section 13.6.1.2 to improve wording of this clause

i) Revisions Effective March 2017

- Updated Section 2.2 – Referenced Publications
- Minor clarification edits to Section 7.3.2 and APPENDIX I
- Updated the NLGA SPS 1 & 3 Ratified Responses and Example Sampling Procedures attached to the end of the Standard

j) Revisions Effective March 2023

- Added Section 1.6 – Interpretations and update Section 2 – Definitions and Referenced Publications
- Deleted "Utility" grade from permitted grades in all applicable Sections
- Rewrote Section 6.2 and added Table 2 for clarification
- Updated Sections 12 and 14 to harmonize with other NLGA Special Product Standards
- Incorporated NLGA SPS 1 & 3 Ratified Responses into relevant Sections
- Added Appendix X - Commentary on Sampling Frequency for Fingerjoint Delamination Quality Control
- Added Appendix XI - Example of QC Sampling Procedures (to incorporate previous Attachment 1)

k) Revisions Effective June 2025

- Updated Section 2 – Definitions and Referenced Publications
- Added 2x5 size to Tables 3, 4, 5, and 6
- Revised test values in Table 4 as per approved new Hem-Fir (N) design values
- Added changes to metric dimensions to align with PS 20
- Reorganized Section 13 - Qualification Procedures

1.0 SCOPE

1.1 PART A AND PART B

This Special Products Standard for Fingerjoined "Vertical Stud Use Only" Lumber consists of two parts.

PART A:

Product Specifications: specifies grade characteristics, standard sizes, visual grading conditions, adhesive requirements, property requirements, joint evaluation procedures, and grade stamping requirements for Fingerjoined "Vertical Stud Use Only" Lumber.

PART B:

Qualification and Quality Control Requirements: specifies minimum qualifications and quality control requirements for a facility producing fingerjoined lumber in accordance with the requirements of **PART A**.

1.2 NLGA STANDARD GRADING RULES

This Standard shall be used in conjunction with and forms part of the NLGA Standard Grading Rules for Canadian Lumber (NLGA Standard Grading Rules).

Note: *Paragraph numbers (NLGA Para. X) referenced in this Standard refer to numbered paragraphs in the NLGA Standard Grading Rules.*

1.3 UNITS

This Standard states values in inch-pound (imperial) units. The equivalent SI (metric) values, given in parentheses, are provided for information only. In case of discrepancy, the values stated in imperial units shall take precedence.

1.4 DESIGN VALUES

For use in Canada, design values are assigned to fingerjoined lumber by the CSA Group – Technical Committee on Engineering Design in Wood and are published in CSA O86.

For use in the U.S., design values are published in NLGA Para. 900 and in the American Wood Council (AWC) National Design Specification (NDS) Supplement.

1.5 FINGERJOINED "VERTICAL STUD USE ONLY" LUMBER

This Standard applies to visually graded fingerjoined "Vertical Stud Use Only" lumber. The profile and quality of the fingerjoint shall be established by inspection and test procedures, and the quality of full-length fingerjoined lumber shall be verified by visual grading in accordance with the NLGA Standard Grading Rules.

1.6 INTERPRETATIONS

The interpretation of the provisions in this Standard are vested in NLGA.

2.0 DEFINITIONS AND REFERENCED PUBLICATIONS

2.1 DEFINITIONS

The following definitions shall apply to this Standard.

AGENCY: organization accredited by the Canadian Lumber Standards Accreditation Board (CLSAB) and/or the American Lumber Standard Committee (ALSC), Board of Review engaged in the grading, grade stamping and/or certification of lumber or who certifies facilities to grade and place a grade stamp upon lumber.

AGENCY SUPERVISOR: representative of the Agency who is approved by the Agency to inspect facilities producing fingerjoined lumber.

AGENCY VERIFICATION: specific set of procedures used by an Agency to verify that an item of grade-stamped fingerjoined lumber conforms to the requirements of this Standard and the NLGA Standard Grading Rules.

BOIL OUT: characteristic of phenol-resorcinol adhesives cured at high temperatures: the paraformaldehyde hardener decomposes to gaseous formaldehyde more rapidly than the formaldehyde can react with the phenol-resorcinol resin.

Note: *If insufficient pressure is applied to the bondline, the result may be a much weaker "foamy" adhesive layer.*

BONDLINE: layer of adhesive that attaches the interlocking finger profiles of two lumber components.

CALIBRATION: procedure of comparing two instruments, measuring devices or standards, one of which is of known accuracy traceable to a nationally recognised standard.

CONFORMANCE: state in which the production process meets the requirements of this Standard.

CONTROL CHARTS: reports or records used to monitor the variation between the process quality level and a predetermined conformance quality level, and to indicate when changes in the process are required to bring the process back into an "**IN-CONTROL**" state as defined by the conformance quality level.

CYCLIC DELAMINATION TEST: test procedure that simulates environmental conditions to which wood products may be exposed during shipment, storage, or use.

DELAMINATION: separation of the bondline because of drying stresses.

Note: *Other causes of delamination may include joint mis-manufacture that produces a bondline that is weaker than the surrounding wood or a bondline softened by water. Drying stresses that produce delamination are similar to those that produce checking in wood.*

DISPLACEMENT: amount of clear wood displaced by a characteristic and considered in its relation to the amount it reduces the strength of the cross-section of the piece of lumber under consideration.

EVALUATION: assessment of a facility's manufacturing process and its quality control programs to determine whether it is capable of producing an item that meets the requirements of this Standard.

FACILITY: manufacturing plant that produces fingerjoined lumber and conducts visual grading and quality control sampling and testing.

GRADE STAMP: grade identification applied on a piece of fingerjoined lumber which includes the appropriate information under Section 10.

Note: *The grade stamp (also referred to as a grade mark) indicates that the fingerjoining process meets the provisions of this Standard and the requirements of the Agency's qualification and quality control procedures.*

HEAT RESISTANT ADHESIVE (HRA): adhesive that meets the elevated temperature performance requirements of ASTM D7374.

HORIZONTAL FINGERJOINT: finger profile formed so that an outline of the fingers appears on the narrow face of the fingerjoined lumber.

IN-CONTROL: state in which on-going quality control testing indicates that the production process meets the mechanical property and/or delamination requirements of this Standard.

INDEPENDENT CALIBRATION LABORATORY: organization that performs testing to verify and establish results for test equipment, operating in accordance with ISO/IEC 17025 and accredited by an Accreditation Body listed under the ILAC Mutual Recognition Agreement (ILAC MRA).

INSPECTION: examination, measurement and/or testing of the properties of an item to ensure they meet the quality control requirements of this Standard.

INTERCHANGEABLE: capable of being assigned the design values of another product under certain end-use conditions.

Note 1: *The specific end-use conditions are described in Section 3.1.2.*

Note 2: *Two products are deemed to be interchangeable only to the extent established by the minimum requirements specified in this Standard. Comparability of properties not explicitly covered by this Standard may require additional assessment.*

ITEM: lumber of a given grade, size (without reference to length), species or species group and moisture content.

NON-CONFORMANCE: deficiency in a property, documentation or procedure that renders the quality of an item not to be in adherence to specified requirements of this Standard and therefore unacceptable.

Note: *Examples that may cause non-conformance include physical defects, test failures, incorrect or inadequate documentation, or deviations from prescribed processing, inspection, or test procedures.*

NON-HEAT RESISTANT ADHESIVE (Non-HRA): adhesive that has not been evaluated to the elevated temperature performance requirements of ASTM D7374.

OUT-OF-CONTROL: state in which on-going quality control testing indicates that the production process does not meet the mechanical property or delamination requirements of this Standard.

QUALITY CONTROL: set of procedures that provide a means of measuring and regulating the performance of an item to specified requirements.

QUALITY CONTROL MANUAL: document which sets forth a specific set of instructions to describe the quality control functions and requirements to be carried out in the production of fingerjoined lumber at a specified facility.

Note: *May be referred to as a Plant Standard.*

RANDOM SAMPLING: procedure by which a representative sample is generated from a population.

SEPARATE-APPLICATION ADHESIVE: multi-component adhesive that has the following characteristics:

- Each adhesive component is applied separately to one or both sides of the joint.
- All adhesive components are required for the bond strength to be fully developed.
- Some separate-application adhesives require that the components be **blended** for the adhesive to develop the required strength and durability. Other systems simply require the components to contact each other.

Note: *"Blended" is defined as thoroughly mixing the adhesive components together resulting in a homogeneous mixture.*

SHIPMENT: one or more bundles, packages or units of lumber that comprise an order.

SPECIMEN: piece of fingerjoined lumber randomly selected from production for purposes of quality control, quality verification testing and any subsequent analysis.

SPOT CHECK: verification that the test equipment is still within calibration tolerances.

TEST EQUIPMENT: equipment used by the facility to determine the bending strength and resistance to delamination of a fingerjoint for the purpose of determining conformance to the specified requirements of this Standard.

TEST LOAD: load that will induce a stress that corresponds to the property value for the item under consideration.

VERTICAL FINGERJOINT: profile formed so that an outline of the fingers appears on the wide face of the fingerjoined lumber.

WOOD FAILURE: failure induced at the bondline where the fingerjoint fails by the tearing away of wood fibre from one or both side(s) of the bondline.

2.2 REFERENCED PUBLICATIONS

ALSC (American Lumber Standard Committee, Incorporated)

Glued Lumber Policy (2024)

AWC (American Wood Council)

National Design Specification (NDS®) Supplement: Design Values for Wood Construction (2024)

ASTM

D245-22 Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber

D2559-12a (2018) Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions

D2915-17 (2022) Standard Practice for Sampling and Data-Analysis for Structural Wood and Wood-Based Products

D4317-16 (2023) Standard Specification for Polyvinyl Acetate-Based Emulsion Adhesives

D4444-13 (2018) Standard Test Methods for Laboratory Standardization and Calibration of Hand-Held Moisture Meters

D7374-21 Standard Practice for Evaluating Elevated Temperature Performance of Adhesives Used in End-Jointed Lumber**D7438-20** Standard Practice for Field Calibration and Application of Hand-Held Moisture Meters

E4-24 Standard Practices for Force Verification of Testing Machines

E74-18e1 Standard Practice for Calibration and Verification for Force-Measuring Instruments

CLSAB (Canadian Lumber Standards Accreditation Board)

Regulations (2024)

CSA Group

CSA O86:24 Engineering design in wood

CSA O141:23 Canadian standard lumber

CSA O112.8:M1977 (R2006) Polyvinyl adhesives

ISO

ISO/IEC 17025:2017 (c2023) General requirements for the competence of testing and calibration laboratories

ISO/IEC 17065:2012 (c2024) Conformity assessment – requirements for bodies certifying products, processes and services

NIST (National Institute of Standards and Technology, U.S. Department of Commerce)

PS 20:25 American Softwood Lumber Standard

NLGA

Standard Grading Rules for Canadian Lumber (2022)

PART A - PRODUCT SPECIFICATIONS FOR FINGERJOINED "VERTICAL STUD USE ONLY" LUMBER

3.0 PRODUCT DESCRIPTION

3.1 APPLICATIONS

3.1.1 END-USE

This Standard applies to visually graded fingerjoined lumber to be used as a member loaded in axial compression where bending and tension design load components do not exceed the duration for wind or seismic loading as defined in the applicable engineering design standard and where the in-service moisture content of the wood will not exceed 19%.

Note: *Product design values and end-use application of fingerjoined lumber are assigned as noted in Section 1.4.*

3.1.2 INTERCHANGEABILITY

"Vertical Stud Use Only" fingerjoined lumber produced to the requirements of SPS 3 is interchangeable with non-fingerjoined lumber of the same grade, nominal size and species or species group except that fingerjoined lumber cannot be visually re-graded or re-manufactured into a higher stress grade even if the quality of the lumber containing fingerjoints would otherwise warrant such re-grading pursuant to the following restrictions.

3.1.3 SPECIAL APPLICATIONS

3.1.3.1 HEAT RESISTANT ADHESIVES

Fingerjoined lumber marked "**HRA**" is manufactured with a heat resistant adhesive that meets the requirements of ASTM D7374.

Note: *Fingerjoined lumber marked as "**Non-HRA**" and used in fire rated assemblies or marked as "**HRA**" and used in non-standard fire rated assemblies may require additional fire protection.*

3.1.3.2 CHEMICALLY TREATED WOOD

Fingerjoining chemically treated lumber or chemical treatment of fingerjoined lumber are not within the scope of this Standard.

3.1.3.3 REWORKING OF FINGERJOINED LUMBER

Modifications or additional manufacturing activities on fingerjoined lumber are outside the scope of this Standard.

Note: *Examples of further activities are alterations to the cross-section such as drilling of holes or profiling.*

3.2 DEMONSTRATION OF CONFORMANCE

Fingerjoined lumber represented as conforming to the requirements of this Standard shall be manufactured using a process in which the quality of the fingerjoints produced is continuously monitored in accordance with all the requirements specified herein. Product conformance information shall be maintained through records and charts recording the results of the inspection and test procedures.

Note: *The application of the grade stamp as per Section 10 indicates that these conditions have been met.*

Shipment of production is permitted only after inspection and testing of the samples representative of the production have been completed and assessed to be in conformance.

4.0 GRADE DESCRIPTION

This Standard applies to visually graded fingerjoined lumber in all the species groups defined in Section 6.1 and to the stress-rated grade classifications of NLGA Paras. 121, 122, and 124 (excluding NLGA Para. 122c – UTILITY grade and NLGA Para. 124a - SELECT STRUCTURAL grade).

5.0 STANDARD SIZES

Fingerjoined "Vertical Stud Use Only" Lumber shall be manufactured in nominal 2x2 through 2x6 sizes only and in lengths not to exceed 12 feet (3.66 m). Specified thickness and widths for fingerjoined lumber produced in accordance with this Standard are shown in Table 1.

TABLE 1 – STANDARD THICKNESSES AND WIDTHS (FROM CSA O141 AND PS 20)

Nominal Dimension	Specified Dimension			
	inches		mm	
	Dry	Green	Dry	Green
Thickness				
2	1-1/2	1-9/16	38.1	39.7
Width				
2	1-1/2	1-9/16	38.1	39.7
3	2-1/2	2-9/16	63.5	65.1
4	3-1/2	3-9/16	88.9	90.5
5	4-1/2	4-5/8	114.3	117.5
6	5-1/2	5-5/8	139.7	142.9

6.0 LUMBER COMPONENT REQUIREMENTS

6.1 SPECIES

The lumber components used in the manufacture of fingerjoined "Vertical Stud Use Only" lumber may be of any species in the species groups specified in NLGA Paras. 7 and 7a.

When components from different species groups are joined in the same piece of lumber, the design values for the lowest (controlling) species group shall apply.

Quality control testing of the mixed species group lumber components shall meet the property test values required for the controlling species group in the fingerjoined lumber product.

6.2 WOOD QUALITY IN THE JOINT

Allowable characteristics permitted in the fingerjoint are based on the requirements of the two lumber grade categories being produced as described in Sections 6.2.1 and 6.2.2.

6.2.1 NLGA PARA. 122 - CONSTRUCTION & STANDARD GRADES AND NLGA PARA. 124 - NO. 1 & NO. 2 GRADES

For production of these grades, fingerjoints shall be formed in sound wood that otherwise meets the visual requirements of the grade within the joint area, except as provided for in Sections 6.2.1.1 to 6.2.1.5. No decay is permitted in the joint.

6.2.1.1 KNOTS AND HOLES

Knots and holes may be located anywhere in the joint area but are restricted on the wide face in diameter as listed in Table 2.

Knots and holes only visible on one face of the joint shall be assessed according to the visible dimension.

Note: *The knot dimension to be assessed refers to only what is visible on a face, and it is not permissible to apply an average.*

Knots outside the joint area exceeding the sizes shown in Table 2 shall be set back from the base of the fingers so that neither the knot(s), nor the grain distortion associated with the knot(s), extend into the fingers.

Knots appearing on the narrow faces are permitted the same cross-sectional area displacement as knots specified on the wide faces.

Manufactured holes shall not exceed the equivalent area of the knot hole permitted in the joint area.

TABLE 2 – MAXIMUM KNOT AND HOLE SIZES ON THE WIDE FACE IN THE JOINT AREA

Nominal Width	NO. 1, NO. 2, and CONSTRUCTION Grades		STUD, NO. 3, and STANDARD Grades	
	inches	mm	inches	mm
2	¼	6.4	⅜	9.5
3	½	12.7	¾	19.1
4	⅝	15.9	1	25.4
5	¾	19.1	1- ¼	31.8
6	⅞	22.2	1- ½	38.1

6.2.1.2 PITCH

Pitch is permitted in the joint area provided it does not exceed 10% displacement.

Note: *10% displacement refers to: only one piece of the joint; or the combination of both pieces of the joint.*

6.2.1.3 FIRM HONEYCOMB

Firm honeycomb is permitted in the joint area of the STANDARD grade only, provided it does not exceed 10% displacement.

6.2.1.4 WANE AND WANE DIP (NLGA PARA. 750)

Wane and wane dip in the joint area shall meet the visual requirement of the grade being grade-stamped except wane on the narrow face shall not exceed half the thickness in any grade.

Note: *Wherever possible, the wane on the two pieces forming the joint should be placed at the same corner of the joint.*

6.2.1.5 SLOPE OF GRAIN

Slope of grain is limited to 1 in 8 for the CONSTRUCTION grade and 1 in 4 for the STANDARD grade.

6.2.2 NLGA PARA. 121 - STUD GRADE AND NLGA PARA. 124 - NO. 3 GRADE

For production of these grades, fingerjoints shall be formed in sound wood that otherwise meets the visual requirements of the NLGA Para. 122b STANDARD grade in the joint area, except as provided for in Sections 6.2.2.1 to 6.2.2.5. No decay is permitted in the joint.

6.2.2.1 PITCH AND/OR FIRM HONEYCOMB

Pitch and/or firm honeycomb are permitted in the joint area provided they do not exceed 10% displacement.

Note: *10% displacement refers to: only one piece of the joint; or the combination of both pieces of the joint.*

6.2.2.2 KNOTS AND HOLES

Knots and holes may be located anywhere in the joint area but are restricted on the wide face in diameter as listed in Table 2.

Knots and holes only visible on one face of the joint shall be assessed according to the visible dimension.

Note: *The knot dimension to be assessed refers to only what is visible on a face, and it is not permissible to apply an average.*

Knots outside the joint area exceeding the sizes shown in Table 2 shall be set back from the base of the fingers so that neither the knot(s), nor the grain distortion associated with the knot(s), extend into the fingers.

Knots appearing on the narrow faces are permitted the same cross-sectional area displacement as knots specified on the wide faces.

Manufactured holes shall not exceed the equivalent area of the knot hole permitted in the joint area.

6.2.2.3 WANE AND WANE DIP (NLGA PARA. 750)

Wane and wane dip shall meet the wane requirements for the grade being grade stamped except wane on the narrow face shall not exceed half the thickness in any grade.

Note: *Wherever possible, the wane on the two pieces forming the joint should be placed at the same corner of the joint.*

6.2.2.4 SLOPE OF GRAIN

Slope of grain is limited to 1 in 4 for the STUD grade and 1 in 8 for the NO. 3 grade.

6.2.2.5 WHITE SPECKS

White specks shall be permitted in conjunction with knot sizes as follows:

a) Unlimited if only occurring on one side of the joint and knot sizes meet Table 2.

b) Restricted to 1/3 the total volume of the joint area, if appearing on both sides of the joint and knot sizes meet Table 2.

c) Otherwise, knots in the joint area shall be restricted to the knot size corresponding to the next smaller cross-sectional piece of lumber (i.e., 1-1/4 inch for 2x6, 3/4 inch for 2x4, 3/8 inch for 2x3, and 10% displacement for 2x2).

6.3 LUMBER QUALITY

The finished product shall be visually graded in accordance with the provisions of the NLGA Standard Grading Rules.

6.4 FINGER PROFILE

The orientation of the finger profile may be manufactured into the lumber at any angle; however, the finger profile shall be formed in a plane at right angles to the longitudinal axis of the lumber components being joined.

6.5 FINGERJOINT TOLERANCES

The tolerances on machining and assembly of the finger profile shall be such that when the end pressure and the face pressure are applied in the gluing process (make-up), the following conditions are met:

6.5.1 TIP GAP

The distance from the tip of any finger in the joint area to the base of the matching profile for that finger shall not exceed 1/16 inch (1.6 mm) measured on the worst face.

Note: *The purpose of a tip gap tolerance is to allow for squeeze out of excess glue and to prevent splitting at the base of the fingers during make-up.*

6.5.2 FINGERJOINT OFFSET

The longitudinal offset between one side of the joint and the other, in either the wide or narrow faces, shall not exceed 1/16 inch (1.6 mm).

6.6 MOISTURE CONTENT

Green and dry lumber components shall not be mixed within the same piece of lumber.

6.7 OVERLAPPING FINGERJOINTS

Previously manufactured finger profiles shall not be permitted in the joint area.

6.8 NUMBER OF JOINTS

The distance between adjacent joints is not restricted.

7.0 ADHESIVE REQUIREMENTS

7.1 ADHESIVE SPECIFICATION

7.1.1 GENERAL

a) The adhesive used for joining of fingerjoints shall meet either Section 7.1.2 or Section 7.1.3, and

b) Fingerjoined lumber marked "**HRA**" shall use adhesives that meet the requirements of Section 7.1.4. Otherwise, fingerjoined lumber shall be marked "**Non-HRA**".

7.1.2 PVA ADHESIVES

PVA adhesives must meet the requirements of Type I as specified in either CSA O112.8 or ASTM D4317.

7.1.3 OTHER ADHESIVES

Adhesives other than PVA adhesives must satisfy ASTM D2559 except for the test for "resistance to deformation under static loading". Tests shall be carried out using Douglas-fir, Western hemlock, or Western larch that meets the requirements of Table 1 in ASTM D2559.

7.1.4 ELEVATED TEMPERATURE (HRA)

The adhesive shall meet the requirements of ASTM D7374.

7.2 ADHESIVE MIXING

Mixing of the adhesive shall be performed in accordance with the instructions of the adhesive supplier.

7.3 JOINT FABRICATION

7.3.1 ADHESIVE APPLICATION

The adhesive shall be applied to the finger profiles in a manner that will ensure that all the gluing surfaces between the fingers receive enough adhesive that results in a squeeze-out of excess glue when the end pressure is applied.

Note: *The adhesive may be applied to one or both sections forming the joint.*

7.3.2 HEAT DAMAGE

Where a procedure is used to apply heat to the finger profile, it shall be such as to ensure that neither the wood surfaces in the profile nor the wood itself are damaged by excess heat.

Note: *In Radio Frequency (RF) curing, wood damage may result from excessively long exposure of the finger profile to the RF field.*

In either situation, both the strength and the long-term durability of the joint may be impaired.

7.3.3 END PRESSURE

The end pressure applied during the joint assembly process and while the bondline is being cured, shall be that required for the specific lumber size, species, finger profile and process used. Pressure shall not be such as to produce splitting in the wood at the base of the fingers.

8.0 PROPERTY REQUIREMENTS

The following requirements shall apply to the test values listed in Tables 3 to 6.

Note 1: *The bending strength levels in Tables 3 to 6 are derived from the CSA O86 - Engineering design in wood or the AWC National Design Specification Supplement, whichever is a higher test value for a given species group, size, and grade.*

Note 2: *The bending strength test values apply only to fingerjoints using a horizontal profile.*

Note 3: *The proof-load tension stress level is set at 1.33/2.1 times the tensile strength.*

8.1 MODULUS OF RUPTURE (MOR)

The minimum requirements for both flat-wise and edge-wise bending strengths measured in accordance with the test procedures set forth in Section 9.1, are determined as follows:

8.1.1 MINIMUM MODULUS OF RUPTURE

"**All**" of the test results shall meet or exceed the minimum bending strength for the given species group, size, and grade as provided in Tables 3 to 6.

8.1.2 FIFTH PERCENTILE (5th %ile) MODULUS OF RUPTURE (MOR_{5th})

The process lower fifth percentile for modulus of rupture (MOR_{5th}) shall equal or exceed the fifth percentile (5^{th} %ile) test value for the given species group, size, and grade as provided in Tables 3 to 6 when subjected to a short-term test load and tested in accordance with Section 9.1.

TABLE 3 – SPS 3 FINGERJOINT TEST VALUES FOR S-P-F

NOMINAL SIZE	GRADE	Edge Bending Strength (psi)		Flat Bending Strength (psi)	
		Minimum	5^{th} %ile	Minimum	5^{th} %ile
2x2 and 2x3	**NO. 1 / NO. 2**	*2790*	*3070*	*2790*	*3210*
	NO. 3 / Stud	*1650*	*1820*	*1650*	*1900*
	Const	*2130*	*2340*	*2130*	*2450*
	Stand	*1200*	*1310*	*1200*	*1370*
2x4	**NO. 1 / NO. 2**	*2790*	*3210*	*3030*	*3490*
	NO. 3 / Stud	*1650*	*1900*	*1730*	*1990*
	Const	*2130*	*2450*	*2310*	*2660*
	Stand	*1200*	*1370*	*1270*	*1460*
2x5	**NO. 1 / NO. 2**	*2570*	*2960*	*2830*	*3250*
	NO. 3 / Stud	*1470*	*1690*	*1620*	*1860*
2x6	**NO. 1 / NO. 2**	*2390*	*2750*	*2750*	*3160*
	NO. 3 / Stud	*1370*	*1570*	*1570*	*1810*

TABLE 4 – SPS 3 FINGERJOINT TEST VALUES FOR HEM-FIR (N)

NOMINAL SIZE	GRADE	Edge Bending Strength (psi)		Flat Bending Strength (psi)	
		Minimum	5th %ile	Minimum	5th %ile
2x2 and 2x3	NO. 1 / NO. 2	*3150*	*3470*	*3150*	*3470*
	NO. 3 / Stud	*1810*	*1990*	*1810*	*1990*
	Const	*2420*	*2660*	*2420*	*2600*
	Stand	*1310*	*1440*	*1310*	*1440*
2x4	NO. 1 / NO. 2	*3150*	*3620*	*3470*	*3980*
	NO. 3 / Stud	*1810*	*2080*	*1990*	*2290*
	Const	*2420*	*2780*	*2660*	*3050*
	Stand	*1310*	*1510*	*1440*	*1660*
2x5	NO. 1 / NO. 2	*2940*	*3380*	*3230*	*3720*
	NO. 3 / Stud	*1690*	*1940*	*1860*	*2140*
2x6	NO. 1 / NO. 2	*2730*	*3140*	*3140*	*3610*
	NO. 3 / Stud	*1570*	*1810*	*1810*	*2080*

TABLE 5 – SPS 3 FINGERJOINT TEST VALUES FOR D FIR-L (N)

NOMINAL SIZE	GRADE	Edge Bending Strength (psi)		Flat Bending Strength (psi)	
		Minimum	5th %ile	Minimum	5th %ile
2x2 and 2x3	NO. 1 / NO. 2	*2680*	*2950*	*2680*	*2950*
	NO. 3 / Stud	*1510*	*1660*	*1500*	*1650*
	Const	*1930*	*2130*	*2000*	*2190*
	Stand	*1090*	*1200*	*1100*	*1210*
2x4	NO. 1 / NO. 2	*2680*	*3080*	*2950*	*3390*
	NO. 3 / Stud	*1510*	*1740*	*1650*	*1890*
	Const	*1930*	*2220*	*2190*	*2520*
	Stand	*1090*	*1260*	*1210*	*1390*
2x5	NO. 1 / NO. 2	2500	2870	2750	3160
	NO. 3 / Stud	1410	1620	1540	1770
2x6	NO. 1 / NO. 2	*2320*	*2670*	*2670*	*3070*
	NO. 3 / Stud	*1310*	*1510*	*1490*	*1710*

TABLE 6 – SPS 3 FINGERJOINT TEST VALUES FOR NORTH SPECIES

NOMINAL SIZE	GRADE	Edge Bending Strength (psi)		Flat Bending Strength (psi)	
		Minimum	5th %ile	Minimum	5th %ile
2x2 and 2x3	NO. 1 / NO. 2	*1890*	*2080*	*1890*	*2080*
	NO. 3 / Stud	*1100*	*1210*	*1100*	*1220*
	Const	*1470*	*1620*	*1470*	*1620*
	Stand	*840*	*920*	*840*	*920*
2x4	NO. 1 / NO. 2	*1890*	*2170*	*2080*	*2390*
	NO. 3 / Stud	*1100*	*1270*	*1210*	*1390*
	Const	*1470*	*1690*	*1620*	*1860*
	Stand	*840*	*970*	*920*	*1060*
2x5	NO. 1 / NO. 2	*1760*	*2030*	*1940*	*2230*
	NO. 3 / Stud	*1030*	*1180*	*1130*	*1300*
2x6	NO. 1 / NO. 2	*1640*	*1880*	*1880*	*2170*
	NO. 3 / Stud	*960*	*1100*	*1100*	*1260*

8.2 DELAMINATION

The average delamination of the joint, measured in accordance with the test procedures in Section 9.2, shall not exceed 10% at the completion of the three cycles. Joints in which the delamination at the end of one cycle does not exceed 5% shall be considered to meet this requirement.

In addition, the delamination on a single specimen shall not exceed 15%. Average delamination of the joint is the average of the delamination found in the two test specimens, except that if only one test specimen is obtained from a short-fingered joint, the average delamination of the joint is that obtained from that single test specimen.

8.3 FINAL GRADE

The final grade of the fingerjoined lumber shall be determined by the lower of the visual grade of the lumber or the stress grade determined by strength tests on the fingerjoints.

9.0 JOINT EVALUATION PROCEDURES

Fingerjoints shall be sampled and tested for bending strength (MOR) and delamination as outlined in the following sections.

9.1 MODULUS OF RUPTURE (MOR)

9.1.1 MOR TEST SPECIMEN

9.1.1.1 FULL WIDTH MOR SPECIMEN

A specimen for determination of bending strength shall consist of a full-size piece 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. The specimen shall be of sufficient length so that the specimen remains positioned over the reaction (pivot) points until the ultimate load has been achieved. The specimen shall not extend more than 10 inches (254 mm) beyond the pivot points unless appropriate corrections are made to the load values to compensate for longer overhangs.

Note: *It is recommended that the specimen length extend at least 4 inches (102 mm) beyond the pivot points.*

The specimen shall not be surfaced or machined in any way prior to testing, except as provided for in Section 9.1.1.2, unless such surfacing or machining is an integral part of the manufacturing process.

Note: *MOR tests may be conducted on rough lumber samples in addition to required tests on specimens of the finished product. This would enable issues in the manufacturing to be detected early so that corrective actions can be taken. Appropriate test load level will need to be developed to account for the larger cross-section and partially cured bondline.*

9.1.1.2 REDUCED WIDTH MOR SPECIMEN

If the test equipment will not permit full-width MOR edge-wise testing, a nominal 2x4 (3.5 inches (88.9 mm) width) reduced-width test specimen is permitted to be ripped lengthwise from the full-width specimen provided it includes an as-manufactured original narrow face.

a) The reduced-width test specimen shall be used for the reduced-width MOR test with the as-manufactured narrow face being randomly selected for testing (random relative to the transverse feed direction).

b) The reduced-width test specimen shall be prepared and tested with the as-manufactured narrow face in tension.

c) The bending strength result of the reduced-width test specimen shall be divided by the reduced-width MOR factor for the original full-width size: **1.03** for nominal 2x5 and **1.06** for nominal 2x6.

Note: *The reduced-width factor (RWF) is based on the formula provided in the Note to Table 4 of the ALSC Glued Lumber Policy and shown below:*

RWF *= (7270 - (177 x* h_1*)) / (7270 - (177 x* h_2*))*

Where: h_1 *= the reduced specimen dimension in the direction of the applied load, and*
h_2 *= the full board width specimen dimension.*

d) The "size-adjusted" test results shall meet or exceed the appropriate bending-strength values given in Tables 3 to 6 for the original full-width nominal size.

Example (for nominal 2x6, S-P-F, STUD grade):

1) *From the full-width nominal 2x6 test piece, rip a nominal 2x4 (3.5 inches (88.9 mm) width) test specimen such that it includes one randomly selected as-manufactured narrow face.*
2) *Test the reduced-width test specimen for MOR, with the as-manufactured narrow face in tension, to failure and record the bending-strength result.*
3) *Determine the size-adjusted test result by dividing the bending-strength test result by **1.06** (the reduced-width MOR factor for nominal 2x6), and*
4) *As per **PART B** of this Standard, compare the size-adjusted test result to the required Minimum and 5th %ile MOR test values for a nominal 2x6, S-P-F, STUD grade in **Table 3**, which are 1370 psi and 1570 psi respectively.*

9.1.2 MOR TEST PROCEDURE

Four-point loading shall be used, with the two loading points symmetrically placed on either side of the fingerjoint. The loading points shall be placed adjacent to and spanning the fingerjoint, approximately 2 inches (50 mm) from the joint area (see APPENDIX I, Figure 1).

The load shall be applied at a uniform rate of movement of the loading head so that the time to maximum load is approximately one minute and in no case less than 35 seconds in any one test.

The test-loading rate shall not exceed the ability of the load-measuring device on the testing machine to respond accurately.

The specimen shall be tested with a shear span to depth ratio between 15 and 20, where depth is the dimension of the specimen under test in the direction in which the loading force is applied.

Note: *Results used to assess if MOR requirements are met only require testing to at least the 5th %tile values provided in Tables 3 to 6. It is good practice to test to destruction and note the failure location and percentage wood failure for troubleshooting. See APPENDIX III.*

9.1.3 MOR CALCULATION AND REPORT

Using the specified dimensions of the test specimen, calculate the MOR from the breaking loads as shown in the example in APPENDIX I, Figure 1 and record the MOR for each test specimen.

The specified dimensions are the dimensions listed in Table 1. These specified dimensions are also used to calculate MOR when joints are tested in green lumber.

If a failure occurs outside of the fingerjoint, it shall be recorded in the quality control records including the cause for the failure.

Note: *A failure that occurs outside of the fingerjoint is not recorded as a joint failure. However, if the failure occurs outside of the fingerjoint area at a load less than the minimum edge-wise or flat-wise bending strength as provided in Tables 3 to 6 then it shall be replaced with another joint specimen.*

9.2 DELAMINATION RESISTANCE EVALUATION

9.2.1 DELAMINATION TEST SPECIMEN

Green lumber shall be dried to 19% or less moisture content prior to performing the delamination test.

Note: *Delamination tests may be conducted on rough lumber specimens in addition to the required tests on specimens of the finished product. This would enable issues in the manufacturing process to be detected earlier so that corrective actions could be taken.*

9.2.1.1 FINGER PROFILES GREATER THAN 5/8 INCH (16 mm) IN LENGTH – LONG-FINGERED (LF) JOINTS

The **LF** test specimen shall consist of a section of the fingerjoined lumber approximately 7 inches (180 mm) long with the fingerjoint in the centre of the length. The specimen shall be cross-cut through the centre of the joint to yield two test specimens.

9.2.1.2 FINGER PROFILES 5/8 INCH (16 mm) AND LESS IN LENGTH – SHORT-FINGERED (SF) JOINTS

The fingers of the **SF** test specimen shall be cross-cut at the tips of the fingers to yield one test specimen approximately 3.5 inches (89 mm) in length with the bondline visible in the end grain.

9.2.2 DELAMINATION TEST PROCEDURE

Place the test specimens in the pressure vessel and weight them down.

Admit water at a temperature of 65° to 85°F (18° to 29°C), until the test specimens are completely submerged.

Separate the test specimens by stickering, wire screens or other means so that all end grain surfaces are freely exposed to water.

Draw a vacuum of 20 to 25 inches (508 to 635 mm) of mercury and hold it for 30 minutes, then release the vacuum and apply a pressure of 75 ± 5 psi (0.517 ± 0.034 MPa) for a period of two hours.

Dry the test specimens using air at a temperature of 160 ± 5˚F (71 ± 3˚C). The air circulation and number of specimens in the oven at any one time shall be selected such that the specimens are dried to moisture content of 19% or less.

During drying, place the specimens at least 2 inches (51 mm) apart, with the end grain surfaces and finger orientation parallel to the direction of the airflow.

Note: *Refer to Figure 2 in Appendix V.*

Dry the specimens until the moisture content (MC) of each specimen has reached 19% or less. Measure and record the delamination immediately, following the procedures set forth in Section 9.2.3.

Note: *In ordinary circumstances drying the specimens overnight (up to 18 hours) should achieve the desired drying, provided the drying chamber is functioning as specified.*

9.2.3 MEASUREMENT OF DELAMINATION

At the end of the drying period, immediately examine the crosscut surface of the specimens for separations of the bondlines and probe any indeterminate areas with a 0.004 inch (0.1 mm) feeler gauge. All bondline separation shall be considered as delamination except for the following:

a) Ignore any separation in the bondlines adjacent to the outer fingers, any separation less than 0.10 inch (2.54 mm) long, and any separation within the knot boundaries visible in the crosscut surface.

b) Where glue skip is present, it is permitted to ignore to a maximum of 10% of the total bondline that is shown to be due to glue skip. Such samples shall be marked to indicate the glue skip, and the records shall show the amounts deducted from the delamination calculations.

Note*: Action should be taken to identify the causes of and prevent glue skip in the joint. If glue skip is suspected, the joint should be opened and the bondlines examined. The use of aids such as indicator dyes and appropriate lighting should be used to identify areas where adhesive is not present.*

Measure the length of the delaminated portions to the nearest 1/16 inch (1.6 mm) and add the various lengths together.

Note: *Testing should be done immediately because if the delamination specimens are removed from the oven and allowed to pick up moisture from the atmosphere, the bondline separation will tend to close.*

9.2.3.1 INITIAL QUALIFICATION AND RE-QUALIFICATION TESTING

If the delamination of any specimen (see Section 9.2.1.2) or, if applicable, the average delamination of a specimen and its matching specimen (see Section 9.2.1.1) after one vacuum, pressure and drying cycle exceeds 5% but is less than 10%, repeat the above vacuum, pressure, drying cycle twice on that specimen and its matching specimen (if any), and record the delamination at the end of the third cycle.

9.2.3.2 QUALITY CONTROL, VERIFICATION AND RE-INSPECTION TESTING

Results from daily quality control, verification, and re-inspection test specimens shall be reported after one cycle of vacuum, pressure and drying.

9.2.4 DELAMINATION CALCULATION & REPORT

The percentage delamination of a specimen is the sum of all the delamination found (excluding the outermost bondlines), divided by the total length of all the bondlines in which the delamination was measured, times 100. Report the percentage delamination of each specimen, the average percent delamination for the joint.

When delamination in a fingerjoint exceeds 10%, the fingerjoint shall be sawn from the wood and the bondlines cleaved open, so that the cause of delamination may be determined. Causes of delamination shall be included in the quality control report.

Note 1: *In facilities that use RF heating of the bondline, the exposed cross-section of the test specimens may show any overheating of the joint area as a discoloration of the wood. Most commonly, delamination is caused by glue skip but may also result from heat damage to the gluing surfaces. Heat damage may result in delamination to an area that shows shallow wood failure. A poorly manufactured finger profile may also contribute to delamination.*

Note 2: *The Agency as part of its policies and procedures may request a facility to hold the delamination test samples intact for examination.*

9.3 ENVIRONMENTAL CONDITIONS

9.3.1 MEASUREMENT OF MOISTURE CONTENT AT TIME OF TEST

For each bending test specimen, a moisture content measurement using a resistance type moisture meter shall be made on each side of the joint. Each of the readings shall be recorded as the moisture content of the specimen(s) component at the time of test.

In the case of specimens that require ripping, measurements shall be taken and recorded for each rip and on each side of the ripped sample and the average moisture content (one MC value) reported as the moisture content for each side of the joint at the time of test.

9.3.2 TEMPERATURE

9.3.2.1 TEST EQUIPMENT

The temperature of the test equipment shall, at the time of the test, be in the range of 50° to 95°F (10° to 35°C) inclusive.

If the proof loading equipment is operated at temperatures below 50°F (10°C), the equipment shall be calibrated at a temperature within ±10°F (5°C) of the temperature at which the equipment will be operated.

9.3.2.2 FINGERJOINT TEST SPECIMENS

Test specimens shall be stored under the same environmental conditions (within ±10°F or ±5°C) as the production run until the start of the fingerjoint bending strength and/or delamination test.

10.0 GRADE STAMPING REQUIREMENTS

10.1 GENERAL

All previous grade stamps shall be removed or obliterated.

10.2 REQUIREMENTS

For fingerjoined "Vertical Stud Use Only" lumber produced in conformance with the requirements of this Standard, the grade stamp on each piece shall contain the following information:

a) Registered symbol of the Agency,

b) Facility identification,

c) Species or species group identification,

d) Seasoning designation,

e) Assigned lumber grade,

f) Designation of "**SPS 3**" and "**CERT FGR JNT- VERT STUD USE ONLY**",

g) Designation of "**HRA**" or "**Non-HRA**" (See Section 7.1.1), and

h) Designation of "**NLGA**" to indicate the grading rules used for visual grading of the fingerjoined lumber.

PART B - QUALIFICATION AND QUALITY CONTROL REQUIREMENTS

11.0 EQUIPMENT

The facility's fingerjoint test and delamination equipment shall meet the following requirements:

11.1 MOR TEST EQUIPMENT

The bending test equipment shall provide the functions illustrated in APPENDIX I, Figure 1 , with a roller action on the reaction supports and sufficient radius on the loading points to avoid significant crushing of the wood. Side supports to prevent buckling of lumber tested on edge shall also be provided.

The load measuring equipment shall be accurate to within ±2% of the actual load.

The load shall be applied through a cross-head.

11.2 DELAMINATION TEST EQUIPMENT

11.2.1 PRESSURE VESSEL

An autoclave or similar pressure vessel designed to safely withstand a pressure of at least 100 psi (0.69 MPa) is required for impregnating the specimens with water. The pressure vessel shall be equipped with a means of obtaining a vacuum of at least 25 inches (635 mm) of mercury (at sea level), and a means of obtaining a pressure of at least 75 psi (0.517 MPa) (gauge pressure). The vessel shall be equipped with a gauge(s) to register vacuum and pressure.

Note: *A suitable vacuum may be obtained from an aspirator attached to the water supply, and 75 psi (0.517 MPa) can usually be obtained from a municipal water supply or a compressed air supply.*

11.2.2 DRYING OVEN

The drying oven shall be capable of maintaining the conditions necessary to dry specimens to a moisture content of 19% or less.

Note: *These drying conditions are those obtainable in crossflow laboratory ovens of the circulating type. They can also be obtained by using a non-circulating configuration in which air heated by a space heater is passed over the specimens and vented.*

Conditions that affect the drying rate include crossflow air velocity, humidity, air temperature and the arrangement, size, and number of specimens in the oven.

Circulating type ovens that provide a crossflow air velocity of 250 ± 50 fpm (75 ± 15 m/min) in the centre of the drying chamber and maintain an air temperature of 160° ± 5°F (71 ± 3°C) should be capable of achieving the specified drying rate.

12.0 QUALITY CONTROL MANUAL

12.1 GENERAL

The Quality Control (QC) Manual is a document outlining requirements for maintaining quality control in the manufacturing facility.

Note: *See APPENDIX II for a general commentary on the contents of a QC Manual.*

12.2 PREPARATION, REVISION AND APPROVAL

Each facility shall:

a) Prepare and maintain a QC Manual in compliance with this Standard and submit the Quality Control Manual to the Agency for approval,

b) Regularly review and update its QC Manual to reflect current production practices and procedures, quality control policies and quality control program procedures and resubmit to the Agency, and

c) Upon approval, implement the updated program in accordance with the QC Manual.

The Agency must approve the contents of the QC Manual at the time of qualification. Qualification shall apply only to the manufacturing, quality control procedures and limits set forth in the QC Manual.

The Agency shall be notified in advance of any changes in the QC Manual that may affect product quality.

12.3 CONTENTS

12.3.1 AGENCY

The QC Manual shall identify the CLSAB and ALSC accredited Agency and include a summary of the following:

a) That the Agency glued lumber certification and quality control procedures comply with the ALSC Glued Lumber Policy and CLSAB Regulations,

b) That the responsibility for the certification and quality control procedures is that of the Agency, and

c) That the CLSAB and ALSC shall monitor whether the certification and quality control procedures are being carried out by the Agency.

12.3.2 GENERAL FACILITY ADMINISTRATION

The QC Manual shall:

a) Define facility management policies, objectives, and responsibilities for quality control, including the responsibility for each division within a multi-division organization,

b) Define the responsibility and authority for those managing and performing the quality control work and of those that are confirming conformance to quality control requirements,

Note: *The facility management relationships may be shown on organizational charts.*

c) Identify the Supervisor, who shall report directly to management at a level to ensure that quality control requirements are not subordinated to manufacturing or sales. The QC Manual shall define the Supervisor's authority to resolve quality matters, and

d) Define the responsibility and authority of personnel responsible for quality control and their organizational freedom to:

- **i)** Identify and record non-conformance to quality,
- **ii)** Recommend or provide solutions through designated positions in the organization,
- **iii)** Confirm implementation of solutions, and
- **iv)** Oversee further processing of a non-conforming item(s) until the deficiency or unsatisfactory condition has been corrected.

12.3.3 QUALITY CONTROL PERSONNEL

The QC Manual shall outline the responsibilities of the quality control personnel.

Persons responsible for quality control shall possess and demonstrate to the satisfaction of the Agency that they have adequate knowledge of the manufacturing process, which shall include:

a) Inspection and test procedures used to monitor the production process,

b) Operation and calibration of the recording and test equipment used, and

c) Maintenance and interpretation of the quality control records.

In addition, the quality control personnel shall be responsible for carrying out and maintaining records of various inspections, and test procedures detailed in the QC Manual.

The quality control personnel shall formally advise the facility management of circumstances resulting from the inspections and test procedures that indicate corrective action may be necessary in the production process.

12.3.4 QUALITY CONTROL PROCEDURES

The QC Manual shall include detailed descriptions specifying how each of the following procedures are to be performed and controlled:

a) Fingerjoining equipment operation,

b) Test equipment operation including calibration and spot-check procedures,

c) Quality control sampling, testing and analysis,

d) Documentation and record keeping,

e) Identification and traceability,

f) Non-conformance, and

g) Corrective action.

13.0 QUALIFICATION REQUIREMENTS

13.1 GENERAL

There are three qualification procedures employed in this Standard:

a) **Initial Facility Qualification:** analysis of test results from random samples drawn from production items from a new facility which has not yet demonstrated conformance with this Standard (see Section 13.2).

b) **Subsequent Qualification:** analysis of test results from random samples drawn from production that is in conformance with this Standard but has been modified for reasons other than to respond to detection of non-conformance.

Production modifications include new items (see Section 13.3.1) and major changes (see Section 13.3.2), and

c) Re-Qualification: analysis of test results from random samples drawn from production items that have undergone corrective action in response to an "**OUT-OF-CONTROL**" condition (see Section 13.4.1) or re-establishing conformance of items where production has ceased for a period exceeding one year (see Section 13.4.4).

13.2 INITIAL FACILITY QUALIFICATION

A facility requesting initial qualification shall provide the Agency with evidence that all the requirements of **PART A** have been met. Upon receipt of the request, the agency supervisor shall visit the facility to determine that:

a) The facility is capable of operating within the requirements of this Standard and its QC Manual,

b) The facility personnel possess ability to undertake the requirements described in Section 12, and

c) The calibration of the test equipment conforms to the requirements of the QC Manual.

Each item shall be qualified prior to issuing grade stamps for that item.

13.2.1 NEW PRODUCTION LINE START-UP (To be performed by the Facility)

During start-up of a new production line, the facility shall immediately notify the Agency.

Prior to grade stamps being issued for lumber from the new production line or to continue grade-stamping privileges in the case of a major change(s), the facility shall provide the Agency with test results of **53** test specimens performed in flat-bending and **53** test specimens in edge-bending using samples generated from two consecutive shifts of operation.

Note: *In addition to an initial start-up of a production line, this requirement also applies to a major change (see Section 13.3.2) and when a facility has not produced for period exceeding 1 year - **CASE A** (see Section 13.4.4.2).*

The specimens for these tests shall be obtained from a single item of the densest species or species group being produced and using a procedure, approved by the Agency, which ensures the sample is representative of the item to be qualified.

Note: *The **106**-specimen fingerjoint test by the facility is intended to verify the adequacy of the joint profile chosen and does not substitute for the requirements called for in Section 13.2.2.*

The **106**-specimen sample shall be tested in accordance with Section 9.1 and the test results shall satisfy the requirements set forth in Section 13.2.3.1.

13.2.2 INITIAL FACILITY QUALIFICATION SAMPLING AND TESTING REQUIREMENTS (To be performed by the Agency)

When the requirements of Section 13.2.1 have been met, the Agency supervisor shall randomly select the following for each item to be qualified:

a) **53** specimens for the edge-bending modulus of rupture (MOR) property evaluations to be tested in accordance with Section 9.1 of this Standard in such a way that the compression face is randomly generated,

b) **53** specimens for the flat-bending modulus of rupture (MOR) property evaluations to be tested in accordance with Section 9.1 of this Standard in such a way that the compression face is randomly generated, and

c) **20** fingerjoint specimens for the delamination resistance tests. This sample may be extracted from the **53** flat or **53** edge bending specimens containing fingerjoints that were not tested in bending. The sample shall be tested in accordance with Section 9.2 of this Standard.

For items **a)** and **b)** above, additional specimens to increase the sample size to **78**, **102**, **125** or **148** specimens may be selected to qualify the fingerjoint bending strength.

Note: *When selecting additional specimens, the minimum sample size will depend on the property being evaluated. See Section 13.2.3.1d.*

Test results shall satisfy the requirements set forth in Section 13.2.3. Each item shall be qualified prior to issuing grade stamps.

13.2.3 QUALIFICATION DECISION RULES

Results of edge and flat-bending and delamination tests shall determine whether grade stamps may be issued for the item being qualified.

Note: *If the test results meet the delamination requirement above but do not meet all the other requirements, the manufacturer may elect to qualify for a lower grade. Alternatively, adjustments to the manufacturing process may be made and new samples selected and tested until the above requirements are satisfied.*

An item shall be considered qualified when all the following requirements have been met:

13.2.3.1 BENDING STRENGTH

a) **"All"** of the **53**-specimen test results shall meet or exceed the "**minimum bending strength**" value as provided in Tables 3 to 6,

b) Not more than **1** of the **53**-specimen test results shall have an edge-bending strength less than the "**5th %ile bending strength**" value as provided in Tables 3 to 6,

c) Not more than **1** of the **53-**specimen test results shall have a flat-bending strength less than the "**5th %ile bending strength**" value as provided in Tables 3 to 6, and

d) When the additional specimen sampling procedure referred to in Section 13.2.2 is used to qualify for bending strength:

i) The number of test results below the "**minimum bending strength**" value, as provided in Tables 3 to 6, shall not exceed **1** in a **102-**specimen sample or **2** in a **148-**specimen sample, and

The number of test results below the "**5th %ile bending strength**" value as provided in Tables 3 to 6 shall not exceed **2** in a **78**-specimen sample; **3** in a **102**-specimen sample; **4** in a **125**-specimen sample; or **5** in a **148**-specimen sample.

13.2.3.2 FINGERJOINT DELAMINATION

13.2.3.2.1 SPECIMEN DELAMINATION CONDITIONING AND CLASSIFICATION

A **20**-specimen delamination sample prepared in accordance with Section 9.2.1 shall be subjected to **1**, or if required, **3** delamination cycles following procedures outlined in Section 9.2.2 and their delamination results processed as follows:

a) After One (1) Cycle:

Test specimens with delamination of less than or equal to 5% shall be deemed as meeting the delamination resistance requirements of this Standard and do not require any further exposure to delamination cycles.

i) For Long-fingered (LF) Joints:

A long-fingered (**LF**) joint does **not** meet the delamination resistance requirements of this Standard if the delamination **exceeds 15%** on either test specimen. Additional exposure to delamination cycles is not required.

Note: *For **LF** delamination testing, a **LF** joint is prepared in accordance with Section 9.2.1.1. The **LF** delamination is determined by the average of the delamination results found on each half of the test specimen taken from the same joint (the sum of the delamination found on each side of the joint divided by 2).*

ii) For Short-fingered (SF) Joints:

A short-fingered (**SF**) joint does **not** meet the delamination resistance requirements of this Standard if the delamination is **greater than 10%.** Additional exposure to delamination cycles is not required.

Note: *For **SF** delamination testing, a **SF** joint is prepared in accordance with Section 9.2.1.2. The **SF** delamination is that obtained from the single test specimen.*

Otherwise, the specimen(s) shall be subjected to two additional cycles for a total of three cycles.

b) After Three (3) Cycles:

i) For Long-fingered (LF) Joints:

A **LF** specimen does **not** meet the delamination resistance requirements of this Standard if the **LF** delamination (see *Note* under 13.6.1.2.1a.i) is **greater than 10%**, or if the delamination is **greater than 15%** on either half of the test specimen.

ii) For Short-fingered (SF) Joints

A **SF** specimen does **not** meet the delamination resistance requirements of this Standard if the delamination is **greater than 10%**.

Otherwise, the specimen shall be deemed as meeting the delamination resistance requirements.

13.2.3.2.2 EVALUATION OF DELAMINATION RESULTS

The delamination resistance requirements are deemed to have been met if at least **19** of the **20** specimens for delamination meet or exceed the delamination resistance requirements assessed in accordance with Section 13.2.3.2.1 .

13.3 SUBSEQUENT QUALIFICATION

During start-up production of a new item or when a major change to the fingerjoining process occurs, the facility shall immediately notify the Agency.

13.3.1 NEW ITEMS

Qualification sampling and testing by the Agency, as outlined in Section 13.2.2 is required for each new item.

Note: *New items may include, but are not necessarily limited to, changes in size and/or species group.*

Test results shall satisfy the requirements of Section 13.2.3.

13.3.2 MAJOR CHANGES

When a major change and/or process condition (which, in the opinion of the Agency, may affect the quality of the product) occurs, the facility shall immediately notify the Agency.

The qualification sampling and testing procedures outlined in Sections 13.2.1 (by the facility) and 13.2.2 (by the Agency) shall be required.

Test results shall satisfy the requirements of Section 13.2.3.

Note 1: *Major changes are production line changes which apply to all items currently being produced. Major changes may include but are not necessarily limited to: any new adhesive, a change to the joint profile, fingerjoining of green or green-frozen lumber, and changes to the manufacturing flow process.*

Note 2: *Changes in size and/or species or species groups are not considered major changes. Requirements set forth in Section 13.3.1 are intended to deal with size and/or species changes.*

Note 3: *Reversion to a previously qualified joint profile or adhesive is generally not considered to be a major change, unless considered so in the opinion of the Agency.*

Note 4: *When the major change involves a new adhesive, the Agency may require samples to be obtained from all items, if in the Agency's judgement the different adhesive application systems, mixing systems or allowance for more extreme gluing conditions warrant an expanded evaluation.*

13.4 RE-QUALIFICATION

13.4.1 REQUALIFICATION PROCEDURES FOR "OUT-OF-CONTROL" CONDITIONS

Re-qualification sampling and testing in this Section are limited to those items that are deemed to be "**OUT-OF-CONTROL**" during the production quality control process.

13.4.2 RE-QUALIFICATION SAMPLING AND TESTING REQUIREMENTS

The minimum sample size for each item and for each property to be re-qualified is as follows:

13.4.2.1 BENDING STRENGTH

a) When the 5th%ile edge-bending modulus of rupture (MOR) is required to be re-qualified, **28** specimens shall be randomly selected. The sample shall be tested for edge-bending MOR in accordance with Section 9.1 of this Standard,

b) When the 5th%ile flat-bending MOR is required to be re-qualified, **28** specimens shall be randomly selected. The sample shall be tested for flat-bending MOR in accordance with Section 9.1 of this Standard,

c) When the minimum edge-bending MOR is required to be re-qualified, **53** specimens shall be randomly selected (see Section 13.4.3.1.2). The sample shall be tested for edge-bending MOR in accordance with Section 9.1of this Standard, and

d) When the minimum flat-bending MOR is required to be re-qualified, **53** specimens shall be randomly selected (see Section 13.4.3.1.2). The sample shall be tested for flat-bending MOR in accordance with Section 9.1 of this Standard.

Increasing the sample size to **53**, **78**, **102** or **148** specimens is permitted to re-qualify the MOR of the fingerjoints.

Note: *When selecting additional specimens, the minimum sample size will depend on the property being evaluated. See Sections 13.4.3.1.1c and 13.4.3.1.2b.*

13.4.2.2 DELAMINATION

When the delamination resistance is required to be re-qualified, **20** fingerjoint specimens shall be randomly selected. The sample shall be tested for delamination resistance in accordance with Section 9.2 of this Standard.

13.4.3 RE-QUALIFICATION DECISION RULES

13.4.3.1 BENDING STRENGTH

The fingerjoined lumber shall be considered re-qualified for Table 3 to 6 bending strength properties when the following requirements are met:

13.4.3.1.1 5TH %ILE BENDING STRENGTH

a) As applicable, "**All**" of the **28**-specimen test results shall meet or exceed the "**5th %ile edge-bending strength**" value as provided for the grade in Tables 3 to 6,

b) As applicable, "**All**" of the **28**-specimen test results shall meet or exceed the "**5th %ile flat-bending strength**" value as provided for the grade in Tables 3 to 6, and

c) When the additional samples referred to in Section 13.4.2.1 are used to re-qualify the 5th %ile bending strength, the number of test results below the "**5th %ile bending strength**" value as provided in Tables 3 to 6 shall not exceed **1** in a **53**-specimen sample; **2** in a **78**-specimen sample; or **3** in a **102**-specimen sample.

13.4.3.1.2 MINIMUM BENDING STRENGTH

a) As applicable, "**All**" of the **28**-specimen test results shall meet the "**5th %ile bending strength**" value as provided in Tables 3 to 6. If this requirement is met, the process is considered re-qualified.

However, the sampling frequency shall be increased (doubled or tripled, etc.) and maintained until an additional **25**-specimen sample has been generated and tested for the bending orientation (edge-wise or flat-wise) that was found to be "**OUT-OF-CONTROL**". "**All**" of the **25** additional test results shall meet or exceed the "**minimum bending strength**" value as provided in Tables 3 to 6, and

b) When the additional samples referred to in Section 13.4.2.1 are used to re-qualify the minimum bending strength, the test results shall meet the following:

i) For sample sizes less than **102** specimens, "**None**" of the test results shall have a bending strength less than "**minimum bending strength**" value as provided in Tables 3 to 6.

ii) Otherwise, the number of test results below the minimum shall not exceed **1** in a **102**-specimen sample or **2** in a **148**-specimen sample.

13.4.3.2 FINGERJOINT DELAMINATION

The fingerjoints shall be considered re-qualified for delamination resistance when the requirements of Section 13.2.3.2 are met.

13.4.4 FACILITY NON-PRODUCTION OF QUALIFIED ITEMS FOR PERIODS EXCEEDING ONE YEAR

13.4.4.1 GENERAL

When a qualified facility does not produce fingerjoined lumber for a period exceeding one year, and the Agency has confirmed that the requirements of Section 13.2 have been met and that a major change as defined in Section 13.3.2 has not occurred, resumption of fingerjoined lumber production is permitted after the requirements of Section 13.4.4.3 (**CASE B**) have been met.

Otherwise, the requirements of Section 13.4.4.2 (**CASE A**) shall be met.

13.4.4.2 CASE A

All grade qualifications for that facility shall become void. The requirements for initial facility qualification (see Section 13.2) shall be satisfied prior to further production of fingerjoined lumber.

13.4.4.3 CASE B

13.4.4.3.1 PRIOR TO RESUMPTION OF PRODUCTION

The highest grade (e.g., highest test load requirements) of the widest width that the facility wishes to produce that was previously qualified and **IN-CONTROL**, shall be sampled, tested, and assessed for bending strength and delamination resistance in accordance with Sections 13.4.2 and 13.4.3.

Note: *If a facility wishes, at a later date, to produce a wider width that was previously qualified and in-control, the highest previously qualified grade (e.g., highest test load requirements) for this width shall be sampled and tested for bending strength and delamination resistance in accordance with Sections 13.2.2 and 13.2.3.*

13.4.4.3.2 SUBSEQUENT TO RESUMPTION OF PRODUCTION

Edge-wise and flat-wise bending samples from two consecutive production shifts for the same grade and width evaluated in Section 13.4.4.3.1 shall meet the requirements of Section 13.4.3.1

13.4.4.3.3 DELAMINATION SAMPLING

Delamination sampling shall revert to Level I as detailed in Section 15.2.2.2.

13.5 INSPECTION

Each qualification or re-qualification specimen shall meet the visual requirements in the joint area of the item being qualified.

14.0 EQUIPMENT CALIBRATION

Records of all calibrations and spot-check verifications shall be maintained for at least **6** years.

14.1 TEST EQUIPMENT AND SPOT-CHECK DEVICES

An independent calibration laboratory acceptable to CLSAB shall calibrate the test equipment and spot-check devices prior to initial qualification and once a year thereafter.

Procedures for calibration shall be consistent with the applicable sections in ASTM E4 and/or other applicable nationally recognized standards, except that the percentage error shall not exceed ±2.0%.

Note: *The listed standard and any other test standards and procedures for calibrating measuring devices and equipment must be nationally recognized and acceptable to CLSAB to be deemed applicable.*

It is the responsibility of the facility to maintain the operating condition of its test equipment in accordance with requirements set forth in their QC Manual and this Standard.

The test equipment shall be spot-checked in accordance with procedures set forth in the QC Manual and with the applicable sections in ASTM E4 and/or other applicable nationally recognized standards.

While a facility is producing fingerjoined lumber, spot-checks shall be performed at a frequency level listed in Table 7 and whenever there is reason to suspect the test equipment may be out of calibration or damaged.

The Agency shall be notified immediately if damage and/or repair to the test equipment or a spot-check device has occurred.

Note: *Re-calibration of the test equipment or spot-check devices by an independent calibration laboratory may be required by the Agency.*

TABLE 7 – TEST EQUIPMENT SPOT-CHECK FREQUENCY WHILE IN PRODUCTION

Equipment	Minimum Spot-Check Frequency
Bending Test Equipment	At least once a week
Other Test Equipment	As per manufacturer's specifications, the Quality Control Manual, or this Standard, whichever period is more frequent.

14.2 CALIBRATION DEVICES

The calibration devices used by the independent calibration laboratory shall meet the applicable requirements of ASTM E74 for force-measuring devices and/or other applicable nationally recognized standards acceptable to CLSAB.

14.3 INDEPENDENT CALIBRATION LABORATORY REPORTING REQUIREMENTS

The calibration report and certificates from the independent calibration laboratory shall comply with the reporting requirements outlined in ASTM E4 and/or other applicable nationally recognized standards.

The report from the independent calibration laboratory shall include at least:

a) Results of the calibration of the sensors of the equipment following applicable sections of ASTM E4, ASTM E74 and/or other nationally recognized standards acceptable to CLSAB,
b) Description of the method of verification including details of the preloading, if applicable,
c) Indication if the sensitivity or point of calibration of the test equipment was changed or not,
d) Information on the Reference calibration devices used by the laboratory including the due date of calibration,
e) The average target and tolerance values to be used.
f) A statement that the test equipment is in satisfactory working condition,
g) Temperature near the test equipment at time of the calibration,
h) Whether a facility quality control person was present to confirm values, and
i) Date and location of the calibration.

A copy of the final calibration report shall be forwarded to the Agency.

15.0 QUALITY CONTROL REQUIREMENTS

15.1 QUALITY CONTROL PROCEDURES

The quality control procedures described herein are intended to detect non-conformance in the fingerjoints. The properties of the fingerjoints to be considered are edge-wise and flat-wise bending strength and delamination.

Note: *For an example of sampling procedures to detect non-conformance, see APPENDIX XI.*

The quality control procedures used by a facility shall be fully documented in their QC Manual.

Verification of product quality includes two independent procedures:

a) One dealing with the quality, strength, and delamination of the fingerjoints, and

b) One dealing with the grade of the lumber containing fingerjoints. Verification as to the grade of the lumber shall follow the grading provisions set forth in the NLGA Standard Grading Rules.

15.2 QUALITY CONTROL SAMPLING

15.2.1 SAMPLING METHOD

The random sampling method shall be approved by the Agency and documented in the QC Manual.

15.2.2 SAMPLING FREQUENCY FOR DAILY QUALITY CONTROL

The frequency of the sampling is stated in Sections 15.2.2.1 and 15.2.2.2. Under special circumstances, such as to accommodate the facility's production schedule, the Agency may request the facility to increase the frequency of inspection and/or testing.

15.2.2.1 BENDING STRENGTH SAMPLING

a) For NLGA Para. 121 - STUD and Para. 124 - NO. 3 Grades

At least one specimen for flat-bending test and one specimen for edge-bending test shall be obtained during each **2** hours of operation, or part thereof, with no fewer than **5** specimens collected during any production shift of less than **5** hours, and

b) For NLGA Para. 122 - CONSTRUCTION & STANDARD and Para. 124 - NO. 1 & NO. 2 Grades

At least one specimen for flat-bending test and one specimen for edge-bending test shall be obtained during each **1** hour of operation, or part thereof, with no fewer than **5** specimens collected during any production shift of less than **5** hours.

15.2.2.2 DELAMINATION SAMPLING

There are four stages of delamination sampling:

a) Delamination Sampling Following Qualification

Immediately following initial qualification of a product, **4** fingerjoint specimens shall be obtained from each **half-shift**, or part thereof, of operation for at least **500** shifts.

These fingerjoints may be taken from specimens sampled for bending tests (refer to Section 9.2).

The delamination results shall be assessed in accordance with Table 8 to determine if verification sampling in accordance with 15.2.2.2d is required.

If, after **500** shifts of performing delamination sampling and testing, the data shows that the facility remained "**IN-CONTROL**" for the last **40** shifts of production, then the facility may go on to "**Level II Delamination Sampling**" and testing.

b) Level I Delamination Sampling

For Level I delamination sampling, **4** fingerjoint specimens shall be obtained from each **half-shift**, or part thereof. These fingerjoints may be taken from pieces sampled for bending tests (refer to Section 9.2). The delamination results shall be assessed in accordance with Table 8 to determine if verification sampling in accordance with 15.2.2.2d is required.

If, after performing delamination sampling and testing, the data shows that the facility remained "**IN-CONTROL**" for the last **40** shifts of production, then the facility may go on to "**Level II Delamination**" sampling and testing.

c) Level II Delamination Sampling

For Level II Delamination Sampling and testing, **1** fingerjoint specimen shall be obtained for each **half-shift**, or part thereof, of operation. The delamination results shall be assessed in accordance with Table 8 to determine if verification sampling in accordance with Section 15.2.2.2d is required.

d) Verification Delamination Sampling

When verification sampling is required (see Table 8), an additional sample of **5** fingerjoint specimens shall be randomly selected from the **half-shift** of production.

When operating under Level II sampling, the **5** fingerjoint specimens shall be randomly taken from the **second half-shift**. The **first half-shift** shall be sampled if required by Section 15.4.2.2a.

Note: *See APPENDIX IX for commentary on Table 8 and delamination sampling results.*

See APPENDIX X for commentary on production shift delamination sampling frequency.

TABLE 8 – HALF-SHIFT DELAMINATION RESULTS REQUIRING FURTHER VERIFICATION SAMPLING

Sampling Stage		Section 15.2.2.2	Joints Sampled per Half-shift	Number of Joints at the Delamination Level that Require Verification Sampling (Section 15.2.2.2d)		All Other Cases
				> 5%	> 10%	
Following Qualification		**(a)**	4	4	1 or more	Verification sampling not required and half-shift of production is "**IN-CONTROL**"
Level I		**(b)**	4	4	1 or more	
Level II	***1st half-shift***	**(c)**	1	1 [1]	1	
	2nd half-shift	**(c)**	1	1 [2]	1	

[1] *Verification sampling pending and required only if sample joint from 2nd half-shift shows delamination greater than 5%.*

[2] *Verification sampling is required only if sample joint from 1st half-shift shows delamination greater than 5%, or if 1st half-shift is deemed to be "**OUT-OF-CONTROL**".*

15.3 QUALITY CONTROL TESTING

Testing for modulus of rupture and delamination shall be performed in accordance with the procedures described in Section 9.

15.4 ANALYSIS OF QUALITY CONTROL TESTS

Test results shall be entered on Agency approved control forms. The control forms shall be designed so that the process properties qualified under Sections 13.2 and/or 13.4 are recorded and "**IN-CONTROL**" and "**OUT-OF-CONTROL**" situations shall be readily detectable.

Note: *See also the process flowcharts in APPENDICES VI, VII, and VIII.*

15.4.1 IN-CONTROL

When all the process properties referred to in Sections 15.3 and 15.3 remain "**IN-CONTROL**", the item from which the quality control sample was drawn shall be deemed to be compliant with the property requirements of this Standard.

15.4.2 OUT-OF-CONTROL

The requirements of this section relate to the conditions described in APPENDICES VI, VII, and VIII.

When the process fails to meet the requirements specified in this Standard, the facility shall be deemed to be "**OUT-OF-CONTROL**" and the production as defined in Sections 15.4.2.1 or 15.4.2.2 shall be held pending the results of the following testing and analysis:

a) An examination of the test procedures, test equipment spot-checks and/or calculations shall be made to determine whether there were errors.

b) If no such errors are identified, proceed to Sections 15.4.2.1 and/or 15.4.2.2.

c) Held production deemed to be "**OUT-OF-CONTROL**" after evaluations in accordance with Sections 15.4.2.1 and/or 15.4.2.2 shall be rejected. The grade stamps from rejected production shall be obliterated or removed.

d) If "**OUT-OF-CONTROL**" for delamination is confirmed, the facility is permitted to break down the half-shift into 1-hour segments and conduct extra verification sampling for each 1-hour segment to isolate the period for which the production grade stamps shall be obliterated.

15.4.2.1 BENDING STRENGTH

When the production represented by a specific time frame from which the quality control sample was drawn fails to meet the bending strength requirements prescribed in Section 8.1, production from this time frame shall be held pending the results of bending tests on a new **28**-specimen sample for each of the bending orientation (edge-wise or flat-wise) that went "**OUT-OF-CONTROL**". This confirmation sample(s) shall be randomly selected and tested in accordance with Section 13.4.2.

15.4.2.1.1 5th %ILE BENDING STRENGTH

When an edge-wise and/or flat-wise bending test specimen falls below the "**5th %ile bending strength**" value as provided in Tables 3 to 6 for the property tested, but not below the "**minimum bending strength**" value, the quality control edge-wise and/or flat-wise bending test results of at least **27** of the next **28** edge-wise and/or flat-wise bending specimens (any size) shall meet or exceed the "**5th %ile bending strength**" value. Otherwise, the facility shall be deemed to be "**OUT-OF-CONTROL**".

When the test results from **27** of the last **28** edge-wise and/or flat-wise bending specimens sampled in accordance with Section 15.2.2.1a or 15.2.2.1b, as applicable, fail to meet the "**5th %ile bending strength**" requirements of Section 8.1.2, the confirmation samples shall be evaluated as follows:

If the **28**-specimen flat-wise bending and/or the **28**-specimen edge-wise bending test results fail to meet the requirements of Section 13.4.3.1.1, the held production is "**OUT-OF-CONTROL**".

15.4.2.1.2 MINIMUM BENDING STRENGTH

When an edge-wise and/or flat-wise bending test sample result sampled in accordance with Section 15.2.2.1a or 15.2.2.1b, as applicable, fails to meet the "**minimum bending strength**" value as provided in Tables 3 to 6, the confirmation samples shall be evaluated for the bending orientation that went "**OUT–OF-CONTROL"** as follows:

a) If the **28-**specimen flat-wise bending and/or **28**-specimen edge-wise bending test, as applicable, fail to meet the requirements of Section 13.4.3.1.2, the held production is "**OUT-OF-CONTROL**".

b) If the **28**-specimen re-qualification sample meets the "**5th %ile bending strength**" requirements of Section 13.4.3.1.2, the process is considered "**IN-CONTROL**". Once back "**IN-CONTROL**"**,** the sampling frequency shall be increased (doubled, tripled, etc.) and maintained until an additional **25-**specimen sample has been generated and tested for the bending orientation (edge-wise or flat-wise) that was found to be "**OUT-OF-CONTROL**".

c) "**All**" of the **25** additional specimen test results shall meet or exceed the "**minimum bending strength**" value as provided in Tables 3 to 6 and not more than one (**1**) of the test results shall be below the "**5th %ile bending strength**" value.

d) Otherwise, the process is deemed to be "**OUT-OF-CONTROL**" for the minimum edge-wise or flat-wise bending strength, whichever bending orientation is undergoing re-qualification.

15.4.2.2 DELAMINATION

a) If the average delamination of the **5**-specimen verification sample (Section 15.2.2.2d) exceeds 10%, the **half-shift** of held production from which the samples were drawn shall be deemed to be "**OUT-OF-CONTROL**" for delamination.

Note: *There is no maximum limit on the percentage delamination observed on any one specimen for "**OUT-OF-CONTROL**" verification samples.*

b) When operating under Level II sampling, the first **half-shift** of production is permitted to be evaluated using verification sampling (Section 15.2.2.2d). Otherwise, the first **half-shift** of production shall also be deemed to be "**OUT-OF-CONTROL**" for delamination.

c) If the average delamination of the **5**-specimen verification sample (Section 15.2.2.2d) is less than or equal to 10%, the **half-shift** of held production from which the sample was drawn, and the first **half-shift** of production if operating under Level II sampling, shall be deemed to be "**IN-CONTROL**" for delamination.

d) If **4 or more** consecutive half-shifts of production are deemed to be "**OUT-OF-CONTROL**" for delamination, the process shall be deemed "**OUT-OF-CONTROL**" for delamination and shall be re-qualified for delamination as specified in Section 13.4.2.2 for sampling and testing, and Section 13.2.3.2 for decision rules. Sampling frequency shall revert to Level I.

15.5 ALTERNATE GRADES

As a result of the number of specimens obtained for qualification, it is statistically possible to qualify a grade and subsequently find that it is not possible to maintain the fingerjoint requirements of the grade. In such a case, the facility, upon approval by the Agency, may wish to grade stamp to a lower grade for which the quality control test requirements can be satisfied.

This provision only applies to the NO. 1 and NO. 2 grades.

15.6 IDENTIFICATION AND TRACEABILITY

Each package of fingerjoined lumber leaving the facility production line shall be identified with the time and date it left the production line.

Note: *This is to allow traceability of an item if further testing is required or in the event of a non-conformance or an "**OUT-OF-CONTROL**" condition.*

15.7 QUALITY CONTROL RECORDS

Facility control records shall include but are not necessarily limited to:

a) Test equipment calibration and maintenance data,

b) Quality control tests, and

c) All fingerjoined production stoppages because of quality control requirements and a report of the corrective actions taken.

Separate records shall be maintained for each item produced. All records shall include the date when performed and shall be retained for at least **6** years. These records shall be made available to the Agency upon request.

16.0 REINSPECTION PROVISIONS

16.1 GENERAL

Response to complaints on fingerjoined lumber involving visual grade, size, moisture content, tally, fingerjoints or assigned design values, shall be based on the applicable requirements within this section of the Standard, and by the requirements set forth in NLGA Para. 400.

Sample selection and testing shall be performed by the Agency whose logo appears on the lumber (or by an independent accredited testing organisation approved by the original grading Agency). Only certified test equipment calibrated to a national standard and using a process mutually agreed upon by the Agency, the seller, and the buyer shall be used.

16.2 JOINT ASSESSMENT SAMPLING AND EVALUATION

16.2.1 JOINT SAMPLING AND TESTING

In the case of a dispute pertaining to fingerjoint strength assigned design values, a random sample of the item under complaint shall be obtained as follows:

a) **80** specimens for the edge-wise bending modulus of rupture property evaluations to be tested in accordance with Section 9.1 in such a way that the compression face is randomly generated, and

b) **80** specimens for the flat-wise bending modulus of rupture evaluations to be tested in accordance with Section 9.1 in such a way that the compression face is randomly generated.

Testing shall be undertaken in accordance with procedures set forth in Section 9.1 using test equipment calibrated to a national standard by an independent calibration laboratory.

16.2.2 JOINT EVALUATION

Test results of the lumber in dispute shall be assessed as follows:

a) For the edge-wise bending modulus of rupture, not more than **6** specimens out of **80** shall have an MOR value that is less than the corresponding 5^{th} %ile value as provided in Tables 3 to 6 for the grade and size, and

b) For the flat-wise bending modulus of rupture, not more than **6** specimens out of **80** shall have an MOR value that is less than the corresponding 5^{th} %ile value as provided in Tables 3 to 6 for the grade and size.

For specimens that fail away from the joint at less than the 5^{th} %ile MOR value as provided in Tables 3 to 6, an equal number of replacement joints shall be selected and tested.

16.3 FINGERJOINED DELAMINATION SAMPLING AND EVALUATION

In cases of complaints pertaining to the fingerjoint delamination, a **20**-specimen sample representing the item shall be randomly selected.

Specimen preparation and testing shall be in accordance with Section 9.2.

If the delamination of any specimen or, if applicable, the average delamination of a specimen and its matching specimen (see Section 9.2.1.1) after one vacuum, pressure and drying cycle exceeds 5% but is less than 10%, repeat the above vacuum, pressure, drying cycle twice on that specimen and its matching specimen (if any), and record the delamination at the end of the third cycle.

Not more than **2** specimens shall show greater than 15% delamination after one vacuum, pressure, and drying cycle.

APPENDICES (Informative Information)

APPENDIX I - BENDING TEST SET-UP AND EXAMPLE

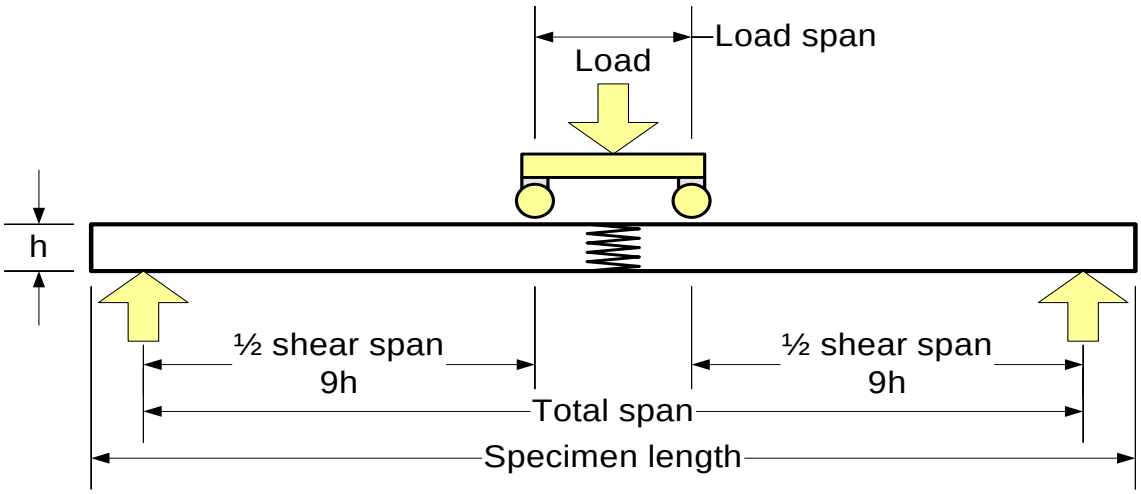

FIGURE 1 – BENDING TEST SET-UP SCHEMATIC

Example:

The specimen is a nominal 2x4 to be tested to determine the flat-wise bending strength of the fingerjoint. The fingers are 1 inch long.

Section 9.1.2 requires that the load points be placed approximately 2 inches from the fingerjoint and that the shear span-to-depth ratio be between 15 and 20.

The following loading configuration is therefore used:

Test on flat (depth)	= 1.5"
Load span	= 5"
Shear span-to-depth ratio	= 18
Overhang (beyond supports)	= 4" each end

Shear span = 18 x 1.5 = 27"
1/2 shear span = 0.5 x 27 = 13.5"
Length = Shear span + Load span + (2 x Overhang)
= 27 + 5 + (2 x 4) = 40"

The **modulus of rupture** (MOR) is calculated using:

$$MOR = \frac{3Pa}{bh^2}$$

Where: ***P*** = the maximum load obtained in pounds
a = half the shear span in inches
h = the specified depth of the specimen in inches
b = the specified breadth of the specimen in inches
MOR = modulus of rupture in psi

For the example shown, the calculations using inch-pound unit is as follows:

$$MOR = \frac{3P \times 13.5}{3.5 \times 1.5^2} = 5.14P$$

with ***P*** in lbs. and **MOR** in psi.

If the breaking load, ***P***, is 935 lbs., the **MOR** is 4,810 psi.

APPENDIX II - QUALITY CONTROL MANUAL CONTENTS

The Quality Control (QC) Manual specifies, in writing, one or more sets of facility operating conditions that are known to result in a product that is in continuous conformance with the requirements of this Standard. The qualification applies only to product(s) produced within the specified limits of the QC Manual.

The details of the QC Manual will vary with the process used. Some aspects of it may be common to all lumber sizes, grades and species combinations, while other aspects may vary with size, grade and species.

The QC Manual provides details of all test procedures used, the wood failure criteria used (if any) and the records to be kept of in-process checks that are made.

The QC Manual describes the manufacturing operation, broken down by station.

For each station in the sequence of manufacture, a description is required of the function performed by the equipment, the skills the operator requires, the responsibility of the operator in control of that station, and what checks are instituted (if

required) to ensure that the equipment and operator are performing within the desired limits. Provisions must be outlined for the absence of any operator with specialized skills essential to the process.

Examples of typical stations are:

a) **Input grading**: station where defects are removed from the ends of the lumber components prior to machining the fingerjoint.

b) **Machining of the fingerjoints**: station where set-up tolerances are monitored and where cutter heads are changed.

c) **Glue mixing**: station concerned with ensuring the prescribed proportions of adhesive and hardener are thoroughly blended at the prescribed temperature levels.

d) **Make-up station**: station consisting of top dead rolls mounted above the in-feed table (ahead of the crowder and retard system) which assists the operator with assembly of the joint, and

e) **Off-line QC test equipment:** station where QC specimens are tested.

The QC Manual must include special provisions for shut-down and start-up of the gluing line, particularly during temporary stoppages. The latter is particularly significant in preheat processes, in which the glue may be spread on heated wood and must be put under gluing pressure within a limited time to avoid pre-cure of the glue.

The sampling in this Standard assumes samples are representative of the quality of the production under continuous production. During temporary stoppages, there may be segments of the production that may be negatively affected (e.g., partially cured adhesive; uneven spread of adhesive). This production will not be represented in the quality control sample and must therefore be removed from production. Similarly, during start-up, there may be some production that may not receive sufficient adhesive.

APPENDIX III - THE USE OF WOOD FAILURE ASSESSMENT IN PROCESS CONTROL

In this Standard, control of the quality of gluing is based on resistance to delamination. However, the results from a delamination test take time. During the start-up, and during periods in which the manufacturing facility goes out of control for no obvious reason, assessing the wood failure developed in the fingerjoint may assess the quality of the bondline more rapidly. In processes using heat to accelerate the cure of the bondline, wood failure may be assessed within a short period of time after assembly of the glued joint, usually within 5 to 15 minutes. This wood failure assessment may be used as a diagnostic tool to identify malfunctions in the manufacturing process.

The significance of wood failure is that it correlates inversely with delamination resistance. If a high degree of wood failure develops, the joint should be resistant to delamination. Conversely, any area in the joint that shows no wood failure may be prone to delaminating in the delamination test.

In this Standard, wood failure shall mean that the joint fails in a shallow layer of the wood next to the bondline. In testing fingerjoints, the difficulty with a wood failure test procedure is a tendency for some of the fingers to break off at the base rather than pull out of the joint. Such broken fingers are not classed as wood failure, but are indeterminate, since the bondline under the finger was not stressed in shear parallel to the bondline.

Another observation of interest is not wood failure, but glue failure. Ordinary glue failure is a failure in the bondline itself, so that glue is visible on both matching surfaces of the joint.

In hot set joints made with phenol-resorcinol glue, a common cause is thick bondlines in which the glue boils out. This may result from inadequate pressure, which in turn may result from a slip in the roller press, improper machining of the joint, or from dirt in the joint which prevents the joint from squeezing together properly. Another cause for glue failure is pre-cure of the glue in circumstances in which glue is spread on both ends of a heated fingerjoined piece.

This pre-cure may affect the whole joint or may be restricted to areas in the joint that received an inadequate spread of glue as a result of glue wipe in the glue spreader.

Another type of failure is adhesion failure, in which the bondline fails not in the bondline, but at the surface of the wood. In such a failure, the glue is visible on one side of the bondline but the matching area on the other side of the bondline is bare wood or wood lightly stained by the glue. Common causes of this is pre-cure of the glue spread on one end of the piece of heated wood, due to either inadequate glue spread in all or part of the joint, or in holding the glue spread piece too long before assembly.

Both types of failure (cohesion failure and adhesion failure) must be distinguished from glue skip, in which a portion of the joint gluing surfaces receives no glue at all. This is not a glue failure; however, any such area may be vulnerable to delamination.

The technique used to open the joint with minimum breakage of the fingers is to fail the joint in bending at right angles to the line of the fingers: e.g., flat bending of a horizontal fingerjoint.

The piece is subjected to a bending load until approximately half of the fingers on the tension face are pulled open. The piece is then turned over and a bending load again applied to pull open the remaining fingers.

In hot set joints, less finger breakage is obtained if the joint is broken open as soon as the glue has hardened. It is particularly important that the entire joint be broken open in flat bending. If the testing machine does not have sufficient displacement capacity, the partially failed joint can be broken completely open by resting it on two supports and applying sufficient force to pull open the joint.

While wood failure assessment is not a mandatory requirement in this Standard, Section 7.3.1 requires that sufficient glue must be applied to the joint.

APPENDIX IV - AGENCY ADMINISTRATION

An accredited Agency shall administer this Standard. Agency approval of a facility to grade stamp fingerjoined lumber shall be contingent upon the facility's compliance with the procedures and requirements of this Standard.

Inspections shall include amongst other things reporting on the following:

a) Examination of specimens from the facility's inventory, the facility's records, and procedures to verify compliance with the requirements of **PART A** of this Standard and the Quality Control Manual.

b) Examination of the bending equipment and the proof loading equipment including observations on:

- **i)** Wear and damage.
- **ii)** Lubrication and operations of moveable parts.
- **iii)** Record of weekly calibration.

c) Examination of the delamination test equipment, including the apparatus for measuring temperature, pressure and time, and the drying chamber.

d) Inspection of the glue mixing equipment and procedures, including the accuracy of the weighing equipment, mixing proportions, and cleanliness of the facility.

e) Verification of the delamination measurement and procedures.

f) Examination of the control system used to prevent overheating of the wood in the gluing surface.

APPENDIX V - FINGER PROFILE ORIENTATION FOR DELAMINATION TEST IN THE DRYING CHAMBER

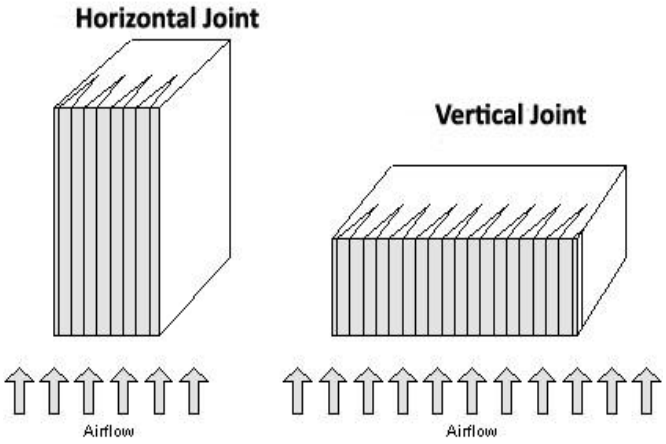

FIGURE 2 – FINGER ORIENTATION RELATIVE TO AIRFLOW

APPENDIX VI - EXAMPLES OF DELAMINATION "IN-CONTROL" AND "OUT-OF-CONTROL" SCENARIOS

In-control - not more than 3 specimens with delamination between 5 and 10% in any half-shift under Level I; and not more than 1 specimen in both half-shift under Level II.

Out-of-control Level I - all specimens between 5 and 10%; or one specimen >10%. Each half-shift of production treated independently.

Out-of-control Level II - specimens between 5 and 10% for both half-shifts, or occasional specimens above 10%.

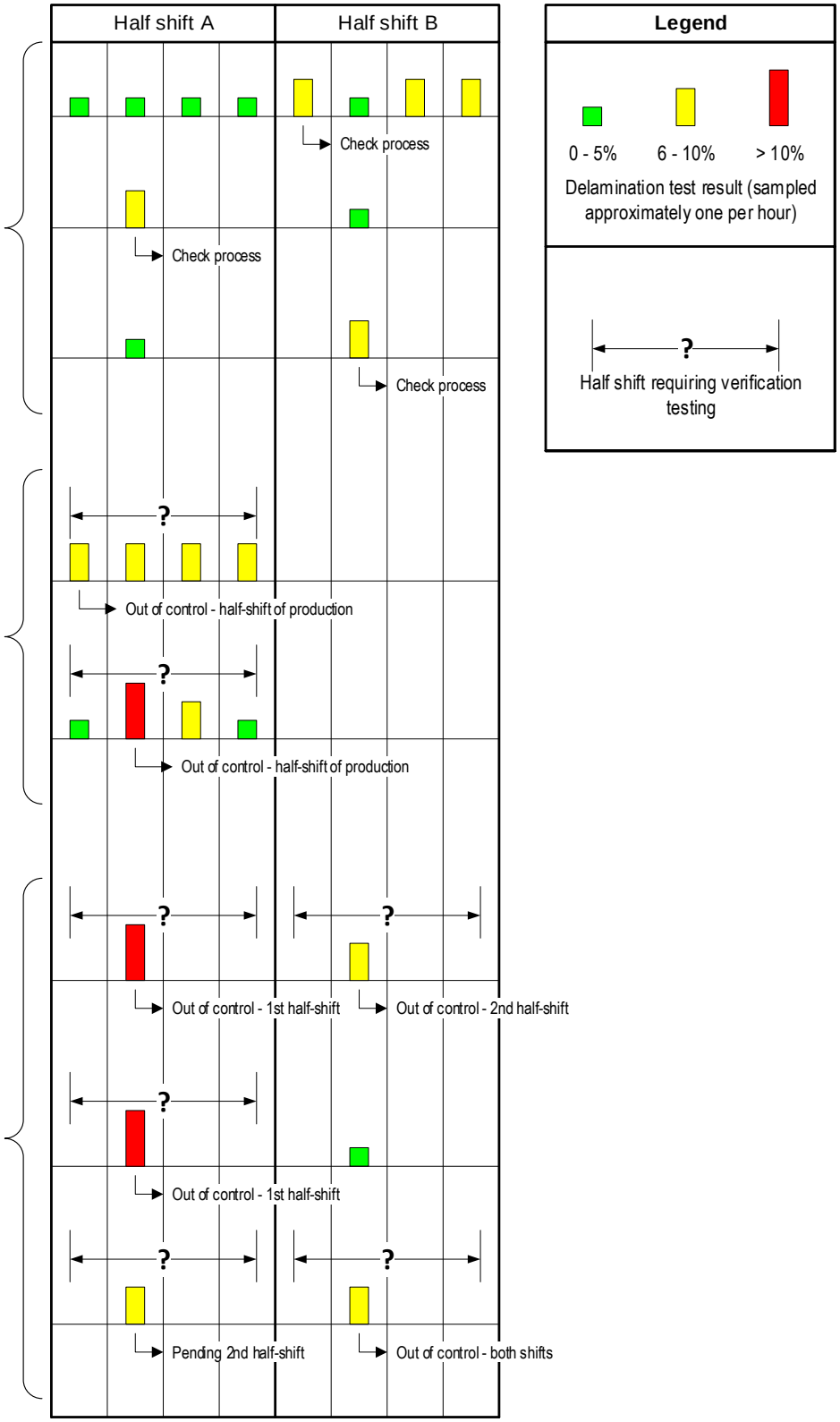

FIGURE 3 – EXAMPLES OF IN-CONTROL AND OUT-OF-CONTROL SCENARIOS

APPENDIX VII - FINGER JOINT VERIFICATION FLOW CHART: DELAMINATION

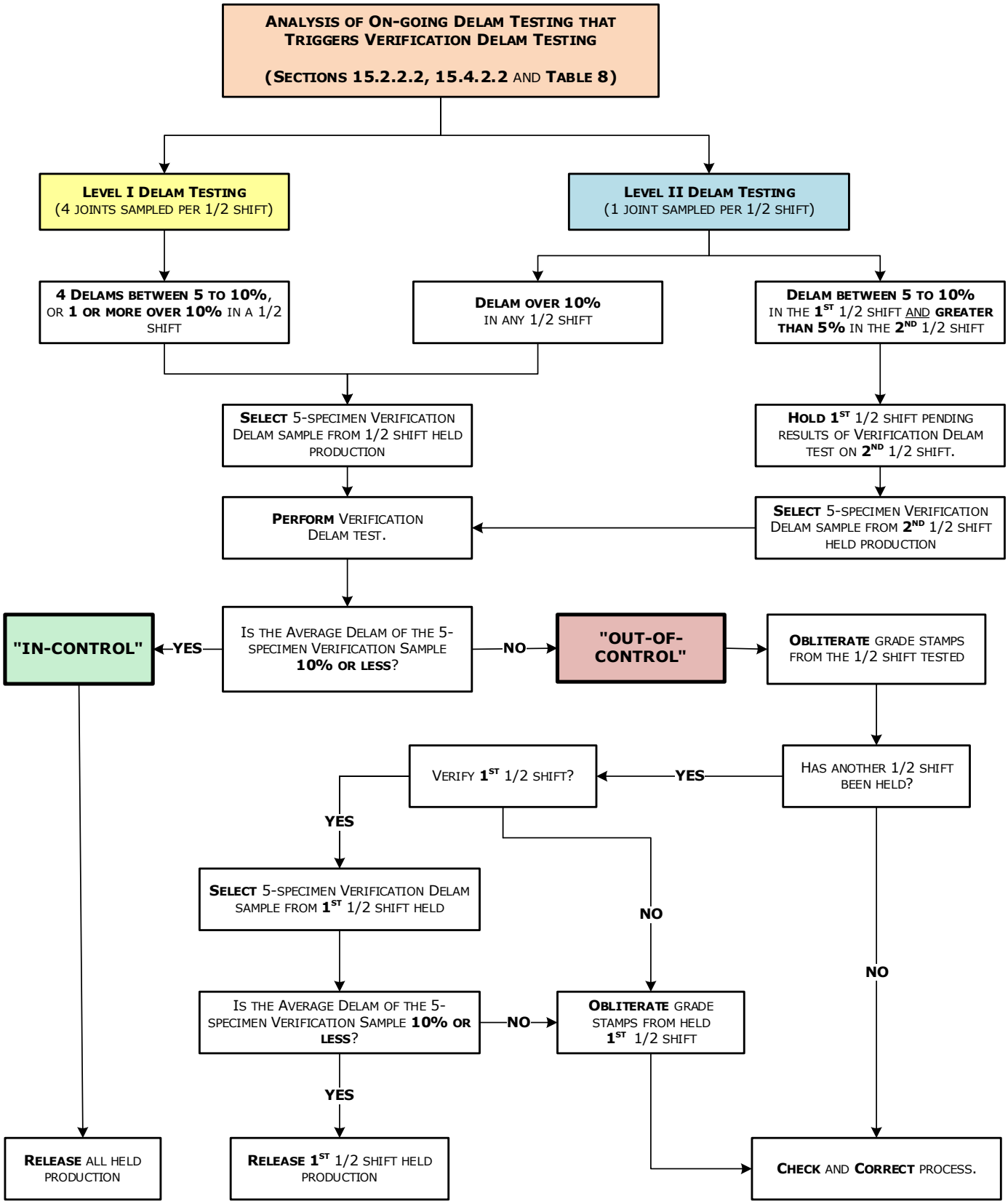

FIGURE 4 – DELAMINATION: FINGERJOINT VERIFICATION FLOW CHART

APPENDIX VIII - FINGER JOINT VERIFICATION FLOW CHARTS: BENDING STRENGTH

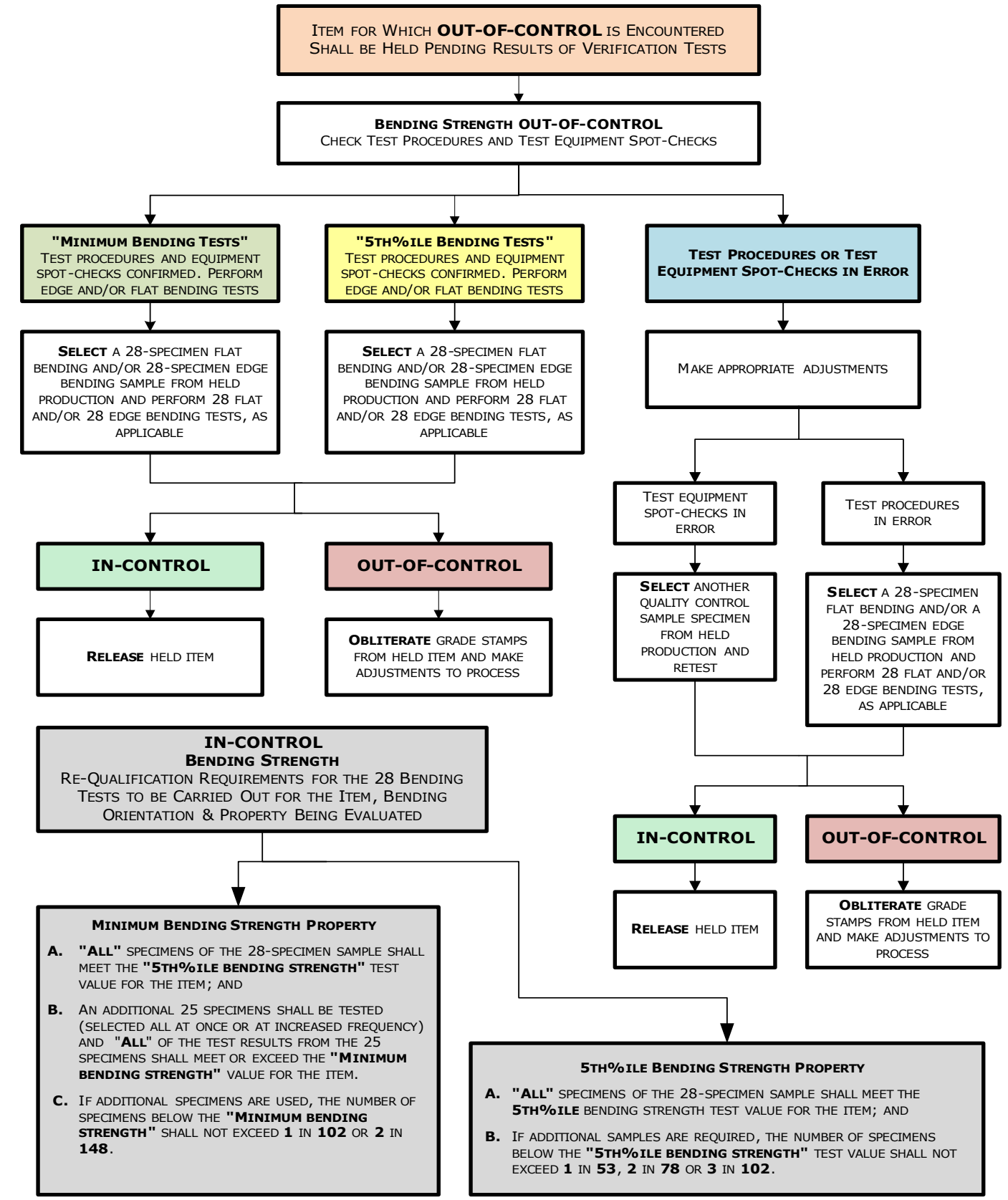

FIGURE 5 – BENDING STRENGTH: FINGERJOINT VERIFICATION FLOW CHARTS

APPENDIX IX - COMMENTARY ON TABLE 8 (HALF-SHIFT DELAMINATION RESULTS REQUIRING FURTHER VERIFICATION TESTING)

a) Evaluation of Delamination Results after Qualification
(Row 1 - Columns 4 & 5)

If following qualification and after one vacuum-pressure-dry cycle, all four fingerjoint specimens show average delamination greater than 5% but less than 10% (Column 4), **OR** one or more of the four fingerjoint specimens show average delamination greater than 10% (Column 5), the half-shift production where the fingerjoint specimens were taken must be re-sampled for verification testing.

b) Evaluation of Level I Delamination Results
(Row 2 – Columns 4 & 5)

If under Level I delamination sampling and after one vacuum-pressure-dry cycle, all four fingerjoint specimens show average delamination greater than 5% but less than 10% (Column 4), **OR** one or more of the four fingerjoint specimens show average delamination greater than 10% (Column 5), the half-shift production where the fingerjoint specimens were taken must be re-sampled for verification testing.

c) Evaluation of Level II 1st Half-Shift Delamination Results
(Row 3 – Columns 4 & 5)

If under Level II delamination sampling and after one vacuum-pressure-dry cycle, the single fingerjoint specimen taken in the **first** half-shift shows average delamination of 5% but less than 10% (Column 4), take no action but wait for the result of the **second** half-shift fingerjoint specimen. However, if the single fingerjoint specimen shows average delamination greater than 10% (Column 5), then the **first** half-shift production where the fingerjoint specimen was taken must be re-sampled for verification testing.

d) Evaluation of Level II 2nd Half-Shift Delamination Results
(Row 4 – Columns 4 & 5)

If under Level II delamination sampling and after one vacuum-pressure-dry cycle, the single fingerjoint specimen taken in the **second** half-shift also shows average delamination of 5% but less than 10% (Column 4), **OR** if the single fingerjoint specimen shows average delamination greater than 10% (Column 5), the **second** half-shift production where the fingerjoint specimen was taken must be re-sampled for verification testing. In addition, the **first** half-shift production must also be re-sampled for verification testing if it has not already been re-sampled under *Row 3* above.

APPENDIX X - COMMENTARY ON SAMPLING FREQUENCY FOR DELAMINATION QUALITY CONTROL

Sampling frequency for delamination quality control of fingerjoined lumber is based on full production shifts of 8 to 10 hours (half-shifts are 4 to 5 hours). For partial shifts or shifts where different items are produced, the intent is that each item is still fully sampled for quality control. The following are sampling frequency examples for non-standard production shifts:

a) For full production shifts longer than 10 hours, the "half-shifts" are limited to a maximum 4 hours in length and the number of "half-shifts" for sampling purposes during the full shift is determined by dividing the full shift hours by 4 and rounding up to the next full number.

For example, an 11-hour full production shift would have 3 "half-shifts" for sampling purposes (11 / 4 = 2.75, rounded up to 3).

b) If production switches from one item to another during the full shift, the required number of test specimens for each item must be collected in proportion to the item's production time with a minimum of at least 1 test specimen per item.

APPENDIX XI – EXAMPLE: QUALITY CONTROL SAMPLING PROCEDURES FOR DETECTING NON-PERFORMANCE SITUATIONS

The following example is intended to promote uniform interpretation of SPS 3, Section 15.4.2 fingerjoined lumber quality control sampling demonstrated by typical "**OUT-OF-CONTROL**" situations. See summary of actions at the end of the time schedule table for procedures.

Legend: **X** - Specimen Selected ✓- Test Performed **O** - Denotes Failure

Line #	Shift	Time	Delamination			Edge Bending			Flat Bending		
			Specimen	Check >5%	Check >10%	Specimen	Check Min	Check 5th %	Specimen	Check Min	Check 5th %
1	Day 1st ½ Shift	9:00 a.m.	x	✔	✔	x	✔	✔ - O	x	✔	✔
2		10:00 a.m.	x	✔	✔						
3		11:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
4		12:00 p.m.	x	✔	✔						
5	Day 2nd ½ Shift	1:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
6		2:00 p.m.	x	✔	✔						
7		3:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
8		4:00 p.m.	x	✔	✔						
9	After Noon 1st ½ Shift	5:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
10		6:00 p.m.	x	✔	✔						
11		7:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
12		8:00 p.m.	x	✔	✔						
13	After Noon 2nd ½ Shift	9:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
14		10:00 p.m.	x	✔	✔						
15		11:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
16		12:00 a.m.	x	✔	✔						
17	Night 1st ½ Shift	1:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
18		2:00 a.m.	x	✔	✔						
19		3:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
20		4:00 a.m.	x	✔	✔						
21	Night 2nd ½ Shift	5:00 a.m.	x	✔	✔	x	✔	✔ - O	x	✔	✔
22		6:00 a.m.	x	✔	✔						
23		7:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
24		8:00 a.m.	x	✔	✔						
25	Day 1st ½ Shift	9:00 a.m.	x	✔	✔	x	✔ - O	✔	x	✔	✔
26		10:00 a.m.	x	✔	✔						
27		11:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
28		12:00 p.m.	x	✔	✔						

Legend: **X** - Specimen Selected ✓- Test Performed **O** - Denotes Failure

Line #	Shift	Time	Delamination			Edge Bending			Flat Bending		
			Specimen	Check >5%	Check >10%	Specimen	Check Min	Check 5th %	Specimen	Check Min	Check 5th %
29	Day 2nd ½ Shift	1:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
30		2:00 p.m.	x	✔ - O	✔ - O						
31		3:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
32		4:00 p.m.	x	✔	✔						
33	After Noon 1st ½ Shift	5:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
34		6:00 p.m.	x	✔	✔						
35		7:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
36		8:00 p.m.	x	✔	✔						
37	After Noon 2nd ½ Shift	9:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
38		10:00 p.m.	x	✔	✔						
39		11:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
40		12:00 a.m.	x	✔	✔						
41	Night 1st ½ Shift	1:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
42		2:00 a.m.	x	✔ - O	✔						
43		3:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
44		4:00 a.m.	x	✔	✔						
45	Night 2nd ½ Shift	5:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
46		6:00 a.m.	x	✔ - O	✔ - O						
47		7:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
48		8:00 a.m.	x	✔	✔						
49	Day 1st ½ Shift	9:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
50		10:00 a.m.	x	✔	✔						
51		11:00 a.m.	x	✔	✔	x	✔	✔	x	✔	✔
52		12:00 p.m.	x	✔	✔						
53	Day 2nd ½ Shift	1:00 p.m.	x	✔ - O	✔	x	✔	✔	x	✔	✔
54		2:00 p.m.	x	✔ - O	✔						
55		3:00 p.m.	x	✔ - O	✔	x	✔	✔	x	✔	✔
56		4:00 p.m.	x	✔ - O	✔						
57	After Noon 1st ½ Shift	5:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
58		6:00 p.m.	x	✔	✔						
59		7:00 p.m.	x	✔	✔	x	✔	✔	x	✔	✔
60		8:00 p.m.	x	✔	✔						

Legend: **X** - Specimen Selected ✓- Test Performed **O** - Denotes Failure

Line #	Shift	Time	Delamination			Edge Bending			Flat Bending		
			Specimen	Check >5%	Check >10%	Specimen	Check Min	Check 5th %	Specimen	Check Min	Check 5th %
61	After Noon 2nd ½ Shift	9:00 p.m.	x	✓	✓	x	✓	✓	x	✓	✓
62		10:00 p.m.	x	✓	✓						
63		11:00 p.m.	x	✓	✓	x	✓	✓	x	✓	✓
64		12:00 a.m.	x	✓	✓						
65	Night 1st ½ Shift	1:00 a.m.	x	✓	✓	x	✓	✓	x	✓ - O	✓
66		2:00 a.m.	x	✓	✓						
67		3:00 a.m.	x	✓	✓	x	✓	✓	x	✓	✓
68		4:00 a.m.	x	✓	✓						
69	Night 2nd ½ Shift	5:00 a.m.	x	✓	✓	x	✓	✓	x	✓	✓
70		6:00 a.m.	x	✓	✓						
71		7:00 a.m.	x	✓	✓	x	✓	✓	x	✓	✓
72		8:00 a.m.	x	✓	✓						
73	Day 1st ½ Shift	9:00 a.m.	x	✓ - O	✓	x	✓	✓	x	✓	✓
74		10:00 a.m.	x	✓ - O	✓						
75		11:00 a.m.	x	✓ - O	✓	x	✓	✓	x	✓	✓
76		12:00 p.m.	x	✓ - O	✓						
77	Day 2nd ½ Shift	1:00 p.m.	x	✓	✓	x	✓	✓	x	✓	✓
78		2:00 p.m.	x	✓ - O	✓						
79		3:00 p.m.	x	✓ - O	✓ - O	x	✓	✓	x	✓	✓
80		4:00 p.m.	x	✓	✓						
81	After Noon 1st ½ Shift	5:00 p.m.	x	✓ - O	✓	x	✓	✓	x	✓	✓
82		6:00 p.m.	x	✓ - O	✓						
83		7:00 p.m.	x	✓ - O	✓	x	✓	✓	x	✓	✓
84		8:00 p.m.	x	✓ - O	✓						
85	After Noon 2nd ½ Shift	9:00 p.m.	x	✓	✓	x	✓	✓	x	✓	✓
86		10:00 p.m.	x	✓ - O	✓						
87		11:00 p.m.	x	✓ - O	✓	x	✓	✓	x	✓	✓
88		12:00 a.m.	x	✓ - O	✓ - O						
89	Night 1st ½ Shift	1:00 a.m.	x	✓	✓	x	✓	✓	x	✓	✓
90		2:00 a.m.	x	✓	✓						
91		3:00 a.m.	x	✓	✓	x	✓	✓	x	✓	✓
92		4:00 a.m.	x	✓	✓						

Legend: **X** - Specimen Selected ✓- Test Performed **O** - Denotes Failure

Line #	Shift	Time	Delamination			Edge Bending			Flat Bending		
			Specimen	Check >5%	Check >10%	Specimen	Check Min	Check 5th %	Specimen	Check Min	Check 5th %
93	Night 2nd ½ Shift	5:00 a.m.	x	✓	✓	x	✓	✓	x	✓	✓
94		6:00 a.m.	x	✓	✓						
95		7:00 a.m.	x	✓	✓	x	✓	✓	x	✓	✓
96		8:00 a.m.	x	✓	✓						

SUMMARY OF ACTIONS

Lines 1 and 2 **See Section 15.4.2.1.1 for reference:**
When an edge-wise and/or flat-wise bending specimen test fails between the **"5th %ile bending strength"** value and the **"minimum bending strength"** value as provided in Tables 3 to 6 and an examination of the bending test procedures confirms that there is no error in the calibration, test procedures or calculations; the quality control edge-wise and/or flat-wise bending test specimen results of at least twenty-seven (**27**) of the next twenty-eight (**28**) edge-wise and/or flat-wise bending tests must meet or exceed the **"5th %ile bending strength"** value. Otherwise, the facility shall be deemed to be **"OUT-OF- CONTROL**".
Note: *Edge and flat bending test results are treated separately.*

Lines 21 and 22 When a second failure occurs below the "**5th %ile bending strength**" value within the 28-specimen sample period, the following action must be taken:

i) An examination of the bending test procedures shall be made to determine whether there were errors in calibration, test procedures and/or calculations.

ii) If no such errors are identified, the production from which the last quality control sample was taken shall be re-sampled to obtain a further twenty-eight (**28**) specimen sample for edge-wise and/or flat-wise bending tests as specified in Section 15.4.2.1.1. If the results from the bending tests fail to meet the requirements of Section13.4.3.1.1, the production identified to be "**OUT-OF-CONTROL**" shall be rejected and the grade stamps shall be obliterated or removed.

- For the example provided, a second 5th %ile edge failure occurred between 5:00 a.m. and 6:00 a.m. of the tenth half-shift within the 28-specimen sample period. This triggers the action that the FJ production identified for the hour the failure occurs shall be re-sampled to obtain a twenty-eight (**28**) specimen sample for edge bending tests as specified in Section 15.4.2.1.1.
- For the purposes of this example, it is assumed that the 28-specimen re-sample had no 5th %ile edge-wise failures and therefore no further action is required.

Lines 25 and 26 **See Section 15.4.2.1.2 for reference:**
When an edge-wise and/or flat-wise bending specimen test fails to meet the **"minimum bending strength"** value as provided in Tables 3 to 6, then the facility shall be deemed to be **"OUT-OF-CONTROL**" and subject to the following actions:

i) An examination of the bending test procedures shall be made to determine if there were errors in calibration procedures and/or calculations.

ii) If no such errors are identified, the production from which the last quality control specimen was taken shall be re-sampled to obtain a twenty-eight (**28**) specimen sample for edge-wise and/or flat-wise bending tests as specified in Section 15.4.2.1.2. If the results from the bending tests fail to meet the requirements of Section 13.4.3.1.2, the production identified to be **"OUT-OF-CONTROL"** shall be rejected and the grade stamps shall be obliterated or removed.

- For the example provided, the specimen edge bending test failed below the "**minimum**" required bending strength value, therefore the FJ production identified as the product produced between 9:00 a.m. and 10:00 a.m. shall be re-sampled to obtain a twenty-eight (**28**) specimen sample for edge-wise bending tests as specified in Section 15.4.2.1.2.
- If the **28**-specimen sample meets the **"5th %ile bending strength"** requirements of Section 13.4.3.1.1, the process is considered re-qualified**.** Once back **"IN-CONTROL",** the sampling frequency shall be increased (doubled, tripled, etc.) and maintained until an additional **25**-specimen sample has been generated and tested for the edge-wise orientation. "**All**" of the **25** additional test results shall meet or exceed the **"minimum bending strength"** value as provided in Tables 3 to 6 and not more than one (**1**) of the test results shall be below the "**5th %ile bending strength"** value.
- If these additional limits are not met, the process is again deemed to be **"OUT- OF-CONTROL"** for the minimum edge-wise bending strength.
- For the purposes of this example, it is assumed that the **25**-specimen re-sample had no edge-wise minimum bending strength failures and therefore no further action is required.

Line 30 **See Section 15.4.2.2a for reference:**
If one or more quality control delamination test specimens from any half-shift of production is greater than 10%, a **5**-piece verification sample (as per Section 15.2.2.2d) shall be randomly selected from the held production.

- For the example provided, a failure occurred to the delamination specimen sampled at 2:00 p.m. and therefore the FJ production must be held pending the delamination results from a **5**-piece verification sample. Five (**5**) specimens shall be randomly selected from the held production (production since the previous half-shift) and subjected to one (**1**) vacuum pressure drying cycle and the results of the tests shall determine the course of action to be taken:
  a) If the average delamination of the 5-piece verification sample exceeds 10%, the half-shift of held production from which the samples were drawn shall be deemed to be "**OUT-OF-CONTROL**" for delamination.
  b) If the average delamination of the 5-piece verification sample is equal to or less than 10%, the half shift of held production from which the samples were drawn, and the first half-shift of production if operating under Level II sampling, shall be deemed to be "**IN-CONTROL**" for delamination.

Line 42 **See 15.2.2.2 and Table 8 for reference:**
The delamination results shall be assessed using Table 8 to determine if verification sampling in accordance with Section 15.2.2.2d is required.

- For the example provided, one delamination specimen in the half-shift tested greater than 5% but less than 10% delamination. Table 8 requires that only if all 4 samples in the half-shift are between 5 and 10%, then a verification sample is required.
- Therefore, this half-shift is deemed to be "**IN-CONTROL**".

Line 46 This is the same scenario as Line 30 above.

Lines 53 to 56 **See Section 15.4.2.2 and Table 8:**
The delamination results shall be assessed using Table 8 to determine if verification sampling in accordance with Section 15.2.2.2d is required.

- For the example provided, all four (**4**) delamination specimens tested between 5 and 10% delamination. Table 8 requires that if all 4 specimens in the half-shift are between 5 and 10%, then a **5**-piece verification sample is required.
- In this case, for the production from the 1:00 p.m. to 4:00 p.m. timeframe, five specimens shall be selected and subjected to one (**1**) vacuum pressure drying cycle and the results of these tests shall determine the course of action to be taken:
  a) If the average delamination of the **5**-piece verification sample exceeds 10%, the half-shift of held production from which the samples were drawn shall be deemed to be "**OUT-OF-CONTROL**" for delamination.
  b) If the average delamination of the **5**-piece verification sample is equal to or less than 10%, the half shift of held production from which the samples were drawn, and the first half-shift of production if operating under Level II sampling, shall be deemed to be "**IN-CONTROL**" for delamination.

Lines 65 and 66 **See Section 15.4.2.1.2 for reference:**

When an edge-wise and/or flat-wise bending specimen test fails to meet the **"minimum bending strength"** value as provided in Tables 3 to 6, then the manufacturing facility shall be deemed to be **"OUT- OF-CONTROL**" and subject to the following actions:

i) An examination of the bending test procedures shall be made to determine whether there were errors in calibration procedures and/or calculations.

ii) If no such errors are identified, the production from which the last quality control specimen was taken shall be re-sampled to obtain a twenty-eight (**28**) specimen confirmation sample for flat-wise bending tests as specified in Section 15.4.2.1.2. If the results from the bending tests fail to meet the requirements of Section 13.4.3.1.2, the production identified to be **"OUT-OF-CONTROL"** shall be rejected and the grade stamps shall be obliterated or removed.

- For the example provided, the flat-wise bending test failed below the "**minimum**" required bending strength value, therefore the FJ production identified as the product produced between 1:00 a.m. and 2:00 a.m. shall be re-sampled to obtain a twenty-eight (**28**) specimen sample for flat bending tests as specified in Section 15.4.2.1.2.
- If the **28**-specimen re-qualification sample meets the **"5th %ile bending strength"** requirements of Section 13.4.3.1.2, the process is considered **"IN-CONTROL"**. Once back **"IN-CONTROL",** the sampling frequency shall be increased (doubled, tripled, etc.) and maintained until an additional **25**-specimen sample has been generated and tested for the flat bending orientation that was found to be **"OUT-OF-CONTROL"**. "**All**" of the **25** additional test results shall meet or exceed the **"minimum bending strength"** value as provided in Tables 3 to 6 and not more than one (**1**) of the test results shall be below the "**5th %ile bending strength"** value. Otherwise, the process is deemed to be **"OUT-OF-CONTROL"** for the minimum flat-wise bending strength.
- For the purposes of this example, it is assumed that the **25**-specimen re-sample had no flat-wise minimum bending strength failures and therefore no further action is required.

Lines 73 to 76 This is the same scenario as Lines 53 to 56.

Line 78 This is the same scenario as Line 42.

Line 79 This is the same scenario as Line 30.

Lines 81 to 84 This is the same scenario as Lines 53 to 56.

Lines 86 and 87 This scenario is the same as Line 42.

Line 88 This is the same scenario as Line 30.

Lines 73 to 88 **See Section 15.4.2.2d for reference:**

If **four or more** consecutive half-shifts of production are deemed to be "**OUT-OF- CONTROL**" for delamination, the **process** shall be deemed to be "**OUT-OF- CONTROL**" and shall be requalified for delamination as specified in Section 13.4.2.2.

Note: *Re-qualification tests are limited to those items that are deemed to be "**OUT- OF-CONTROL**".*

- For the example provided, failures occurred in four (**4**) consecutive half-shifts (from lines 73 – 88). If each of the four (**4**) half-shift **5**-piece delamination test results were deemed to be "**OUT-OF-CONTROL**" following verification testing, then the product process must be re-qualified for delamination (Section 13.4.2.2) as follows:
  - **a)** Randomly selecting twenty (**20**) fingerjoint specimens from on-going production and testing them in accordance with Section 9.2.
  - **b)** The results of the test must satisfy Section 13.2.3.2.2.

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This NLGA Special Products Standard for Fingerjoined “Vertical Stud Use Only” Lumber (**SPS 3**) consists of **39** pages.

This Standard, like all NLGA Standards, is subject to periodic review and may be amended from time to time.

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