NATIONAL LUMBER GRADES AUTHORITY

SPS 4

Special Products Standard for Fingerjoined Machine Graded Lumber

April 2026

SPS 4

SPECIAL PRODUCTS STANDARD

FOR

FINGERJOINED MACHINE GRADED LUMBER (FJ-MGL)

EFFECTIVE: April 15, 2026

Supersedes All Previous Editions, Revisions, and Supplements

Approved by the Canadian Lumber Standards Accreditation Board (CLSAB) – March 27, 2026

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PREFACE

This Special Products Standard is amended and updated from time to time. The following is a chronological listing of **SPS 4** revisions.

Revised Sections Effective Dec. 1, 2005

- Sections 6.1, 7.13, 9.3.3, 13.6.1.2, 15.2.2.2, 15.4.2.2.1, and 16.3
- Table 4 and Appendices VIII, IX, and XII

Revised Sections Effective Dec. 1, 2006

- Section 9.3.4, 14.1, and 15.4.2.2; Figure 4 – Action 1; and Appendix IX

Revised Sections Effective Nov. 1, 2010

- Section 2.1 - added "HRA" and "Spot-Check" definitions and updated the "Interchangeable" definition
- Section 2.2 - updated the "Reference Publications"
- Added new Section 3.4
- Section 14.2 & 14.3 – Added "Spot-check" references

Revised Sections Effective March 9, 2011

- Replaced all references to Fingerjoined "Flange Stock Lumber (FJ-FS)" with "Fingerjoined Machine Graded Lumber (FJ-MGL)" throughout this document
- Section 1.5 updated Note
- Section 2.1 - added definitions for "FJ-MGL", "Dry Use Only", updated the "Heat resistant adhesive" definition and deleted the FJ-FS definition
- Section 2.2 - "Reference Publications" added ASTM D73704-08 & CSA-0112.10
- Table 1 – Revised grade names and deleted Comp. Parallel to Grain columns
- Revised Sections 3.1 and 7.1.1
- Added Section 7.1.3.2
- Added Section 10.1.4

Revised Sections Effective February 1, 2013

- Table 6 - added "or load cell" to the "once a week - Bending Proof Loader" requirement
- Replaced "Calibration" in the Table 6 heading with "Spot-Check"
- Section 13.3 - added (To be performed by the Facility) to the Section title
- Section 13.4 - added (To be performed by the Agency) to the Section title

Revised Sections Effective November 1, 2014

- Updated Section 2.2 Reference Publications
- Revised Section 13.6.1.4 to improve wording of this clause

Revised Sections Effective January 1, 2020

- Added new Section 1.5 Design Values to align with SPS 1 & 2 and renumbered subsequent sections
- Revised Section 2.1 to harmonize definitions with other NLGA Standards
- Added and updated references in Section 2.2
- Edited Section 7.4.2 Heat Damage to align with SPS 1
- Added new Section 9.2.1.3 for reduced-width specimen testing in tension
- Added new Section 13.11 Grading Machine Major Maintenance
- Revised Sections 14.2, 14.3 and 14.4 Test Equipment and Calibration to align with SPS 2
- Revised charts in Appendices III, IX and X to align with applicable sections in this Standard

Revised Sections Effective December 1, 2024

- Added Section 1.7
- Updated Section 2.0 – Definitions and References
- Updated Section 9.5.2 – Temperature
- Updated Section 12 – Quality Control Manual
- Added Appendices XIII and XIV

Revised Sections Effective November 1, 2025

- Table 1 – revised Hem-Fir (N) SG values
- Added changes to metric sizes to align with PS 20 throughout the Standard

Revised Sections Effective April 15, 2026

- Move Section 1.5 to new Section 3.3
- Harmonized the Interchangeability clauses across all SPS glued lumber standards
- Updated Sections 3 and 4
- Updated Sections 15.4.2.2.2 and 15.4.2.2.3 and Appendix X, Figures 13 and 14 from 28 to 30 test specimens to enable the use of the CUSUM charts

SPECIAL PRODUCTS STANDARD FOR FINGERJOINED MACHINE GRADED LUMBER

1.0 SCOPE

1.1 PART A AND PART B

This Fingerjoined Machine Graded Lumber (FJ-MGL) Standard consists of two parts.

PART A - PRODUCT SPECIFICATIONS

This Part specifies grade characteristics, standard sizes, visual grading, mechanical and adhesive property requirements, property evaluation procedures, and grade stamping requirements for FJ-MGL.

PART B - QUALIFICATION AND QUALITY CONTROL REQUIREMENTS

This Part specifies minimum qualifications and quality control requirements for a facility producing FJ-MGL 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 yard-pound (imperial) units. The equivalent SI (metric) values, given in parentheses, are provided for information only. In case of a discrepancy, the values stated in imperial units shall take precedence.

1.4 MACHINE GRADED LUMBER

This Standard has been established to permit production of FJ-MGL where the lumber components have been machine graded prior to fingerjoining.

1.5 FINGERJOINED MACHINE GRADED LUMBER (FJ-MGL)

This Standard applies to Fingerjoined Machine Graded Lumber (FJ-MGL), in which the quality of the fingerjoint is established by inspection and test procedures and the quality of the full-length fingerjoined lumber, is established in accordance with the appropriate sections of this Standard.

Note: *The requirement of this Standard does not supersede or replace any responsibility or obligation of the component manufacturer to ensure full compliance with appropriate end use standards.*

1.6 INTERPRETATION

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

2.0 DEFINITIONS & 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 FJ-MGL.

AGENCY VERIFICATION: specific set of procedures used by an Agency to verify that an item of post grade stamped FJ-MGL 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.

CANDIDATE LUMBER STOCK: non-fingerjoined lumber components used for the manufacture of FJ-MGL that have met NLGA SPS 2 qualification and quality control requirements of an equivalent or higher MGL grade than the FJ-MGL grade being produced.

Note: *There are two types of candidate lumber stock specified in this Standard (see Section 3.5):*

- ***a)*** ***TYPE A*** *candidate lumber stock that has met NLGA SPS 2 qualification and quality control requirements for* ***MOE****, and*
- ***b)*** ***TYPE B*** *candidate lumber stock that has met NLGA SPS 2 qualification and quality control requirements for* ***MOE*** *and* ***MOR****.*

CHARACTERISTIC NUMBER OF JOINTS (CNJ): number of fingerjoints present, on average, in an 8-foot section of FJ-MGL.

Note: *This value is determined as follows:*

$$CNJ = \frac{8 \times N}{L}$$

Where N is the number of fingerjoints in the specimen and L is the overall length of the specimen in feet. The CNJ value is rounded up to the nearest whole number.

CHARACTERISTIC PROPERTY VALUE: value corresponding to a percentile in the assumed statistical distribution of a particular property of the material.

Note: *For the purpose of this Standard, characteristic strength values (such as MOR and UTS) are defined as the population 5th percentile values obtained under a short-term test load.*

Characteristic stiffness values (such as E_{5th} or E) are defined as the population 5th percentile or mean values, respectively, obtained under a short-term test load.

The characteristic specific gravity is defined as the population mean value.

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 on adhesive bondlines that simulates alternating wetting and drying conditions to which wood products may be exposed during shipment, storage, or use.

DELAMINATION: a separation of the bondline as a result of drying stresses.

Note: *Other causes of delamination may include joint mis-manufacture that produces a bondline that is weaker than the surrounding wood, a bondline that is softened by water, or delamination when an incorrect adhesive mix is used. 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.

DRY USE ONLY: designation on the grade stamp of FJ-MGL which indicates that the product is to be only used under dry service conditions as defined in the applicable engineering design standard.

Note 1: *In Canada, a dry service condition is defined in CSA O86 as a climatic condition in which the average equilibrium moisture content of solid wood over a year is 15% or less and does not exceed 19%.*

Note 2: *In the U.S., a dry service condition is defined in the National Design Specification (NDS) as a climatic condition where the lumber moisture content in service will be a maximum of 16%.*

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 FJ-MGL and conducts visual grading and quality control sampling and testing on the product.

FINGERJOINED MACHINE GRADED LUMBER (FJ-MGL): lumber that has been non-destructively tested by a grading machine such as MSR lumber or MEL and is subsequently fingerjoined to meet the product specifications of this Standard.

GAUGE LENGTH: length of lumber between the inside ends of the tension machine grips that is subject to the full tension load.

Note: *The procedures and tension strength requirements specified in this Standard are based on an assumed gauge length of 8 feet.*

GRADE STAMP: grade identification applied on a piece of FJ-MGL which includes the appropriate information under Section 10.

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

GRADING MACHINE: CLSAB and/or ALSC approved and certified equipment used to sort lumber into mechanical property classes (e.g., stiffness classes).

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 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).

INDEPENDENT CERTIFICATION AGENCY: organization operating in accordance with ISO/IEC 17065 and accredited by an Accreditation Body listed under the International Accreditation Forum (IAF).

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: *Specific end-use conditions for FJ-MGL are described in Section 3.0.*

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

LUMBER ASSESSMENT: tests conducted on fingerjoined lumber randomly selected from production.

MACHINE EVALUATED LUMBER (MEL): lumber that has been non-destructively evaluated by a grading machine and meets the MEL requirements of NLGA SPS 2.

MACHINE STRESS-RATED (MSR) LUMBER: lumber that has been non-destructively evaluated by a grading machine and meets the MSR requirements of NLGA SPS 2.

MAJOR MAINTENANCE: maintenance activity that could cause the grading machine to measure or interpret the indicating property differently than when the grading machine last underwent initial or subsequent qualification.

Note: *This includes actions such as, but not limited to, structural or moving component changes; repairs due to failure of a machine component; load cell, stress-wave, or acoustic replacement; and major software upgrades.*

MODULUS OF ELASTICITY (MOE): ratio of stress to corresponding strain below the proportional limit.

Note: *In this Standard, the modulus of elasticity is determined by edgewise bending at a span of 21 times the depth in accordance with ASTM D198. The surfaced size (net finished size) is used in computing the modulus of elasticity.*

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

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

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 FJ-MGL 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.

RE-QUALIFICATION: analysis of the test results from a random sample drawn from a process that has undergone corrective action in response to an "**OUT-OF-CONTROL**" condition or re-establishing conformance of FJ-MGL items where production has ceased for a period exceeding one year.

SAMPLING FREQUENCIES: two sampling frequencies for ongoing quality control are used in this Standard:

a) **STANDARD QC SAMPLING**: random sampling undertaken to generate one 5-specimen sample from every 4 hours, or part thereof, of ongoing production

b) **INCREASED (DOUBLE) SAMPLING:** random sampling undertaken to generate two 5-specimen samples from every four hours, or part thereof, of production, for a period of three 8-hour production shifts or for a total of 60 specimens.

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.

SPECIFIC GRAVITY: the weight of a substance relative to the weight of an equal volume of water.

Note: *Specific gravity (SG) is also commonly known as relative density. The SG is based on the mass and volume of the wood at the oven-dried moisture content.*

SPECIMEN: piece of full-size FJ-MGL randomly selected from tension proof-loaded 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.

SUBSEQUENT QUALIFICATION: analysis of the test results from a random sample drawn from a process whose production is in-conformance with the requirements of this Standard but has been modified for reasons other than to respond to a detection of non-conformance.

Note: *Subsequent qualification procedures apply only to the process changes specified in Section 13.8 of this Standard. Other process changes are evaluated using the Initial Qualification procedures.*

TENSION JOINT ASSESSMENT: tension tests conducted on the characteristic number of consecutive joints from one or more specimens of fingerjoined lumber.

TENSION PROOF-LOADING: process whereby all inline production of fingerjoined lumber is loaded to a pre-determined proof-load tensile stress level.

TEST EQUIPMENT: equipment used by the facility to determine the modulus of elasticity (MOE), resistance to delamination of a finger joint, and the ultimate tensile strength (UTS) 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 characteristic property value for the item under consideration.

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

WOOD FAILURE: type of failure induced at the bondline where the fingerjoint fails by the tearing away of wood fibre from one or both sides of the bondline. .

Note: *Fingers that break off at the base or away from the fingerjoint are not considered to be wood failure.*

2.2 REFERENCED PUBLICATIONS

ALSC (American Lumber Standard Committee, Inc.)

Glued Lumber Policy (2024)

Machine Graded Lumber Policy (2019)

ASTM

D198-22 Standard Methods of Static Tests of Timbers in Structural Sizes

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

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

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

D4688/D4688M-14 (2021)e1 Standard Test Method for Evaluating Structural Adhesives for Finger Jointing Lumber

D5055-24 Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists

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

E83-23 Standard Practice for Verification and Classification of Extensometer Systems

AWC (American Wood Council)

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

CLSAB (Canadian Lumber Standards Accreditation Board)

CLSAB Regulations (2024)

CSA

CSA O86:24 Engineering design in wood

CSA O141:23 Canadian standard lumber

CSA O112.7:M1977 (R2006) Resorcinol and phenol-resorcinol resin adhesives for wood

CSA O112.9:21 Evaluation of adhesives for structural wood products (exterior exposure)

CSA O112.10:24 Evaluation of adhesives for structural wood products (limited moisture exposure)

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 (National Lumber Grades Authority)

Standard Grading Rules for Canadian Lumber (2025)

SPS 1 NLGA Special Products Standard for Fingerjoined Structural Lumber (2025)

SPS 2 NLGA Special Products Standard for Machine Graded Lumber (2025)

PART A - PRODUCT SPECIFICATIONS FOR FINGERJOINED MACHINE GRADED LUMBER (FJ-MGL)

3.0 PRODUCT DESCRIPTION

3.1 GENERAL

Fingerjoined Machine Graded Lumber (FJ-MGL) is a product comprised of multiple pieces of solid-sawn lumber (candidate lumber stock) that have been non-destructively evaluated by a grading machine prior to fingerjoining.

3.2 APPLICATIONS

FJ-MGL produced to the requirements of this Standard is interchangeable (see definition in Section 2.1) with non-fingerjoined machine graded lumber (MGL) products of the same grade, size, and species pr species group. FJ-MGL 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.

Note 1: *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.

Note 2: *This product is intended for use as a joist, rafter or stud member in a repetitive member assembly, or as headers, lintels, and or built-up beams. Its suitability for use as a component in other products and applications should be assessed in accordance with the applicable engineering design product standard.*

3.3 DESIGN VALUES

FJ-MGL produced to the requirements of this Standard is assigned design values equivalent to non-fingerjoined machine graded lumber of the same grade, size, and species or species group.

For use in Canada, design values are assigned to the FJ-MGL grades by the CSA Group – Technical Committee on Engineering Design in Wood and are published in NLGA Paras. 856 and 857, and in CSA O86.

For use in the U.S., design values for the FJ-MGL grades are published in NLGA Para. 909 and in Table 4c of the American Wood Council's (AWC) National Design Specification (NDS) Supplement.

3.4 SPECIAL APPLICATIONS

Where FJ-MGL is joined with an adhesive for limited moisture exposure (see commentary to CSA O112.10) the product is marked "**DRY USE ONLY**". Such products are only to be used in applications where the in-service moisture content of the wood will not exceed 19%.

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

3.5 DEMONSTRATION OF CONFORMANCE

Lumber that is represented as conforming to the requirements of this Standard shall be manufactured by a process in which the quality of FJ-MGL is produced in accordance with all the requirements specified herein.

Product conformance shall be documented by the maintenance of records and charts on the results of the inspection and test procedures.

Qualification and subsequent quality control of the modulus of elasticity (MOE) and ultimate tensile strength (UTS) are required for each item.

Note 1: *Qualification and subsequent quality control procedures are both based on two processes: 1) an assessment of the FJ-MGL quality; and 2) a separate assessment of the fingerjoint quality.*

The MGL is also assessed following the procedures of NLGA SPS 2.

Note 2: *The application of the grade stamp as per Section 10 indicates that these conditions have been met.*

3.6 CANDIDATE LUMBER STOCK

3.6.1 GENERAL

The candidate lumber stock shall not contain any fingerjoints.

This Standard applies to two types of candidate lumber stock designated as **Type A** and **Type B** as defined below:

3.6.1.1 TYPE A

Type A candidate lumber stock used in the assembly of FJ-MGL shall have met the qualification and quality control requirements for MOE in accordance with NLGA SPS 2 requirements for the grade(s) being produced as specified in Table 1.

The plant layout, production sequence and identification of the candidate stock shall be described in the Quality Control Manual and shall ensure that all lumber components in the final product originate and can be verified to have originated from production that meets the NLGA SPS 2 requirements for MOE of the grade being produced.

Note: ***Type A*** *candidate lumber stock is product that is "MOE qualified" under NLGA SPS 2 in an MSR/MEL facility and routed to a FJ-MGL production facility without further quality control. This product may be cross-cut into shorter lengths after MOE qualification.*

3.6.1.2 TYPE B

Type B candidate lumber stock used in the assembly of FJ-MGL shall have met all the qualification and quality control requirements in accordance with NLGA SPS 2 requirements for the grade(s) being produced as specified in Table 1.

The plant layout, production sequence and identification of the candidate stock shall be described in the Quality Control Manual and shall ensure that all lumber components in the final product originate and can be verified to have originated from production that meets the NLGA SPS 2 requirements of the grade being produced.

Note: ***Type B*** *candidate lumber stock is product that has met all the quality control requirements for MGL under NLGA SPS 2. This lumber is generally grade-stamped product.*

FJ-MGL processed with **Type B** candidate stock that results in a CNJ of greater than **1** shall be processed as **Type A** candidate stock in this Standard.

3.6.2 SPECIES

The candidate lumber stock used in the manufacture of FJ-MGL may be of any species in the species groups specified in NLGA Paras. 7 and 7a.

These species may be combined in any combination that preserves the species group.

Lumber components from different species groups shall not be mixed within the same production item.

3.7 OVERSIZE CANDIDATE LUMBER STOCK

Candidate lumber stock may be machine graded in an oversized condition to allow for re-surfacing the lumber after the fingerjoining process. When candidate lumber stock is oversized, the grading machine shall be calibrated to account for the greater cross-sectional area of the lumber, and the MOE test equipment results shall be corrected to account for this greater cross-section area.

3.8 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 "HRA" and used in non-standard fire rated assemblies may require additional fire protection. See ASTM D7374 for background on standard fire-rated assembly.*

4.0 GRADE DESCRIPTION

FJ-MGL grades are designated by an MGL grade that references a specific set of characteristic properties values.

FJ-MGL shall not be visually re-graded or re-manufactured into a higher stress grade even if the quality of the lumber containing the fingerjoints could otherwise warrant such re-grading.

The grades of FJ-MGL produced in accordance with this Standard are listed in Table 1.

TABLE 1 – CHARACTERISTIC PROPERTY VALUES AND IN-LINE TENSION PROOF STRESS FOR FJ-MGL GRADES

FJ-MGL Grade	Grade & Minimum Required for SPS 2 Candidate Lumber Stock	Mean Modulus of Elasticity		Minimum Modulus of Elasticity		Ultimate Tensile Strength (UTS or F_t)		In-Line Tension Proof Stress	
		(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)
1500Fb-1.4E	1500Fb-1.4E	1,400,000	9,653	1,148,000	7,915	1,890	13.0	1,195	8.2
1650Fb-1.5E	1650Fb-1.5E	1,500,000	10,342	1,230,000	8,481	2,142	14.8	1,355	9.3
1800Fb-1.6E	1800Fb-1.6E	1,600,000	11,032	1,312,000	9,046	2,467	17.0	1,560	10.8
1950Fb-1.7E	1950Fb-1.7E	1,700,000	11,721	1,394,000	9,611	2,887	19.9	1,830	12.6
2100Fb-1.8E	2100Fb-1.8E	1,800,000	12,411	1,476,000	10,177	3,307	22.8	2,095	14.4
2250Fb-1.9E	2250Fb-1.9E	1,900,000	13,100	1,558,000	10,742	3,675	25.3	2,330	16.1
2400Fb-2.0E	2400Fb-2.0E	2,000,000	13,789	1,640,000	11,307	4,042	27.9	2,560	17.7

Specific gravity values are assigned as follows:

D Fir-L (N):	1.2E to 1.9E	SG = O.49	**S-P-F:**	1.2E to 1.7E	SG = 0.42	**Hem-Fir (N):**	SG = 0.44 (all grades)
	2.0E to 2.2E	SG = 0.53		1.8E to 1.9E	SG = 0.46	**North Species:**	SG = 0.35 (all grades)
	2.3E & higher	SG = 0.57		2.0E & higher	SG = 0.50		

5.0 STANDARD SIZES

Standard thickness and widths for FJ-MGL produced in accordance with this Standard are shown in Table 2. Other thickness and widths can be used on qualification.

Note: *Items that are surfaced undersize to clean up glue spread and/or slight offsets require qualification as a separate item and are grade stamped as an undersized product. See Section 10.*

TABLE 2 – STANDARD THICKNESSES AND WIDTHS (AS OBTAINED FROM CSA O141 AND PS 20)

Nominal Dimension	Specified Dimension			
	inches		mm	
	Dry	Green	Dry	Green
Thickness				
1	3/4	25/32	19.1	19.8
1-1/4	1	1-1/32	25.4	26.2
1-1/2	1-1/4	1-9/32	31.8	32.5
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
8	7-1/4	7-1/2	184.2	190.5
10	9-1/4	9-1/2	235.0	241.3
12	11-1/4	11-1/2	285.8	292.1

6.0 VISUAL GRADING REQUIREMENTS

6.1 MACHINE GRADED CANDIDATE LUMBER STOCK

6.1.1 GENERAL

Prior to fingerjoining, machine graded candidate lumber stock shall be well manufactured and visually graded to limit defined characteristics on the FJ-MGL product even though the actual strength may not be affected.

Characteristics permitted and limiting provisions shall be:

Checks: Seasoning checks not limited. Through checks at ends are limited as splits.

Manufacture: Standard "F". See NLGA Para. 722f.

Shake: If through at ends - limited as splits.

Away from ends - through shakes - up to 2 feet long, well separated.

If not through - single shakes shall not exceed 3 feet or 1/4 the length, whichever is the greater.

Skip: Hit and miss, with a maximum of 5% of the pieces containing hit or miss or heavy skip 2 feet or less in length. See NLGA Para. 720.

Slope of Grain: For grading machines not evaluating slope of grain, the limitation on general slope of grain is based on the characteristic UTS value assigned to the grade and is shown in Table 4.

Splits: Equal in length to 1-1/2 times the width of the piece.

Note: *Splits may affect the tolerances of fingerjoint profile.*

Wane: 1/3 the thickness and 1/3 the width, full length, or equivalent on each face, provided the wane does not exceed 2/3 the thickness or 1/2 the width for up to 1/4 the length. See NLGA Para. 750.

Warp: Light. See NLGA Para. 752.

White Specks: Firm, 1/3 face or equivalent.

6.1.2 VISUAL QUALITY LEVEL (VQL)

In addition to the visual limitations on characteristics listed above, strength-reducing characteristics such as knots, knot holes, burls, abnormal grain distortion or decay partially or wholly at the edges of wide faces, shall not occupy more of the net cross-section than the Visual Quality Level strength-reducing characteristic limits listed for the characteristic UTS values assigned in Table 3.

6.1.3 CROSS-SECTION KNOTS OR KNOTS OTHER THAN EDGE KNOTS FOR TYPE A CANDIDATE STOCK

For **Type A** candidate stock, cross-section knots or knots other than edge knots shall not exceed the size or displacement of the edge knot permitted in the next lower edge displacement classification as assigned in Table 3.

TABLE 3 – VQL STRENGTH-REDUCING CHARACTERISTIC LIMITS FOR TYPE A CANDIDATE LUMBER STOCK

Edge Displacement	MOE (million psi)	Characteristic UTS Value (psi)
1/3	< 1.4	< 1890
1/4	1.4 to 1.7	1890 to 2887
1/6	> 1.7	> 2887

6.1.4 SLOPE OF GRAIN REQUIREMENTS FOR TYPE A CANDIDATE STOCK

Slope of grain for **Type A** candidate stock shall be limited as shown in Table 4.

TABLE 4 – SLOPE OF GRAIN LIMITS FOR TYPE A CANDIDATE LUMBER STOCK

Slope of Grain	MOE (million psi)	Characteristic UTS Value (psi)
1 in 8	< 1.4	< 1890
1 in 10	1.4 to 1.7	1890 to 2887
1 in 12	> 1.7	> 2887

6.2 ESTABLISHING ALTERNATE VISUAL QUALITY LEVELS

Strength-reducing characteristics larger than those listed in Sections 6.1.2 and 6.1.3 are permitted provided the additional requirements of Section 13.2 are followed. In such cases, the limiting size of the strength-reducing characteristic shall be documented.

6.3 WOOD QUALITY IN THE JOINT

6.3.1 SOUND WOOD

For all grades of FJ-MGL, the fingerjoints shall be formed in sound wood that otherwise meets the slope of grain and other visual requirements of the grade, except as provided for in Sections 6.3.2 and 6.3.3. No decay is permitted in the joint.

6.3.2 KNOTS AND HOLES

In all grades, the fingers shall not contain knots that exceed 10% displacement. Knots appearing on the narrow faces are permitted the same cross-sectional area displacement as knots specified on wide faces.

All knots exceeding 10% displacement 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.

For knots that are only visible on one face of the joint, the knot dimension shall be assessed based on the visible dimension only. No averaging with an assumed opposite dimension is permitted.

Manufactured holes shall not exceed 10% displacement.

6.3.3 WANE

Wane shall not exceed half the thickness in any grade.

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

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 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:

a) The tip gap, which is 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).

b) Fingerjoint offset between the surfaces of the lumber, in either a lateral or vertical direction, shall not exceed 1/16 inch (1.6 mm).

Note: *The spacing between the gluing surfaces on either side of the fingers is such to reduce glue boil out in the joint area during the curing process. Boil out may occur on surfaces adjacent to the outside fingers because of inadequate pressure.*

6.6 MOISTURE CONTENT

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

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 fingerjoints is not restricted.

7.0 FINGERJOINT ADHESIVE REQUIREMENTS

7.1 ADHESIVE SPECIFICATION

7.1.1 GENERAL

The adhesive used for the joining of fingerjoints shall meet the requirements of either Section 7.1.2 or Section 7.1.3, in addition to Section 7.1.4.

7.1.2 RESORCINOL & PHENOL RESORCINOL ADHESIVES

The adhesive used for joining of the fingerjoints shall meet the requirements of CSA O112.7

Note: *The adhesive may be mixed with the minimum amount of inert fillers required for its performance in the process being used.*

7.1.3 ALTERNATE ADHESIVES

The adhesive used for joining of the fingerjoints shall meet the requirements of CSA O112.9 or CSA O112.10 when evaluated for one of the softwood species specified in those Standards.

FJ-MGL joined with an adhesive that only meets CSA O112.10 shall be designated "**DRY USE ONLY**" on the grade stamp.

Note: *See Section 10 for grade-stamping requirements.*

7.1.4 ELEVATED TEMPERATURE

The adhesive used for joining of the fingerjoints shall meet the requirements of ASTM D7374.

7.2 "SEPARATE APPLICATION" ADHESIVES

7.2.1 GENERAL

7.2.1.1 NON-PERMISSIBLE "SEPARATE APPLICATION" ADHESIVES

"Separate application" adhesives are **not permitted** when adhesive components, which are applied separately, need to be blended for the joint to achieve the required bond strength and durability.

7.2.1.2 PERMISSIBLE "SEPARATE APPLICATION" ADHESIVES

"Separate application" adhesives utilising additional components that only require contact between the components in order to develop the required bond strength and durability are permitted provided the requirements of Sections 7.2.2 and 7.2.3 are met.

7.2.2 MONITORING REQUIREMENTS

In addition to meeting the requirements of Section 7.2.1.2, the following information shall be provided and documented in the Quality Control Manual:

a) Procedures for continuous monitoring of the proportions of the components applied to joint, and the coverage required for each component,

b) Systems for notifying the operator when the component proportions or coverage are beyond the acceptable limits as defined in the adhesive specification. Acceptable operating limits shall be qualified under Section 7.2.3, and

c) Procedures for identifying the production that was produced while the adhesive application system was operating outside of the acceptable limits. Such production shall be evaluated in accordance with Section 15.4.2.

7.2.3 QUALIFICATION

Prior to performing the qualification requirements outlined in Section 13.4, the procedures outlined in Section 13.4.2 shall be used to qualify both the upper and lower limits of that provided in the adhesive specification.

Joints shall be sampled as specified in Section 13.4.2 from production set to operating conditions corresponding to the upper component proportions or coverage and tested in accordance with Section 13.4.2. This sampling and testing shall be repeated for production set to operating conditions corresponding to the lower component proportions or coverage.

7.3 ADHESIVE MIXING

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

7.4 JOINT FABRICATION

7.4.1 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 squeeze-out of excess glue when the end pressure is applied.

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

7.4.2 HEAT DAMAGE

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

Note 1: *In Radio Frequency (RF) curing, wood damage may result from excessively long exposure of the finger profile to the RF field, and both the strength and the long-term durability of the joint may be impaired.*

Note 2: *Pre-heating of profiles at high temperatures may also have the same effects as improper RF curing. Pre-heating of fingerjoints formed in green wood may distort the fingers and impact the fit of the joint.*

7.4.3 END PRESSURE

The end pressure applied during the joint assembly process and while the bondline is being cured, shall be that required to ensure good adhesive bond formation for the lumber size, species group, finger profile, and process used.

The end pressure shall be limited to prevent splitting in the wood at the base of the fingers.

8.0 MECHANICAL PROPERTY REQUIREMENTS

The following process requirements shall apply to the characteristic property values listed in Table 1.

8.1 MEAN MODULUS OF ELASTICITY

The process mean edge bending modulus of elasticity (E) tested in accordance with Section 9.1.1 shall equal or exceed the characteristic mean modulus of elasticity value for the grade E (E_g).

$$\mathbf{E \geq E_g}$$

8.2 MINIMUM MODULUS OF ELASTICITY

The process lower fifth percentile for edge bending modulus of elasticity (E_{5th}) for Table 1 FJ-MGL grades tested in accordance with Section 9.1.1 shall equal or exceed 0.82 times the characteristic mean modulus of elasticity value for the grade E (E_g).

$$\mathbf{E_{5th} \geq 0.82\ x\ E_g}$$

8.3 ULTIMATE TENSILE STRENGTH (UTS)

The process lower fifth percentile for tensile strength (UTS_{5th}) shall equal or exceed the characteristic ultimate tensile strength (UTS_g) value for the grade when subjected to a short-term test load and tested in accordance with Section 9.1.2.

$$\mathbf{UTS_{5th} \geq\ UTS_g}$$

9.0 PROPERTY EVALUATION PROCEDURES

The test methods described in this Section conform to either ASTM Standards D198 or D5055.

9.1 FJ-MGL EVALUATION

9.1.1 MODULUS OF ELASTICITY (MOE) – LUMBER ASSESSMENT

Specimens shall be tested on edge using third point loading and a span to depth ratio of 21.

The specimen depth is the surfaced dry width as provided in Table 2.

MOE shall be determined using load and deflection data collected at load levels less than the specimen proportional limit.

Specimens shall be centred in the test span. The tension stressed edge of the specimen shall be randomly selected.

9.1.2 ULTIMATE TENSILE STRENGTH (UTS) - LUMBER ASSESSMENT

UTS - Lumber Assessment testing is required for FJ-MGL that uses **Type A** candidate stock (see Section 3.5.1.1) and for **Type B** candidate stock, where the characteristic number of joints (CNJ) exceeds 1 (see Section 3.5.1.2).

For off-line tensile strength testing, UTS shall be determined by applying a test load that will induce a maximum stress not less than the characteristic UTS value for the grade under consideration.

Specimens shall be tested using a gauge length (test span) of at least 8 feet (2.44 m) whenever the test sample lengths permit.

The maximum strength-reducing characteristic, as determined by visual grading, shall be positioned within the test span and, whenever possible, at least a minimum of two times the nominal test specimen width away from grips.

If the maximum strength-reducing characteristic is found to be located partially or wholly within the grips, the specimen shall be replaced.

The load shall not induce a rate of stress increase that will exceed 4,000 psi/min (0.46 MPa/sec).

Specimens that carry the test load without fracture or with only partial failure, meet the test requirements. If a specimen fails before the test load has been achieved, the load at failure shall be recorded.

Note: *The producer has the option of using the samples that are tested to failure for the characteristic number of joint assessments.*

9.2 JOINT STRENGTH EVALUATION PROCEDURES

9.2.1 ULTIMATE TENSILE STRENGTH (UTS) - JOINT ASSESSMENT

9.2.1.1 FULL WIDTH UTS SPECIMEN

Enough full-size FJ-MGL specimens shall be selected to permit, where possible, the characteristic number of consecutive joints in a specimen to be tested as described in Section 9.2.1.2.

Additional joints required to complete the CNJ UTS - joint assessment test (if needed) shall be obtained from full-size supplemental specimens selected consecutively from production. Consecutive joints from the supplemental specimens shall be tested as described in Section 9.2.1.2.

9.2.1.2 UTS TEST PROCEDURE

The following procedures are required for UTS joint assessment:

a) Except as noted in Section 9.2.1.2 f), the gauge length shall be between 1 and 2 feet (0.30 and 0.61 m), but not less than 4 times the largest cross-section dimension.

b) The fingerjoint shall be centred in the test span and loaded in tension to failure. The load shall not induce a rate of stress increase that will exceed 4,000 psi/min (0.46 MPa/sec).

c) A UTS joint assessment shall be carried out for each specimen in the sample.

d) The number of joints tested per UTS joint assessment shall be equal to or greater than the CNJ to be qualified or evaluated.

e) The joints tested shall be those contained in the specimen plus any additional joints selected consecutively from supplemental specimens of FJ-MGL.

f) Except for joints positioned wholly or partially in the tension grips, joints evaluated under Section 9.1.2 are permitted to provide results for the UTS joint assessments provided the specimen is loaded to failure. Only joints located at least 2 times the largest cross-section dimension away from the grips shall be considered.

g) Substitution of results for joint tests with failure occurring away from the fingerjoint is permitted (See APPENDIX IV – Mode 6). Results from the next closest available joint on the same specimen, if possible, shall be used.

9.2.1.3 REDUCED-WIDTH SPECIMEN TESTING

If the test equipment grips will not permit full-width specimens to be tested in tension, a reduced-width specimen is permitted to be ripped lengthwise from the full-width specimen and shall be used for the test procedure as per Section 9.2.1.2.

The following procedures apply:

a) The full-width specimen shall be ripped to a reduced-width specimen to either 3.5±0.05 inches (88.9±1.0 mm) or 5.5±0.05 inches (139.7±1.0 mm) in width.

Note: *When testing nominal 2x8 and wider widths it is recommended that the 5.5 inch (139.7 mm) reduced-width size be used.*

b) The reduced-width specimen shall include a randomly selected “as manufactured” original narrow face on one edge of the piece.

c) The reduced-width UTS test result shall meet or exceed the tension strength value calculated using the following equation:

$$\textbf{Reduced-width UTS} \geq \mathbf{F_t} \times \textbf{RWF} \times \textbf{1.15}$$

where,

F_t = UTS for the applicable FJ-MGL grade listed in Table 1.

RWF = Applicable reduced-width factor provided in Table 5.

1.15 = The "vertical or horizontal finger-joint profile tension factor" obtained from Table 6 of the ALSC Glued Lumber Policy.

TABLE 5 –REDUCED-WIDTH FACTORS (RWF)

Reduced-width Size in inches	Full-width Size in inches				
	3.50	**5.50**	**7.25**	**9.25**	**11.25**
3.50	1.00	1.06	1.11	1.18	1.26
5.50	N/A	1.00	1.05	1.12	1.19

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

*RWF = (7270 - (177 x **h1**)) / (7270 - (177 x **h2**))*

*Where: **h1** = the reduced specimen dimension in the direction of the applied load, and **h2** = the full board width specimen dimension.*

9.2.1.4 UTS CALCULATION AND REPORT

The UTS joint assessment result for each specimen shall be the minimum joint test result obtained from the specimen and any additional joints from supplemental pieces of FJ-MGL necessary to obtain the minimum number of joint tests for that specimen.

The tensile strength assigned to each of the joints evaluated under Section 9.2.1.2 f) shall be the UTS of the specimen obtained in the lumber assessment.

9.3 DELAMINATION RESISTANCE EVALUATION

9.3.1 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 to enable issues in the manufacturing process to be detected earlier so that corrective actions could be taken. This preliminary testing would not replace the sampling and testing of the finished product.*

9.3.1.1 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 crosscut through the centre of the joint to yield two test specimens.

9.3.1.2 FINGER PROFILES LESS THAN OR EQUAL TO 5/8 INCH (16 mm) 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.

9.3.2 DELAMINATION TEST PROCEDURE

Test specimens shall be placed in the pressure vessel and weighed down to prevent floating. Enough water, at a temperature of 65° to 85°F (18° to 29°C), shall be admitted to the pressure vessel so that the test specimens are completely submerged.

Test specimens shall be separated by stickering, wire screens or other means so that all end grain surfaces are freely exposed to water.

A vacuum of 20 to 25 inches (508 to 635 mm) of mercury shall be drawn and held for 30 minutes, followed by releasing the vacuum and applying a pressure of 75±5 psi (0.517±0.034 MPa) for a period of 2 hours.

The test specimens shall be dried 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, the specimens shall be placed at least 2 inches (50.8 mm) apart, with the end grain surfaces and finger orientation parallel to the direction of the airflow.

Note: *Refer to APPENDIX VII, Figure 9 for joint specimen placement.*

The specimens shall be dried until the moisture content (MC) of each specimen has reached 19% or less.

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.*

When the target MC has been achieved the delamination shall be immediately measured and recorded, following the procedures set forth in Section 9.3.3.

Note: *Delamination should be measured immediately after the drying period, otherwise 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.*

9.3.3 MEASUREMENT OF DELAMINATION

At the end of the drying period, the crosscut surface of the specimens shall immediately be examined for separations of the bondlines, and any indeterminate areas shall be probed using 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 (2.5 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.*

The length of the delaminated portions shall be measured to the nearest 1/16 inch (1.6 mm) and the various lengths added together.

9.3.3.1 INITIAL QUALIFICATION, RE-QUALIFICATION AND RE-INSPECTION TESTING

If the delamination of any specimen or, if applicable, the average delamination of a specimen and its matching specimen (see Section 9.3.1.1) after 1 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.

9.3.3.2 QUALITY CONTROL AND VERIFICATION TESTING

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

9.3.4 DELAMINATION CALCULATION AND 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, multiplied by 100.

The percentage delamination of the joint , or if applicable, the average percentage delamination of a joint (specimen and its matching specimen as per Section 9.3.1.1) shall be recorded.

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

When delamination in a fingerjoint **exceeds 10%**, the fingerjoint shall be sawn from the test specimen and the bondlines cleaved open, to determine the cause of delamination. Causes of delamination shall be included in the quality control report.

Note: *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.

9.4 IN-LINE TENSION PROOF-LOADING

All fingerjoints shall be tension proof loaded during production by applying a tensile stress as provided in Table 1 for the item being produced. Production processes where the fingerjoints are consistently located within the grips shall not be permitted.

Note: *Occasional fingerjoints that appear near the ends and fall within the grips may be excluded from this requirement.*

9.5 ENVIRONMENTAL CONDITIONS

9.5.1 MEASUREMENT OF MOISTURE CONTENT AT TIME OF TEST

For each UTS joint assessment test specimen, a moisture content measurement using a resistance type moisture meter shall be made on each side of the joint and sufficiently back from the base of the joint so that the meter readings are not influenced by the presence of the adhesive.

Each of the readings shall be recorded as the moisture content of the specimen's components at the time of test.

9.5.2 TEMPERATURE

9.5.2.1 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.

9.5.2.2 FINGERJOINT TEST SPECIMENS

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

9.5.2.3 FJ-MGL TEST SPECIMENS

All strength and stiffness evaluations shall be performed on test specimens that have a temperature range of 50 to 95°F (10 to 35°C) inclusive.

10.0 GRADE STAMPING

10.1 GENERAL

A grade stamp on FJ-MGL indicates that the grading process meets the requirements of this Standard and the Agency's qualification and quality control procedures.

10.2 REQUIREMENTS

For FJ-MGL produced in conformance with the requirements of this Standard, the grade stamp on each piece shall contain the information described in Table 6.

All previous grade stamps shall be removed or obliterated.

10.3 OTHER REQUIREMENTS

Where FJ-MGL is joined with an adhesive that meets CSA O112.10 only, the product shall also be marked "**DRY USE ONLY**".

Where FJ-MGL product is surfaced to less than standard sizes, the size must be indicated on the grade stamp. See NLGA Para. 43.

TABLE 6 – GRADE STAMPING REQUIREMENTS

DESCRIPTION	FJ-MGL from Type A Candidate Stock	FJ-MGL from Type B Candidate Stock	EXAMPLE
Agency Identification	✓	✓	**CLSAB/ALSC Accredited Agency Logo**
Facility Identification	✓	✓	**100**
Species or Species Group	✓	✓	**"S-P-F"**
Seasoning Designation	✓	✓	**"S-DRY" or "KD"**
Grade Code	✓	✓	**"2400Fb - 2.0E" or "2400Fb 2.0E" or "2400Fb 2.0E"**
Grade Rule	✓	✓	**"NLGA"**
Ft Rating	✓	**Optional**	**"1925 Ft"**
Alternate VQL [1]	**Optional**	**Optional**	**"2.0E-4"** [2]
Special Products Standard 4	✓	✓	**"SPS 4"**
Certified Fingerjoint	✓	✓	**"CERT FGR JNT"**
Heat Resistant Adhesive	✓	✓	**"HRA"**
CSA O112.10 Adhesive	✓	✓	**"DRY USE ONLY"**

[1] *The maximum VQL if the requirements of Section 13.2 are met.*

[2] *For the example: -4 means ¼ edge knot was qualified.*

Note: *If the "Optional" items are marked on the grade stamp, the facility shall follow additional quality control procedures.*

PART B - QUALIFICATION AND QUALITY CONTROL REQUIREMENTS

11.0 EQUIPMENT

The facility's grading machine and test equipment shall meet the following requirements:

11.1 GRADING MACHINE

A grading machine (if applicable) shall be of a make and model for which an Agency application to the CLSAB and ALSC has been made, and approval has been granted.

11.2 QUALITY CONTROL TEST EQUIPMENT

The test equipment shall be capable of accurately measuring the mechanical properties described in **Part A**.

The equipment shall be certified by an independent certification organisation.

The load and deflection measuring devices shall be accurate to within ±2% of the actual measurement.

Note: *The use of load and deflection measuring devices that are accurate to within 1% of the actual measurement are preferred.*

11.2.1 MOE TEST EQUIPMENT ACCURACY

The test span and the location of the load points shall be capable of being set to within ±1/16 inch (1.6 mm).

The device used to measure deflection shall be capable of measuring to the nearest 0.001 inch (0.02 mm).

The load shall be applied through a crosshead. The rate of crosshead movement shall not exceed 5 inches/min (2.12 mm/sec) during specimen testing.

11.2.2 TENSION TEST EQUIPMENT ACCURACY

11.2.2.1 OFF-LINE UTS TEST EQUIPMENT

The test span shall be set to within ±3 inches (76 mm) of the specified test span.

The rate of load application shall not exceed 4,000 psi/min (0.46 MPa/sec) during specimen testing.

11.2.2.2 IN-LINE TENSION PROOF LOADER

The load shall not induce a rate of stress increase that will exceed 130,000 psi/min (14.9 MPa/sec).

11.3 DELAMINATION EQUIPMENT

11.3.1 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).

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.*

11.3.2 DRYING OVEN

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

Note: *These drying conditions are those obtainable in crossflow, laboratory type 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 the requirements for maintaining quality control in the manufacturing facility.

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

All product quality control processes shall comply with the requirements of this Standard and the QC Manual.

12.2 PREPARATION, REVISION AND APPROVAL

Each facility shall:

a) Prepare a QC Manual in compliance with this Standard and submit the 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 for approval, and

c) Upon approval, implement the new or updated procedures in accordance with the QC Manual.

The Agency shall approve 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 FJ-MGL certification and quality control procedures comply with the CLSAB Regulations and the ALSC Glued Lumber and Machine Graded Lumber Policies,

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 organization 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 control 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 control the process,

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

c) Maintenance and interpretation of quality control records.

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 procedures specifying how each of the following is to be performed and controlled:

a) Grading machine operation and calibration (including a list of major maintenance activities that might affect the ability of the grading machine to assess the indicating property) and 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-conformances, and

g) Corrective action.

The QC Manual shall list and provide the credentials of the independent calibration laboratory acceptable to CLSAB.

13.0 QUALIFICATION REQUIREMENTS

13.1 GENERAL

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 will 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 grading machine (if applicable) and the test equipment conforms to the requirements of the QC Manual.

The characteristic number of joints (CNJ) in FJ-MGL manufactured from **Type B** candidate stock shall not exceed 1. Otherwise, the lumber shall be qualified as **Type A** candidate stock.

Qualification sampling and testing as outlined in Sections 13.3 and 13.4 are required prior to issuing grade stamps.

13.2 QUALIFICATION REQUIREMENTS FOR ALTERNATE VQL

a) To qualify an alternate VQL that is larger than those listed in Section 6.1.2, a maximum VQL shall be specified which has the potential of being qualified.

b) Prior to selecting the qualification samples, **6** specimens containing the maximum VQL to be qualified, shall be randomly selected. The specimens shall be tested with the maximum VQL positioned in the test span. Each of the 6 specimens shall satisfy the required tension test load for the grade under consideration.

c) When an alternate VQL is qualified, the qualification sample shall include the maximum characteristic as it randomly occurs.

d) The alternate VQL shall be re-qualified whenever qualification testing is required for the grade.

13.3 NEW PRODUCTION LINE START-UP OR MAJOR CHANGE REQUIREMENTS (TO BE PERFORMED BY THE FACILITY)

During start-up of a new production line or when a major change to the fingerjoint process occurs, 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 tension using specimens generated from two consecutive shifts of operation.

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

The specimens shall be tested in accordance with Section 9.2.1 and the test results shall satisfy the requirements set forth in Section 13.6.1.3.

Note: *This **53**-specimen tension test is required in the initial start-up of a fingerjoining plant or when there is a major change to the fingerjoining process: it is intended to verify the adequacy of the joint profile chosen and does not substitute for the Initial Qualification requirements called for in Section 13.4.*

The **53**-specimen tension test sample can also be used to determine an initial characteristic number of joints to guide the new facility in establishing this parameter.

Grade stamping shall be contingent upon qualification of the items in accordance with Section 13.4.

13.4 INITIAL QUALIFICATION SAMPLING (TO BE PERFORMED BY THE AGENCY)

13.4.1 FJ-MGL

The Agency supervisor shall randomly select the following for each item to be qualified:

a) **53** specimens for the edge-bending modulus of elasticity property evaluations to be tested in accordance with Section 9.1.1, and

b) **53** specimens for the ultimate tensile strength evaluations (optional for **Type B** candidate stock with CNJ equal to 1). The specimens shall be tested in accordance with Section 9.1.2.

Qualification specimens are restricted to a maximum of 24 feet (7.31 m) in length.

For clauses **a)** and **b)** above, additional specimens to increase the total sample size to **78**, **102**, or **125** may be selected to qualify the minimum modulus of elasticity, and/or ultimate tensile strength.

13.4.2 FINGERJOINTS

The Agency supervisor shall randomly select the following from one or more items to be qualified:

a) **20** fingerjoints for the delamination resistance tests. The sample shall be tested in accordance with Section 9.3 of this Standard.

b) Additional specimens shall be selected to supplement the **53**-specimen tension test sample in Section 13.4.1 to permit the fingerjoint tension strength assessment in accordance with Section 9.2.1.

When additional joints are required to complete the CNJ UTS-joint assessment as described in Section 9.2.1.1 for a specimen(s), the result(s) of each supplemental UTS joint assessment test shall be recorded sequentially for each of the specimens that have insufficient CNJ UTS - joint assessment tests.
The UTS joint assessment result for the specimen(s) shall be the minimum joint test result obtained from the specimen and the supplemental specimen.

c) A minimum of a **53**-specimen sample shall be selected for FJ-MGL manufactured from **Type B** candidate stock to permit the fingerjoint tension strength assessment in accordance with Section 9.2.1 of this Standard.

For clauses **b)** and **c)** above, additional specimens to increase the total sample size for joint assessments to **78**, **102**, or **125** may be selected to qualify the fingerjoint tension strength.

Each qualification specimen shall meet the visual requirements in the joint area of the grade being qualified.

13.5 RE-QUALIFICATION SAMPLING

The Facility quality control supervisor shall randomly select one or more of the following samples for each item and for each property to be re-qualified:

a) **28** specimens for the edge bending modulus of elasticity property evaluations. The sample shall be tested in accordance with Section 9.1.1.

b) **28** specimens for the ultimate tensile strength evaluations (optional for **Type B** candidate stock with CNJ equal to 1). The sample shall be tested in accordance with Section 9.1.2.

c) **20** fingerjoints for the delamination resistance tests. The sample shall be tested in accordance with Section 9.3.

d) Sufficient specimens shall be selected to permit **28** fingerjoint tension strength assessments in accordance with Section 9.2.1.

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

For clauses **a)**, **b)**, and **d)** above, it is permitted to select additional specimens to increase the total sample size for joint assessments to **53** or **78** to re-qualify the minimum modulus of elasticity, ultimate tensile strength of the lumber, and/or ultimate tensile strength of the fingerjoints.

13.6 DECISION RULES

13.6.1 INITIAL QUALIFICATION RULES

Results of edge bending modulus of elasticity, tensile strength tests, fingerjoint tensile strength and the 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 at a lower grade.*

Alternatively, adjustments to the manufacturing process may be made; new samples selected and tested until the above requirements are satisfied.

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

13.6.1.1 CHARACTERISTIC NUMBER OF JOINTS

The characteristic number of joints (CNJ) (see definition in Section 2.1) shall be set at the time of qualification. The CNJ shall be **not less than** the maximum number found in any of the **52** of **53** specimens taken in the initial qualification sample.

Note: *The CNJ as determined at the time of qualification will set the basis for on-going quality control. A facility may choose to qualify the process for a higher CNJ if the facility anticipates that the number of joints may increase.*

13.6.1.2 FJ-MGL ASSESSMENT

a) The mean edge bending modulus of elasticity of the **53**-specimen sample **equals or exceeds** 0.97 times E_g,

b) **Not more than 1** of the **53** specimens has a modulus of elasticity value **less than** 0.82 of E_g, and

c) **Not more than 1** of the **53** specimens has a tensile strength **less than** the tensile strength value listed in Table 1 for the grade. For each specimen, the tension test result shall be the result from the lumber strength assessment specified in Section 9.1.2.

When the additional specimen sampling procedure referred to in Section 13.4.1 is used to qualify for minimum modulus of elasticity, and tensile strength, the number of specimens below the requirements shall **not exceed 2** in a **78**-specimen sample; **3** in a **102**-specimen sample; or **4** in a **125**-specimen sample

13.6.1.3 FINGERJOINT ULTIMATE TENSILE STRENGTH

Not more than 1 of the **53** joint assessment test results shall be **less than** the tensile strength value listed in Table 1 for the grade.

When the additional joint assessments referred to in Section 13.4.2 are used to qualify for the fingerjoint tensile strength, the number of joint assessment results below the requirements shall **not exceed 2** in a **78**-specimen sample; **3** in a **102**-specimen sample; or **4** in a **125**-specimen sample.

13.6.1.4 FINGERJOINT DELAMINATION

13.6.1.4.1 Specimen Delamination Conditioning & Classification

A **20**-specimen delamination test sample prepared in accordance with Section 9.3.1 shall be subjected to **1** or if required, **3** delamination cycles following procedures outlined in Section 9.3.2 and their delamination results processed as follows:

a) After 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 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, an **LF** joint is prepared in accordance with Section 9.3.1.1. 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 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, an **SF** joint is prepared in accordance with Section 9.3.1.2. 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 3 Cycles:

i) For Long-fingered Joints:

A long-fingered (**LF**) specimen does **not** meet the delamination resistance requirements of this Standard if the **LF** delamination (see Note under 13.6.1.4.1 a) i) above) is **greater than** 10%, or if the delamination is **greater than** 15% on either half of the test specimen.

ii) For Short-fingered Joints

A short-fingered (**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.

13.6.1.4.2 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 13.6.1.4.1 of this Standard.

13.6.2 RE-QUALIFICATION RULES

13.6.2.1 CHARACTERISTIC NUMBER OF JOINTS (CNJ)

Provided all other properties remain "**IN-CONTROL**", re-qualification for a higher characteristic number of joints shall be performed in accordance with Sections 13.5 and 13.6.2.3.

Otherwise, for FJ-MGL produced from **Type A** candidate stock, re-qualification for a higher characteristic number of joints shall be performed in accordance with Sections 13.4 and 13.6.2.3.

13.6.2.2 FJ-MGL ASSESSMENT

The FJ-MGL shall be considered re-qualified for Table 1 characteristic properties when the following requirements are met:

a) The mean edge bending modulus of elasticity of the **28**-specimen sample **equals or exceeds** 0.96 times E_g,

b) **None** of the **28** specimens has a modulus of elasticity value **less than** 0.82 of E_g, and

c) **None** of the **28** specimens have an ultimate tensile strength **less than** the characteristic UTS listed for the grade in Table 1.

13.6.2.3 FINGERJOINT ULTIMATE TENSILE STRENGTH

The fingerjoint shall be considered re-qualified for ultimate tensile strength when all the joint assessment results equal or exceed the tensile strength value listed in Table 1 for the grade.

When additional joint assessments referred to in Section 13.5 are used to qualify for the fingerjoint tensile strength, the number of joint assessment results below the requirements shall **not exceed 1** in a **53**-specimen sample; **2** in a **78**-specimen sample; or **3** in a **102**-specimen sample.

13.6.2.4 FINGERJOINT DELAMINATION

The fingerjoints shall be considered re-qualified for delamination resistance when the requirements of Section 13.6.1.4 are met.

13.7 INCREASED SAMPLING FOLLOWING QUALIFICATION

Immediately following qualification or re-qualification, increased sampling (see definition in Section 2.1) shall be performed for all Table 1 properties on the grades qualified.

Test results must satisfy the quality control requirements of this Standard.

13.8 SUBSEQUENT QUALIFICATION

13.8.1 NEW ITEMS

Separate qualification tests are required for each new item for which a grade stamp is desired.

If a facility is qualified to produce a given item, to which it desires to add a new item, the following shall be performed:

a) Initial qualification tests on the new item,

b) Increased sampling, following qualification of the new item, on both the new item and the adjacent lower grade item of the existing combination.

In clause **b)** above, test results shall satisfy the quality control requirements of this Standard.

13.8.2 INCREASING THE CHARACTERISTIC NUMBER OF JOINTS

Subsequent qualification to increase the characteristic number of joints is only permitted for **Type A** candidate stock:

a) Qualification to increase the characteristic number of joints by 1 shall be performed in accordance with Sections 13.5 d) and 13.6.2.3.

b) Otherwise, qualification for a higher characteristic number of joints shall be performed in accordance with Sections 13.4 and 13.6.2.3.

13.8.3 MAJOR CHANGES

The qualification procedures outlined in Section 13.3 shall be required for any major changes and/or process conditions, which in the opinion of the Agency may affect the quality of the product.

Note 1: *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/or producing a grade(s) that has higher design values than those initially qualified.*

Note 2*: Changes in size and/or species or species groups are not considered major changes. Requirements set forth in Section 13.4 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.*

13.9 NON-PRODUCTION OF QUALIFIED ITEMS EXCEEDING ONE YEAR

When a facility does not produce a FJ-MGL item for a period exceeding one year, subsequent production of that item shall only be permitted after re-qualification is performed on the item in accordance with Sections 13.5 and 13.6.2. The test results shall satisfy the quality control requirements of this Standard.

When a qualified facility does not produce any FJ-MGL for a period exceeding one year, all item qualifications for that facility shall become void. The requirements for initial qualification shall be satisfied prior to renewed production of FJ-MGL.

13.10 NOTIFICATION REQUIREMENTS FOR DISCONTINUANCE OF QUALITY CONTROL PROCEDURES FOR ALTERNATE VQL

When an item has been qualified under the procedures for quality control of alternate VQLs, discontinuance of the procedure requires written notification from the facility to the Agency at least one week prior to the action being implemented.

13.11 GRADING MACHINE MAJOR MAINTENANCE

Agency notification is required when there is major maintenance carried out on the grading machine. Intensive sampling shall be performed on the first item being produced after major maintenance. The test results shall meet the quality control requirements of this Standard.

14.0 EQUIPMENT CALIBRATION

Records of all calibration checks shall be maintained for at least **6** years.

14.1 GRADING MACHINE CALIBRATION

A grading machine, if applicable, shall be calibrated in accordance *w*ith the procedures set forth in the QC Manual.

Calibration checks shall be performed as follows:

a) At the start-up of each production shift,

b) Approximately every **4** hours of grading machine operation thereafter or as prescribed by the grading machine manufacturer,

c) After any adjustment to the grading machine, and

d) After any maintenance to the grading machine.

14.2 TEST EQUIPMENT CALIBRATION AND SPOT CHECKS

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, equipment operation manual(s), and this Standard.

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

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, ASTM E83 and /or other applicable nationally recognized standards acceptable to CLSAB.

Spot-checks shall be performed at a frequency level listed in Table 7 and whenever there is reason to suspect the 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-certification of the test equipment or spot-check devices by an independent calibration laboratory may be required by the Agency.*

The calibration report and certificates from the independent calibration laboratory shall comply with the reporting requirements outlined in ASTM E4, ASTM E83 and/or other applicable nationally recognized standards acceptable to CLSAB.

TABLE 7 – TEST EQUIPMENT SPOT-CHECK FREQUENCY

Equipment	Minimum Spot Check Frequency
Bending Proof Loader	At least once a shift with the spot check device (e.g., proof bar) and once a week with the calibration device (e.g., proof ring or load cell)
Tension Tester	At least once a week (off-line and in-line machines)
Other Test Equipment	As per manufacturer's specifications, the QC Manual, or this Standard, whichever period is more frequent.

14.3 INDEPENDENT CALIBRATION LABORATORY REPORTING REQUIREMENTS

The report of 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 and ASTM E83,

b) Description of the method of verification including details of the preloading,

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 the 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 mill facility operator 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.

14.4 CALIBRATION DEVICES

The calibration devices used by the independent calibration laboratory shall meet the applicable requirements of ASTM E74 for force measuring devices, ASTM E83 for displacement devices and/or other applicable nationally recognized standards acceptable to CLSAB.

15.0 QUALITY CONTROL REQUIREMENTS

15.1 QUALITY CONTROL PROCEDURES

The quality control procedures described herein are intended to detect non-conformance in the FJ-MGL and the fingerjoints.

The FJ-MGL properties to be considered are mean modulus of elasticity, minimum modulus of elasticity, and tensile strength (if applicable).

The fingerjoint properties to be considered are tension strength and delamination. In addition, all fingerjoints are required to be proof-loaded during production to a tension stress level as listed in Table 1.

This Standard utilizes the Cumulative Sum (CUSUM) control chart method as one method of maintaining statistical quality control of the FJ-MGL ultimate tensile strength and modulus of elasticity.

Note: *CUSUM parameters are included in APPENDIX II.*

Quality control procedures other than those described (CUSUM) may be used in conjunction with this Standard, provided they assure that the requirements described in **Part A** of this Standard have been met.

Note: *The choice of a given quality control method implies a commitment not only to the data analysis procedures but also to the sampling procedures (sample size as well as sampling frequency).*

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

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.

Specimens shall be sampled from grade stamped production. The sampling method shall include procedures for selecting the FJ-MGL specimen and which portion of the FJ-MGL will be tested for MOE and UTS.

15.2.2 SAMPLING FREQUENCY

The sampling frequency is dependent on the required test as stated in Sections 15.2.2.1 and 15.2.2.2.

Note 1: *The intent is to collect a sample that is representative of production over the work shift or sampling period. This can be achieved by obtaining quality control test specimens at approximate equal time intervals throughout the production shift or sampling period.*

Note 2: *Under special circumstances, such as to accommodate the facility's production schedule, the Agency may request the facility to increase the frequency of evaluation.*

15.2.2.1 FJ-MGL

A minimum of one **5**-specimen sample for each period of 4 hours, or part thereof, of production shall be randomly selected and tested for modulus of elasticity (MOE) and tensile strength (UTS) evaluation.

Note: *The UTS evaluation is optional for **Type B** candidate stock with CNJ equal to 1.*

15.2.2.2 FINGERJOINTS

a) CHARACTERISTIC NUMBER OF JOINTS

The CNJ for each specimen and the average characteristic number of joints for each 4 hours, or part thereof, of production from the **5**-specimen sample selected shall be determined during this period as specified in Section 15.2.2.1.

b) TENSION TESTING

UTS joint assessment shall be performed for each of the 5 specimens identified in Section 15.2.2.1. during each 4 hours, or part thereof, of operation in accordance with Section 9.2.1.2.

c) DELAMINATION SAMPLING

There are four stages of delamination sampling:

i) 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 test results shall be assessed in accordance with Table 8 to determine if verification sampling under Section 15.2.2.2 c) iv) 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**".

ii) 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 (see Section 9.2).

The delamination test results shall be assessed in accordance with Table 8 to determine if verification sampling in accordance with Section 15.2.2.2 c) iv) 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**".

iii) Level II Delamination Sampling

For Level II Delamination Sampling, **1** fingerjoint specimen shall be obtained for each half-shift, or part thereof, of operation.

The delamination test results shall be assessed in accordance with Table 8 to determine if verification sampling in accordance with Section 15.2.2.2 c) iv) is required.

iv) 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 selected from the second half-shift. The first half-shift shall be sampled if required by Section 15.4.2.2.

Note: *See APPENDIX XIII for commentary on delamination sampling results with reference to Table 8.*

See APPENDIX XIV for commentary on delamination sampling frequency.

15.3 QUALITY CONTROL TESTING

Testing for MOE, delamination, and UTS (if applicable) shall be performed in accordance with the procedures described in Section 9.

TABLE 8 – HALF-SHIFT DELAMINATION RESULTS REQUIRING VERIFICATION SAMPLING

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

15.4 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 13.4 and 13.6.1 are recorded and "**IN-CONTROL**" and "**OUT-OF-CONTROL**" situations shall be readily detectable.

15.4.1 IN-CONTROL

When all the process properties referred to in Section 15.4 remain "**IN-CONTROL**", the item from which the quality control sample was drawn shall be deemed to compliant with the mechanical property requirements of this Standard.

15.4.2 OUT-OF-CONTROL

The requirements of this Section relate to the conditions described in APPENDICES III and VIII to XI.

When any of the process properties described in Section 15.4 become "**OUT-OF-CONTROL**", the item from which the quality control sample was drawn shall be held pending results of the following tests (if applicable):

a) FJ-MGL Verification (visual grade, moisture content, calibration of the grading machine, grade boundary settings, and spot-check of the test equipment),

b) Fingerjoint Verification (delamination, UTS, and characteristic number of joints).

15.4.2.1 FJ-MGL VERIFICATION

The results of the verification tests in Section 15.4.2 a) (see APPENDIX III, Figure 1) shall determine the course of action to be taken:

RESULT A [See APPENDIX III (A), Figure 2]

When the accuracy of the visual grade, moisture content, grading machine calibration (if applicable), test equipment spot-checks, and grade boundary settings are confirmed, re-qualification sampling shall be taken from continued production.

When test results indicate that the process is back "**IN-CONTROL**", the held item shall be deemed to comply with the mechanical property requirements of this standard, and the production of FJ-MGL may resume.

When the test results continue to show that the process is still "**OUT-OF-CONTROL**", the facility shall proceed to either **ACTION 1** or **ACTION 2**, as applicable.

If the grade boundary settings are not readily available, the facility shall proceed to **ACTION 4.**

RESULT B [See APPENDIX III (B), Figure 3]

When the grading machine calibration (if applicable), test equipment spot-checks and grade boundary settings have been confirmed, but accuracy of the visual grade or the moisture content is found in error, the facility shall either immediately re-grade the held item for visual grade and/or moisture content or perform re-qualification sampling on the held item.

When the re-qualification sampling option is selected, the item shall be deemed to comply with the mechanical property requirements of this Standard when the "**IN-CONTROL**" requirements have been regained.

When the test results continue to show that the process is still "**OUT-OF-CONTROL**", the item shall be re-graded for visual grade and/or moisture content.

Re-qualification sampling shall be performed on the residual of the re-graded FJ-MGL item.

When the test results confirm that the "**IN-CONTROL**" requirements have been regained, the re-graded item shall be deemed to comply with the mechanical property requirements of this Standard.

When the test results continue to show that the process is still "**OUT-OF-CONTROL**", the facility shall proceed to either **ACTION 1** or **ACTION 2**, as applicable.

RESULT C [See APPENDIX III (C), Figure 4]

When the grading machine calibration (if applicable) or test equipment spot-checks are found in error, corrective action shall be taken to correct the condition prior to further machine grading or testing being performed.

When only the test equipment spot-check is found in error, an additional **5**-specimen sample shall be selected and tested from the held item.

When the grading machine calibration is found in error, re-qualification sampling shall be performed from the continued production.

When the test results confirm that the "**IN-CONTROL**" requirements have been regained, the production of FJ-MGL may resume and the held production shall be evaluated in accordance with **ACTION 3**.

When the test results continue to show that the process is still "**OUT-OF-CONTROL**", the facility shall proceed to either **ACTION 1** or **ACTION 2**, as appropriate.

ACTION 1 [See APPENDIX III (D), Figure 5]

When grade boundary settings are changed by 3% or less, re-qualification sampling shall be performed from continued production.

When the test results confirm that the "**IN-CONTROL**" requirements have been regained, FJ-MGL production may resume, and the held item shall be evaluated in accordance with **ACTION 3** if the grading machine calibration or test equipment spot-check indicated adjustment was required.

When the test results continue to show that the process is still "**OUT-OF-CONTROL**", the facility shall proceed to **ACTION 2**.

ACTION 2 [See APPENDIX III (E), Figure 6]

When grade boundary settings are changed by more than 3%, the held item shall be deemed to be in non-compliance with the requirements of this Standard, and all grade stamps shall be obliterated from the FJ-MGL. The held stock shall be re-evaluated or used to produce a lower FJ-MGL grade.

Only after appropriate action has been taken to correct the process and re-qualification sampling test results confirm that the "**IN-CONTROL**" requirements have been regained may the process be deemed to be back "**IN-CONTROL**".

Increased (double) sampling shall then be performed on the item.

ACTION 3 [See APPENDIX III (F), Figure 7]

The quality of the held item shall be evaluated as follows:

a) When the grading machine calibration is adjusted by 2% or less or the test equipment spot-check indicated adjustment was required, the held item shall be considered to comply with mechanical property requirements of this Standard, or

b) When the grading machine calibration is adjusted by more than 2%, re-qualification sampling shall be performed on the held item.

When the test results confirm that the "**IN-CONTROL**" requirements have been regained, the held item shall be deemed to comply with the mechanical property requirements of this Standard.

When the test results confirm an "**OUT-OF-CONTROL**" process, the held item shall be deemed to be in non-compliance with the requirements of this standard and all grade stamps shall be obliterated from the FJ-MGL.

ACTION 4 [See APPENDIX III (G), Figure 8]

When grade boundaries are not readily available to the facility, all grade stamps shall be obliterated from the FJ-MGL.

Note: *This stock may be re-graded to a lower FJ-MGL grade for which the test results confirm that "**IN-CONTROL**" requirements have been met.*

Only after appropriate action has been taken to correct the process and re-qualification sampling test results confirm that the "**IN-CONTROL**" requirements have been regained may the process be deemed to be back "**IN-CONTROL**". Increased (double) sampling shall then be performed on the item.

15.4.2.2 FINGERJOINT VERIFICATION (See APPENDICES VIII to XI**)**

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 15.4.2.2.1 and/or 15.4.2.2.2 and/or 15.4.2.2.3 shall be held pending the results of the following analysis and testing:

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 15.4.2.2.1 and/or 15.4.2.2.2 and/or 15.4.2.2.3,

c) Held production deemed to be "**OUT-OF-CONTROL**" after evaluations in accordance with Sections 15.4.2.2.1 and/or 15.4.2.2.2 and/or 15.4.2.2.3 shall be rejected. The grade stamps from rejected production shall be obliterated or removed.

15.4.2.2.1 DELAMINATION (See APPENDICES VIII to IX)

a) If the average delamination of the **5**-specimen verification sample [refer to Section 15.2.2.2 c) iv)] **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) When operating under Level II sampling, the first half-shift of production is permitted to be evaluated using verification sampling [refer to Section 15.2.2.2 c) iv)]. 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 [refer to Section 15.2.2.2 c) iv)] is **less than or equal to 10%**, the half-shift of held production from which the specimens were 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 13.5 c).

15.4.2.2.2 FINGERJOINT ULTIMATE TENSILE STRENGTH (UTS) (See APPENDIX X)

When the production represented by a specific time frame from which the quality control sample was drawn fails to meet or exceed the required characteristic minimum UTS value for the grade as listed in Table 1, production from this time frame shall be held pending the results of one **30**-specimen sample for fingerjoint ultimate tensile strength verification.

These confirmation samples shall be randomly selected and tested in accordance with Section 9.2.1.

When the **30**-specimen UTS test results confirm that the "**IN-CONTROL**" requirements have been regained, the held item shall be deemed to comply with the mechanical property requirements of this Standard.

When the **30**-specimen UTS test results confirm an "**OUT-OF-CONTROL**" process for joint minimum tensile strength, the held item shall be deemed to be in non-compliance with the requirements of this Standard and all grade stamps shall be obliterated from the FJ-MGL.

15.4.2.2.3 CHARACTERISTIC NUMBER OF JOINTS (CNJ) (See APPENDIX XI)

During production, the average characteristic number of joints (CNJ) for the **5**-specimen quality control sample shall not exceed the characteristic number of joints at qualification and /or the CNJ for a given specimen shall not exceed by more than 1 joint than the characteristic number of joints for the qualified item.

When the production represented by a specific time frame from which the quality control sample was drawn fails to meet the CNJ requirements, production from this time frame shall be held pending the results of one **30**-specimen sample for characteristic number of joints verification.

If the **30**-specimen characteristic number of joints test fail to meet the CNJ established in Section 13.6.1.1, the held production is deemed to be "**OUT-OF-CONTROL**" for characteristic number of joints.

a) Production Deemed to be "OUT-OF-CONTROL"

When the held production is deemed to be "**OUT-OF-CONTROL**" after evaluation of the **30**-specimen sample, the grade stamps from rejected production shall be obliterated or removed unless further sampling and testing is conducted in accordance with Section 15.4.2.2.3 b) below.

b) Further Assessment of Production Deemed to be "OUT-OF-CONTROL"

The facility may, at its discretion, further select and test a **30**-specimen sample in accordance with Section 13.5 d).

The **30**-specimen sample shall be taken from either continued production or held production.

i) If the test results meet the requirements of Section 13.6.2.3, the held production shall be deemed "**IN-CONTROL**" for CNJ.

ii) If the test results fail to meet the requirements of Section 13.6.2.3, the held production shall be deemed "**OUT-OF-CONTROL**" for CNJ and the grade stamps from held production shall be obliterated or removed.

15.5 ALTERNATE GRADES FOR HELD PRODUCTION

The facility, upon approval by the Agency, is permitted to grade stamp held production to a lower grade for which the quality control test requirements can be satisfied.

Note: *Since lumber properties and fingerjoint strength are not perfectly correlated, it is possible to qualify an item and subsequently find that it is not possible to maintain the fingerjoint requirements of the grade.*

15.6 IDENTIFICATION AND TRACEABILITY

Each package of FJ-MGL leaving the facility shall be identified with the time and date it left the production line.

Note: *This requirement is to facilitate 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) Grading machine grade boundary settings and subsequent changes to the grade level boundary settings, calibration and maintenance data (if applicable),

b) Test equipment spot-check and maintenance data,

c) Quality control tests, and

d) All FJ-MGL production stoppages as a result of quality control requirements and a report of the corrective actions taken.

Separate records shall be maintained for each item produced. In some instances, a given item may be run individually or in combination with other items. In either case, one CUSUM record shall be maintained if an item is run individually and another CUSUM record shall be maintained when items are run in combination.

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 FJ-MGL 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 the 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.

The properties, for which conformance is required shall include the mean flexural stiffness and the minimum flexural stiffness of the FJ-MGL; the delamination resistance; and the tension strength of the fingerjoints. The property or properties under dispute shall determine the sampling and subsequent evaluation.

16.2 FJ-MGL SAMPLING AND EVALUATION

In cases of complaints pertaining to the conformance of the FJ-MGL to the assigned design values, an **80**-specimen sample shall be randomly selected. Each **80**-specimen sample shall be tested as specified in Section 9.1.1 and the results evaluated as follows:

a) The mean E of the sample shall **equal or exceed 0.97** times the assigned E_g value, and

b) **Not more than 6** specimens out of **80** shall have an E value less than 0.82 times the E_g value.

16.3 FJ-MGL UTS-JOINT ASSESSMENT SAMPLING AND EVALUATION

In cases of complaints pertaining to the FJ-MGL joint tensile strength, an **80**-specimen sample representing the item shall be randomly selected.

a) An 8-foot (2.44-m) section, whenever possible, shall be randomly selected from each specimen.

Note: *An allowance should be made for the specimen to be gripped.*

b) The number of fingerjoints tested in the UTS joint assessment (see Section 9.2.1.2) for each specimen shall not be less than the number of complete fingerjoints in the 8-foot (2.44-m) section of the specimen. If no fingerjoints are present in the 8-foot (2.44-m) section, a single joint closest to the 8-foot (2.44-m) section shall be tested.

c) **Not more than 6** specimens out of **80** shall have a UTS joint assessment result value that is less than the value listed in Table 1 for the grade.

d) For specimens that fail away from the joint (see APPENDIX IV – Mode 6) at less than the required UTS proof stress listed in Table 1, replacement joints shall be selected and tested.

16.4 FJ-MGL 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 9.3.

If the delamination of any specimen or, if applicable, the average delamination of a specimen and its matching specimen (see Section 9.3.1.1) 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 joints out of **20** shall show greater than 15% delamination.

APPENDICES (INFORMATIVE)

APPENDIX I - REFERENCE MODULUS OF ELASTICITY

Since modulus of elasticity, determined in a bending test, is affected by machine deflection measuring techniques and loading application procedure, it is necessary to define a single reference procedure for calibration of quality control equipment.

The reference modulus of elasticity (E) is tested in accordance with ASTM D198. The modulus of elasticity data is adjusted to 15% moisture content, in accordance with ASTM D1990, and to a 21 to 1 span-to-depth ratio in accordance with ASTM D2915.

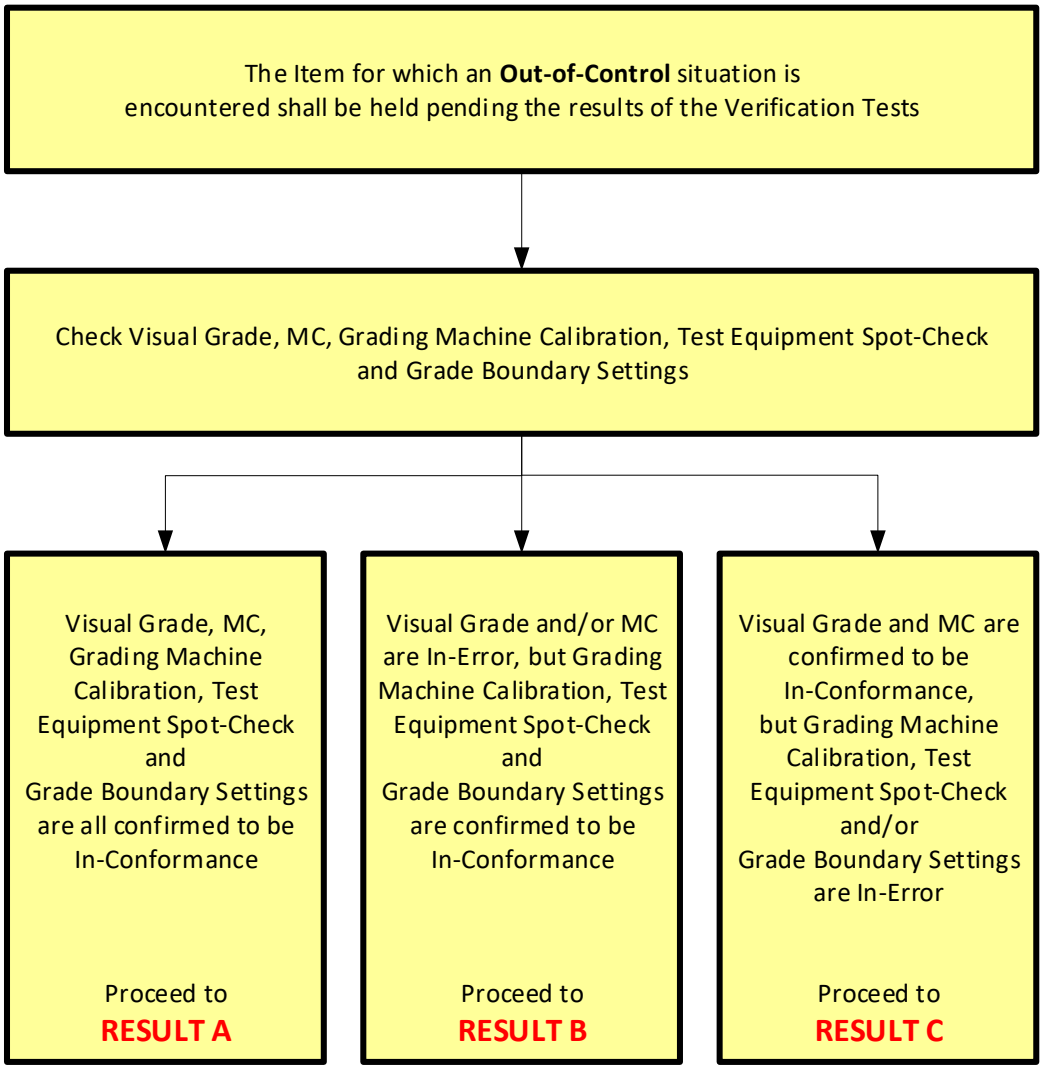
APPENDIX II - CUSUM PARAMETERS

TABLE 9 – CUSUM PARAMETERS FOR MOE STATISTICAL CONTROL

E Value (10^6)	E Designation	W	X	Y	Z
1.4E	140	115	1350	163	378
1.5E	150	123	1450	186	402
1.6E	160	131	1550	211	428
1.7E	170	139	1650	236	455
1.8E	180	147	1750	262	483
1.9E	190	156	1850	288	511
2.0E	200	164	1950	316	542

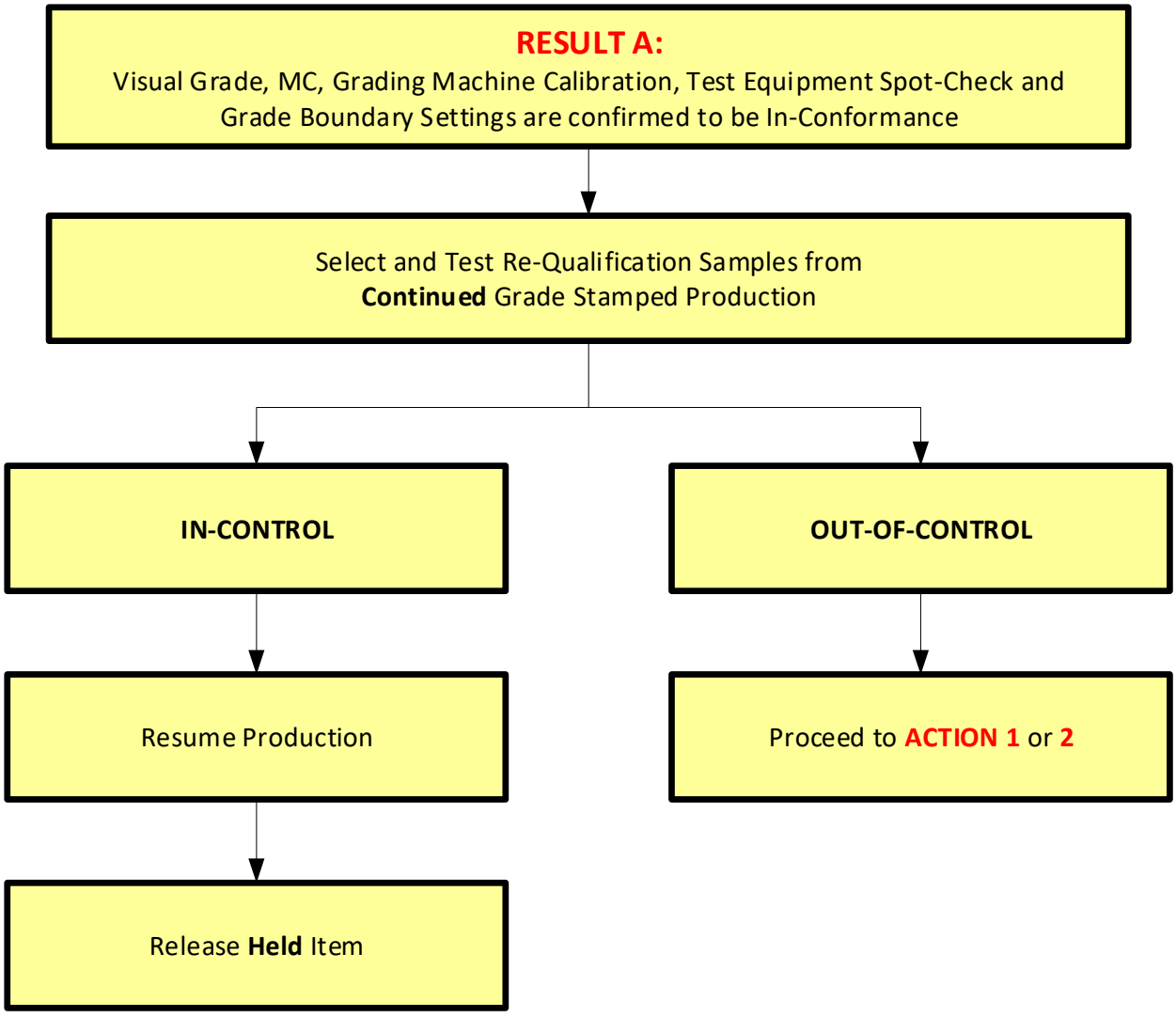
APPENDIX III - OUT-OF-CONTROL FLOW CHARTS FOR FJ-MGL VERIFICATION

FIGURE 1 – VERIFICATION – DECISION FLOWCHART



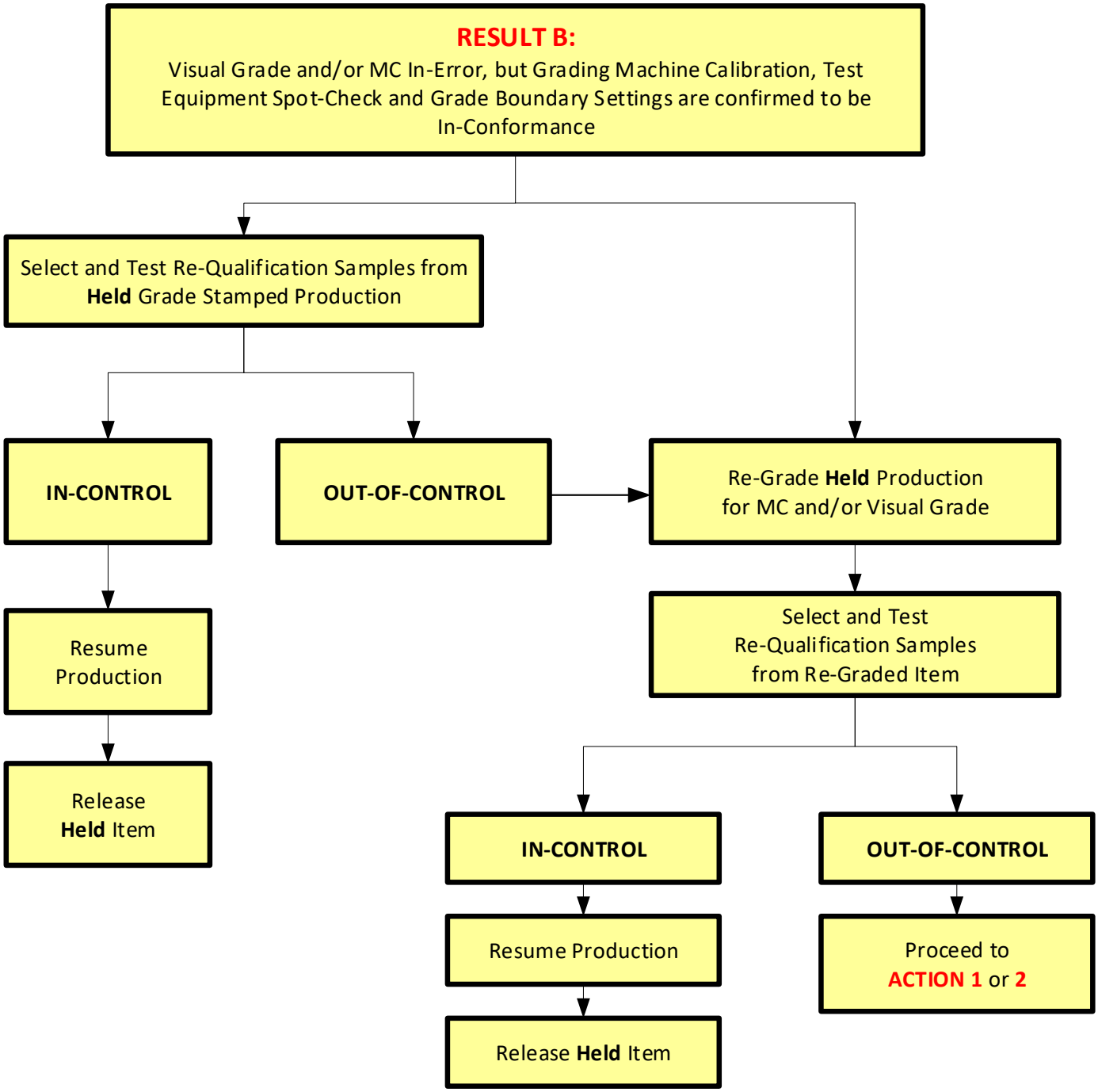
APPENDIX III (A): OUT-OF-CONTROL FLOW CHART FOR FJ-MGL VERIFICATION: RESULT A

FIGURE 2 – RESULT A – DECISION FLOW CHART



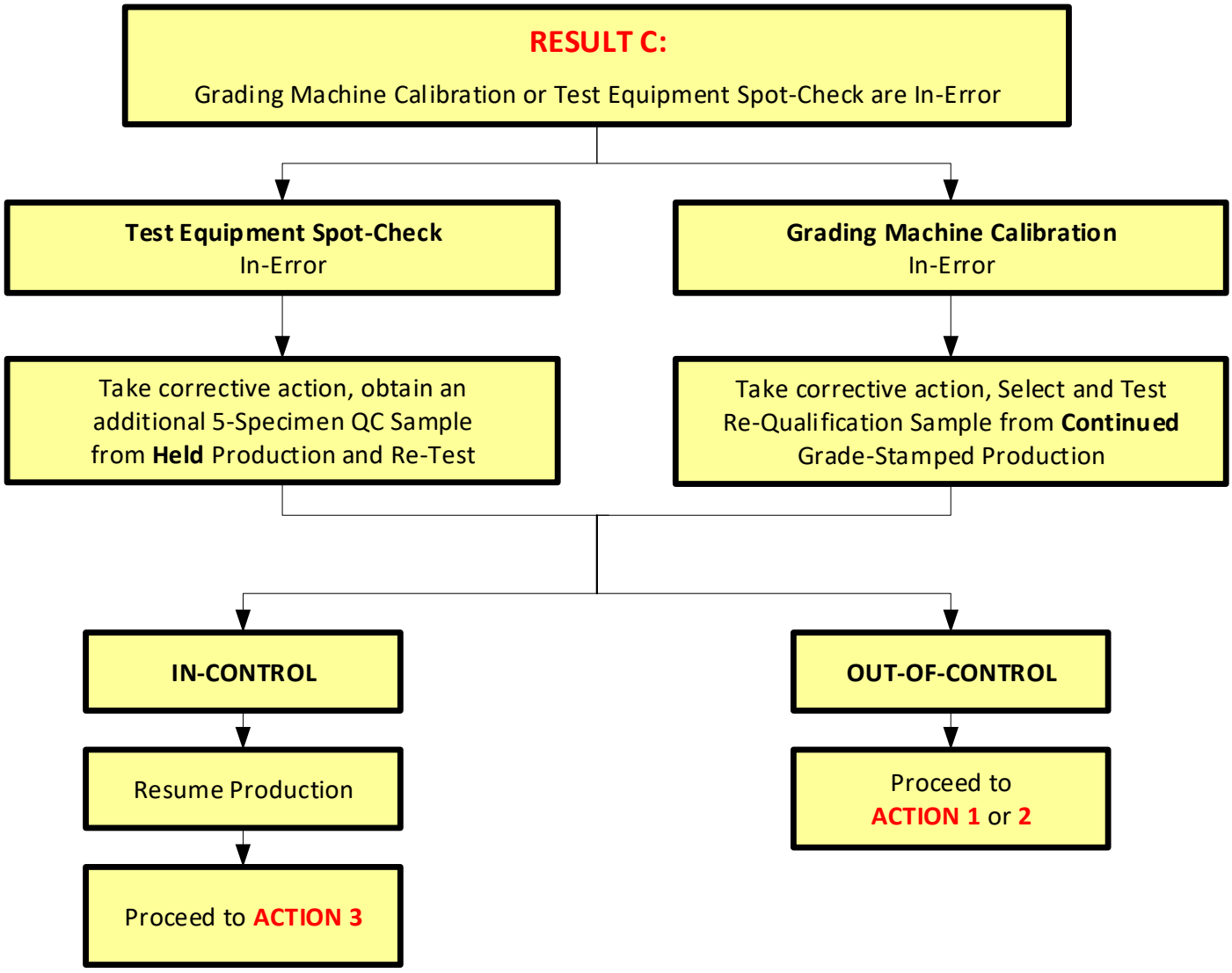
APPENDIX III (B): OUT-OF-CONTROL FLOW CHART FOR FJ-MGL VERIFICATION: RESULT B

FIGURE 3 – RESULT B – DECISION FLOW CHART



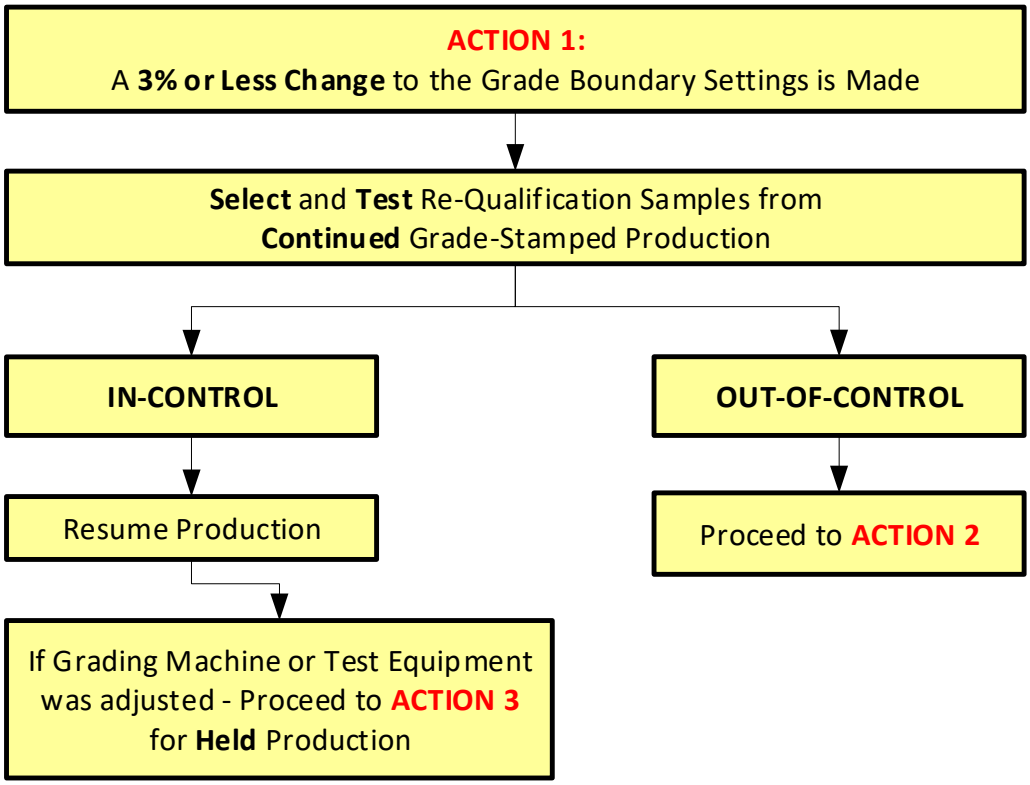
APPENDIX III (C): OUT-OF-CONTROL FLOW CHART FOR FJ-MGL VERIFICATION: RESULT C

FIGURE 4 – RESULT C – DECISION FLOW CHART



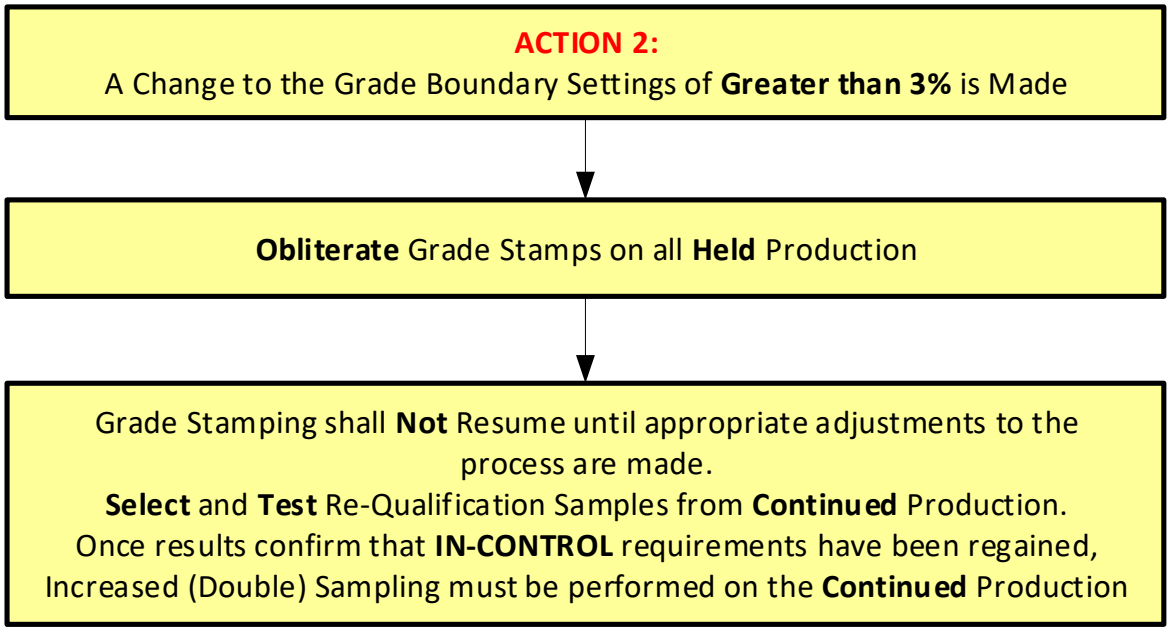
APPENDIX III (D): OUT-OF-CONTROL FLOW CHART FOR FJ-MGL VERIFICATION: ACTION 1

FIGURE 5 – ACTION 1 – DECISION FLOW CHART



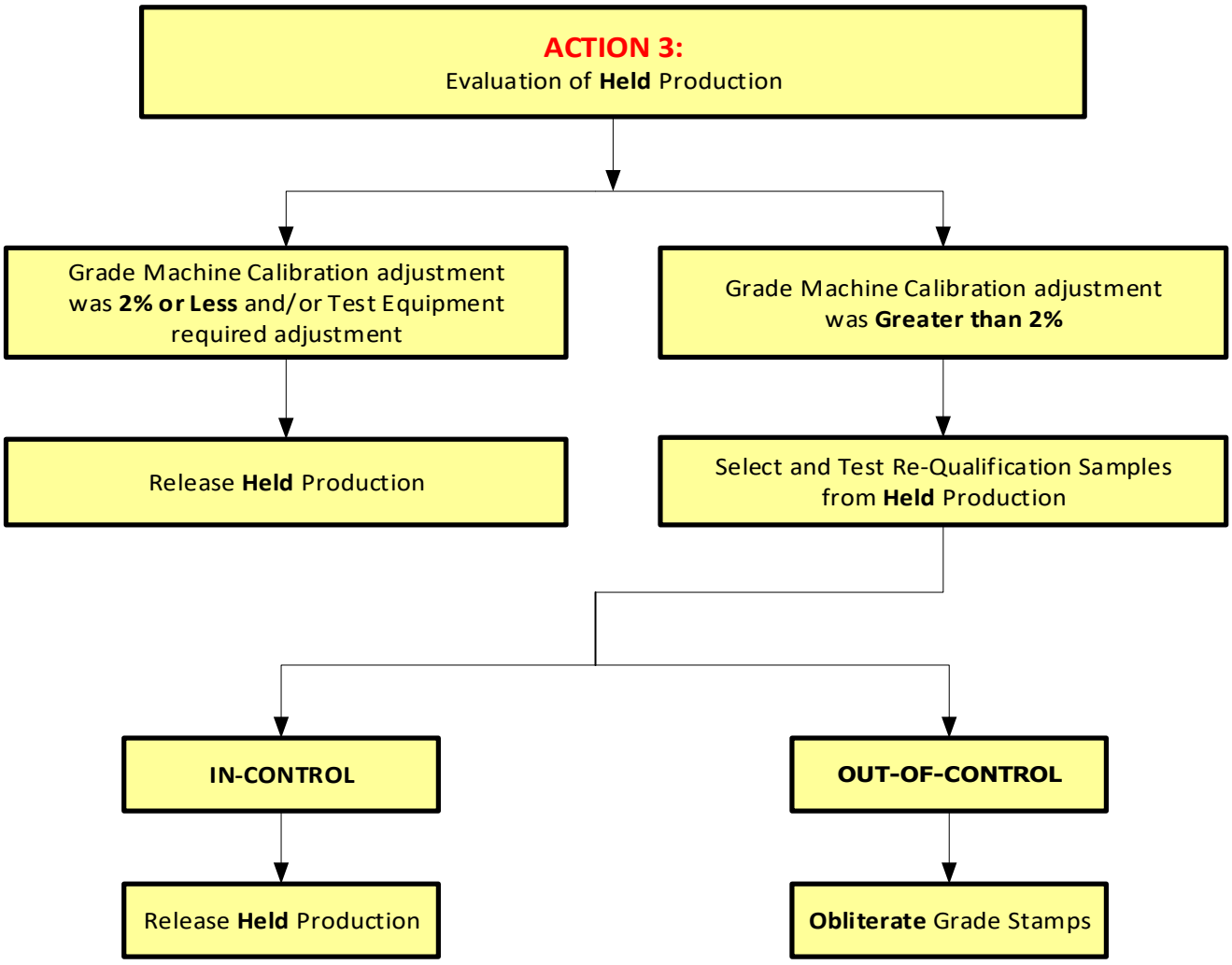
APPENDIX III (E): OUT-OF-CONTROL FLOW CHART FOR FJ-MGL VERIFICATION: ACTION 2

FIGURE 6 – ACTION 2 – DECISION FLOW CHART



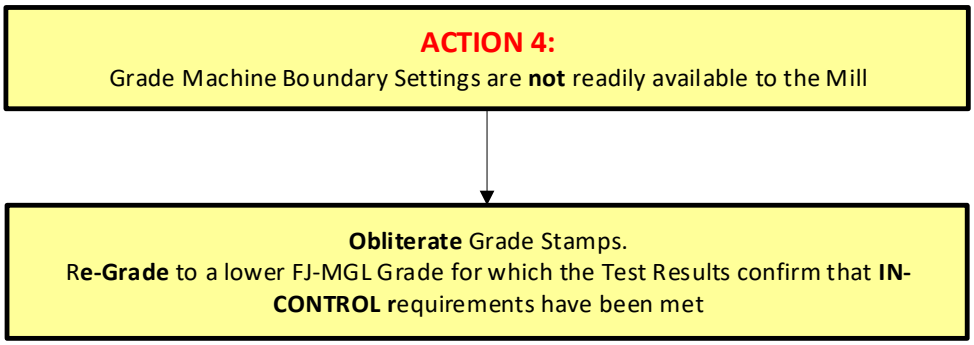
APPENDIX III (F): OUT-OF-CONTROL FLOW CHART FOR FJ-MGL VERIFICATION: ACTION 3

FIGURE 7 – ACTION 3 – DECISION FLOW CHART



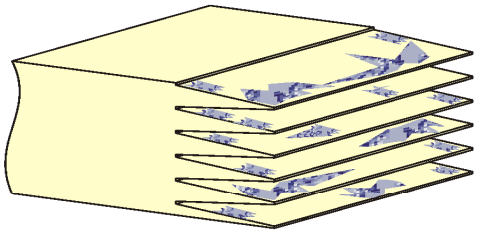
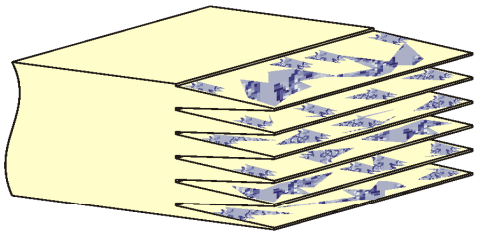
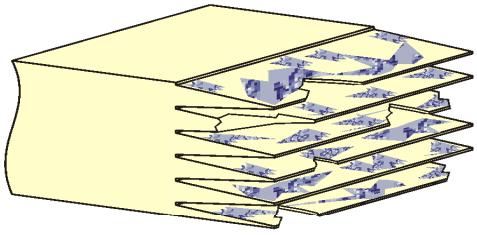
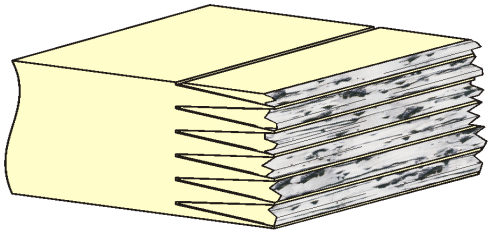
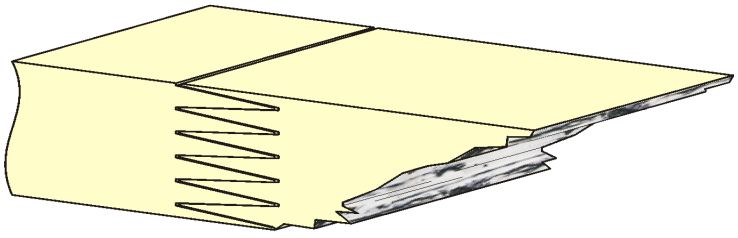
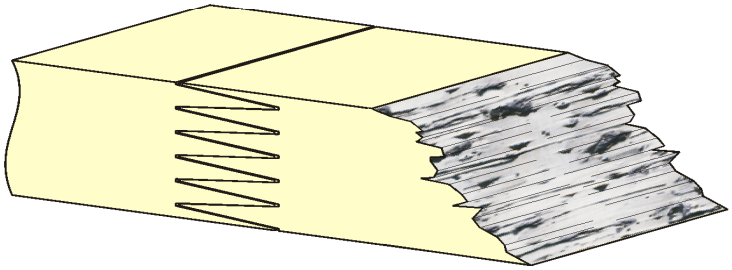
APPENDIX III (G): OUT-OF-CONTROL FLOW CHART FOR FJ-MGL VERIFICATION: ACTION 4

FIGURE 8 – ACTION 4 – DECISION FLOW CHART



APPENDIX IV – FAILURE MODES BASED ON ASTM D4688

FIGURE 9 – FAILURE MODES BASED ON ASTM D4688

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

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APPENDIX V – THE USE OF WOOD FAILURE ASSESSMENT IN PROCESS CONTROL

In this Standard, control of the quality of the gluing is 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, the quality of the bondline may be assessed more rapidly by assessing the wood failure developed in the fingerjoint. 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 means 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 the glue is spread on both end 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 the 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 are pre-cure of the glue spread on one end of the piece of heated wood, due either to inadequate glue spread in all or part of the joint, or in holding the glue spread pieces 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 enough displacement capacity, the partially failed joint can be broken completely open by resting it on two supports and applying enough force to pull open the joint.

Wood failure assessment is not a mandatory requirement of this Standard; however, Section 7.4.1 requires that enough glue must be applied to the joint.

APPENDIX VI – AGENCY ADMINISTRATION

This Standard is administered by an accredited Agency. Agency approval of a facility to grade stamp fingerjoined lumber is contingent upon the facility's compliance with the procedures and requirements of this Standard.

Inspections should include, but are not limited to, reporting on the following:

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

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

- **i)** wear and damage,
- **ii)** lubrication and operations of moveable parts, and
- **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.

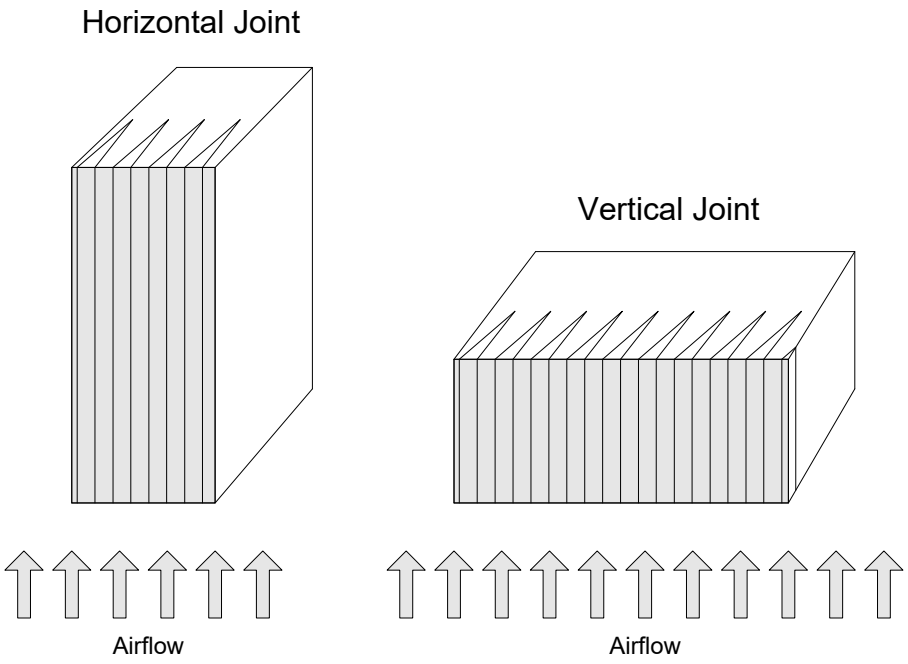
d) Inspection of the glue mixing equipment and procedures, including the accuracy of the weighing equipment, mixing proportions, and cleanliness of the facility.

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.

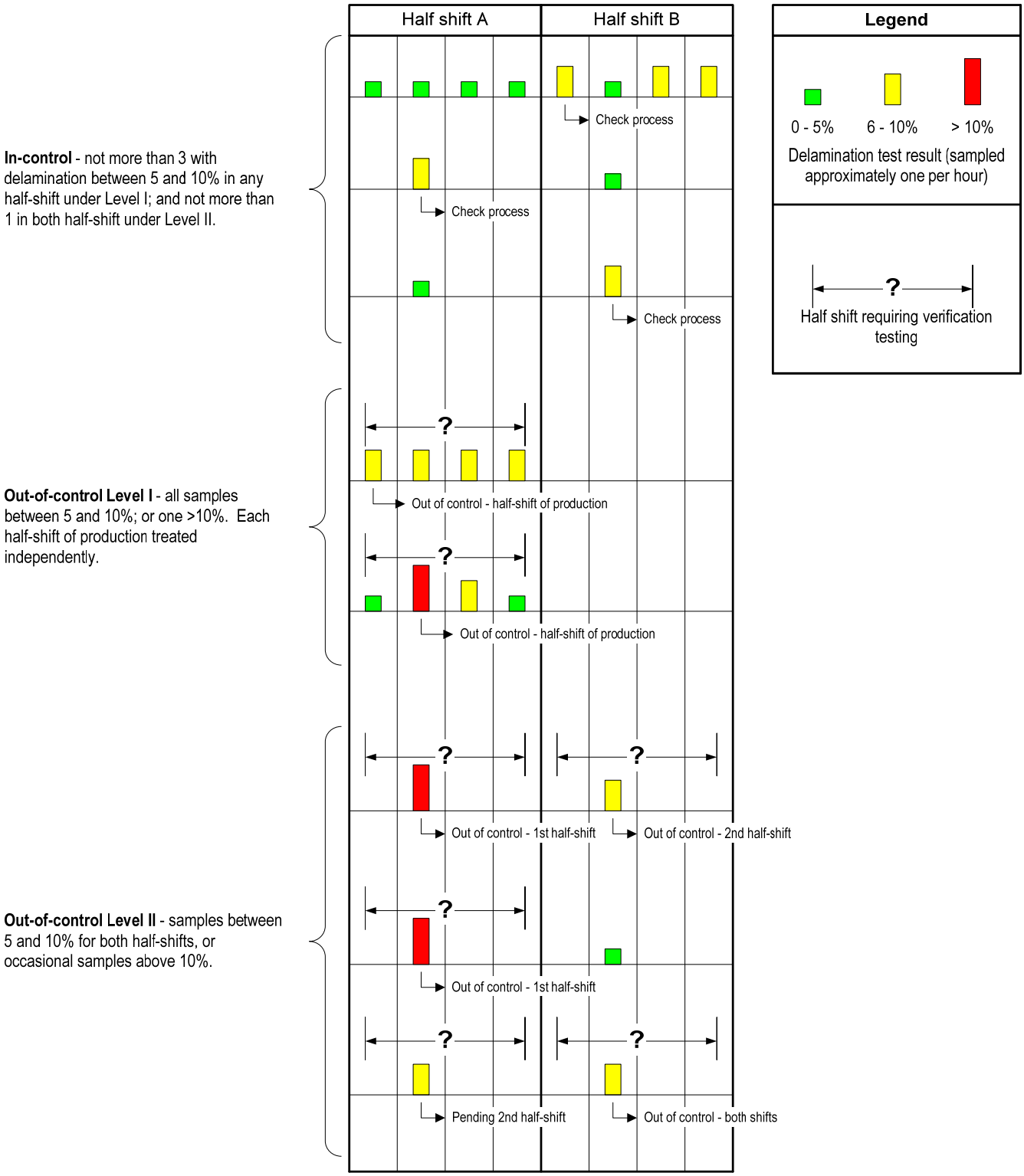
APPENDIX VII – FINGER PROFILE ORIENTATION FOR DELAMINATION IN THE DRYING CHAMBER

FIGURE 10 – FINGER ORIENTATION RELATIVE TO AIRFLOW



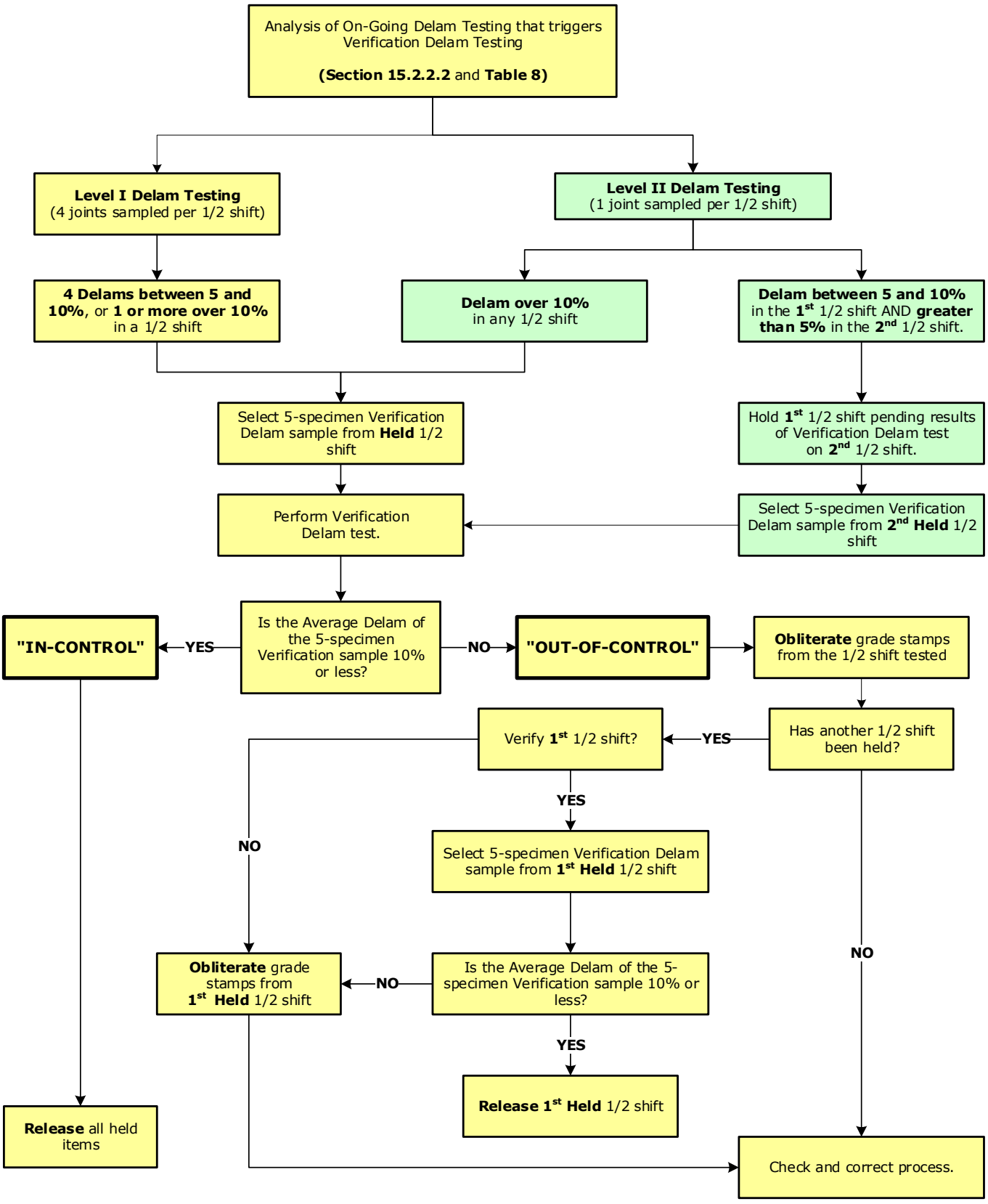
APPENDIX VIII – EXAMPLES OF DELAMINATION "IN-CONTROL" AND "OUT-OF-CONTROL" SCENARIOS

FIGURE 11 – EXAMPLES OF IN-CONTROL AND OUT-OF-CONTROL SCENARIOS



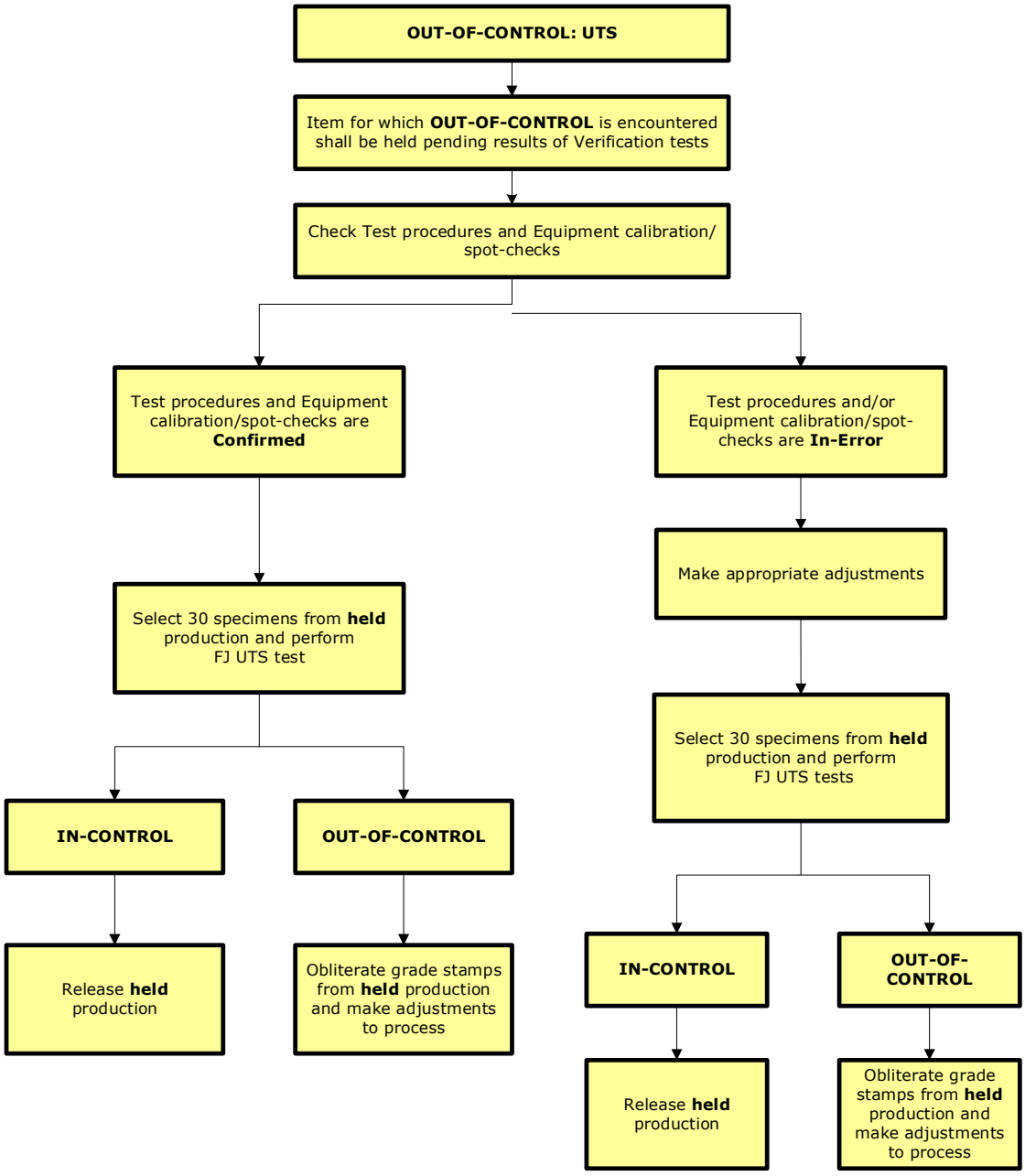
APPENDIX IX – FINGER JOINT VERIFICATION FLOW CHARTS (A): DELAMINATION

FIGURE 12 – DELAMINATION FINGERJOINT VERIFICATION – DECISION FLOW CHART



APPENDIX X – FINGER JOINT VERIFICATION FLOW CHARTS (B): UTS

FIGURE 13 – UTS FINGERJOINT VERIFICATION – DECISION FLOW CHART



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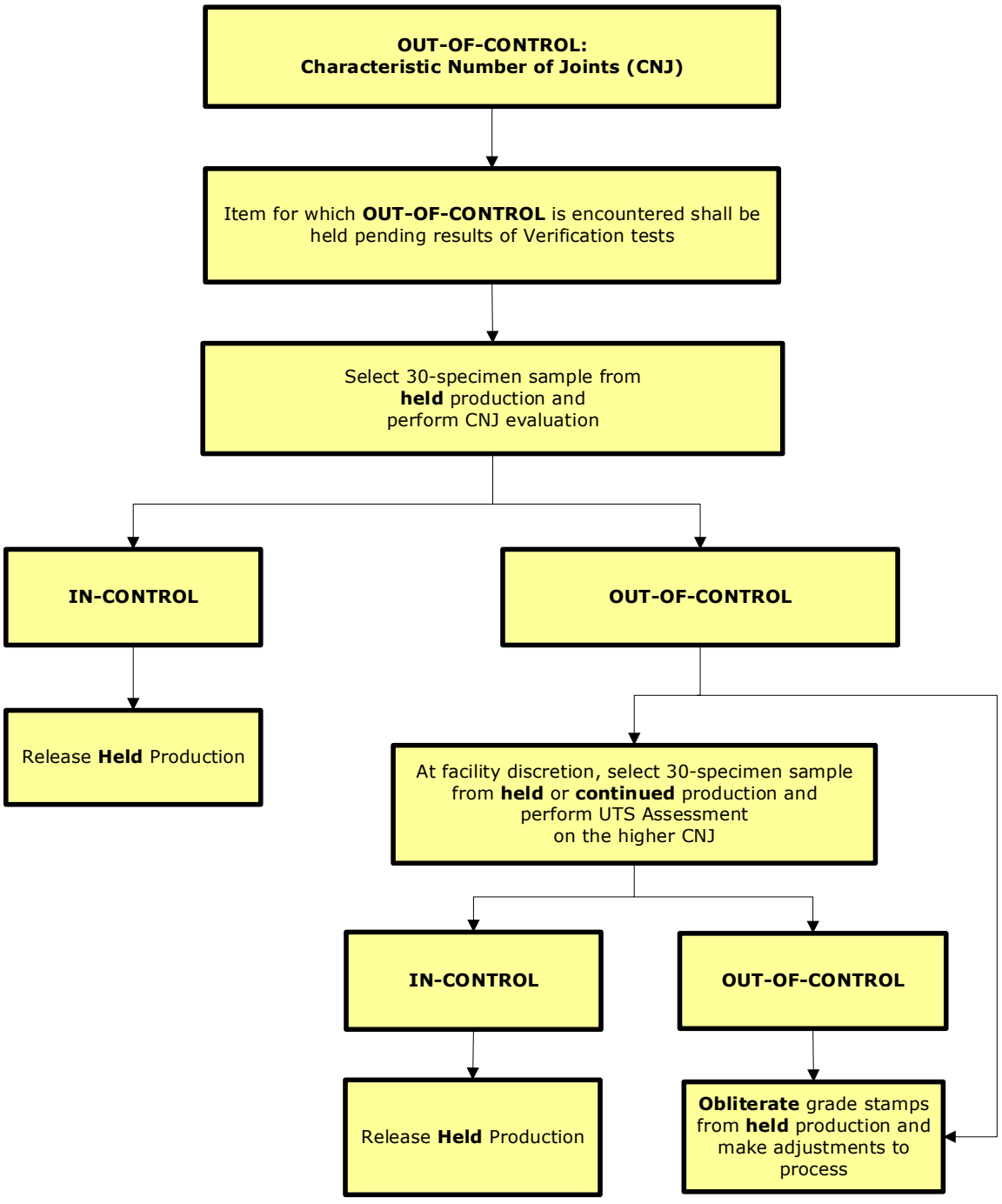
APPENDIX XI – FINGER JOINT VERIFICATION FLOW CHARTS (C): CNJ

FIGURE 14 – CNJ FINGERJOINT VERIFICATION – DECISION FLOW CHART



IN-CONTROL: CNJ QUALITY CONTROL REQUIREMENTS

1) The average CNJ of the 5-specimen QC sample shall not exceed the CNJ established at qualification; and/or

2) The CNJ for a given specimen shall not exceed 1 joint more than the CNJ for the qualified item

APPENDIX XII – COMMENTARY ON TABLE 8 (HALF-SHIFT DELAMINATION RESULTS REQUIRING VERIFICATION TESTING)

The following discussion refers to the scenarios outlined in Table 8 for evaluation of the delamination test results from different sampling stages (see Section 15.2.2.2 c)).

a) Evaluation of Delamination Results after Qualification (Row 1 – Columns 3 and 4)

If following qualification and after one vacuum-pressure-dry cycle, all four joint specimens show average delamination greater than 5% but less than 10% (Column 3), **OR** one or more of the four joints show average delamination greater than 10% (Column 4), the half-shift production where the joints were taken will have to be re-sampled for verification testing.

b) Evaluation of Level I Delamination Results
(Row 2 – Columns 3 and 4)

If under Level I delamination sampling and after one vacuum-pressure-dry cycle, all four joint specimens show average delamination greater than 5% but less than 10% (Column 3), **OR** one or more of the four joints show average delamination greater than 10% (Column 4), the half-shift production where the joints were taken will have to be re-sampled for verification testing.

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

If under Level II delamination sampling and after one vacuum-pressure-dry cycle, the single joint specimen taken in the *first half shift* shows average delamination of 5% but less than 10% (Column 3), take no action but wait for the result of the second half shift joint sample. However, if the single joint specimen shows average delamination greater than 10% (Column 4), then the first half shift production where the joint was taken will have to be re-sampled for verification testing.

d) Evaluation of Level II 2nd Half-Shift Delamination Results (Row 4 – Columns 3 and 4)

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

APPENDIX XIII – COMMENTARY ON 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 (if required) what checks are instituted 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) Grading machine setup: station where grading machine settings are adjusted and monitored.

b) Candidate lumber stock: station where candidate stock is identified and tracked.

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

d) Machining of the fingerjoint: station where set-up tolerances are monitored and where cutter heads are changed.

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

f) 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.

g) In-line tension proof loader: station where equipment is calibrated and spot-checked.

h) Off-line QC test equipment: station where quality control specimens are tested.

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 or uneven spread of adhesive).

The QC Manual must include special provisions for shut-down and start-up of the gluing line, particularly during temporary production 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 period to avoid pre-cure of the glue.

APPENDIX XIV – COMMENTARY ON SAMPLING FREQUENCY FOR DELAMINATION QUALITY CONTROL

Sampling frequency for delamination quality control of FJ-MGL (see Section 15.2.2.2 c) is based on standard production shifts of 8 to 10 hours (half-shifts are 4 to 5 hours). For partial or longer 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 of 4 hours 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) and the required number of test specimens would be selected for each "half-shift".

b) If production switches from one item to another during the standard production shift, the required number of test specimens for each item must be collected for each half-shift, or part thereof, of each item's production time period.

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

To identify or obtain the most current version of NLGA – SPS 4, or any associated Supplements or Errata, check the publication section of the NLGA website at www.nlga.org.