SPS 2

Special Products Standard for Machine Graded Lumber

Effective April 1, 2019

Approved by the Canadian Lumber Standards Accreditation Board

Supersedes All Previous Editions, Revisions and Supplements

SPS 2

SPECIAL PRODUCTS STANDARD

FOR

MACHINE GRADED LUMBER

EFFECTIVE: April 1, 2019

Supersedes All Previous Editions, Revisions and

Supplements Prior to April 1, 2019

Approved by the Canadian Lumber Standards Accreditation Board – March 12, 2019

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PREFACE

The following is a list of the revisions to SPS 2 since December 2003.

a) Revised Sections Effective December 1, 2004

- Section 6.1;
- Section 6.2; and
- Section 9.1.

b) Revised Sections Effective December 1, 2005

- Section 6.1; and
- Sections 6.2.

c) Revised Sections Effective December 1, 2006

- Section 1.1;
- Section 6.1;
- Section 6.2;
- Section 13.1;
- Section 14.4.2;
- Flowchart Action 1; and
- Added New Part C,

d) Editorially Revised Sections May 24, 2008

- Sections 16.2.3 & 16.2.5

e) Editorially Revised Part C - June 1, 2009

- Added New Section 16.4.1;
- Section 16.4.1 – Note added; and
- Revised Table 17.

f) Editorially Revised Part C – Dec. 1, 2009

- Updated Revised Table 17

g) Revised Sections Effective July 14, 2010

- Section 12.8

h) Revised Sections Effective November 1, 2010

- Section 2.1 - added Spot-Check definition;
- Section 2.2 - updated the "Reference Publications"; and
- Section 13.2 & 13.3 – Added "Spot-check" references.

i) Revised Sections Effective February 1, 2013

- Table 11 - added "or load cell" to the "once a week - Bending Proof Loader" requirement and replaced "Calibration" in the Heading with "Spot-Check"
- Revised the footnote to Table 18 to now read: "Values adapted from ASTM D2915 Section X4"

j) Revised Sections Effective Feb 15, 2017

- Section 2.1 – added definitions for Independent Certification Agency and Independent Calibration Laboratory
- Section 2.2 – updated and added references
- Revised Section 13.2 – Test Equipment
- Added new Section 13.2.1 – Independent Calibration Laboratory Reporting Requirements
- Revised Section 13.3 – Calibration Devices
- Revised Section 14.6 – Quality Control Records
- Revised Table 9 – Grade Stamping (Marking) Requirements

k) Revised Sections Effective April 1, 2019

- Section 2.1 – minor edits and add definition for Major Maintenance
- Section 2.2 – updated references
- Section 6.0 – clarified and reorganized sub-sections.
- Section 11.2.3 – added requirements for QC Manual related to Major Maintenance
- Section 12.10 – added new section for Grading Machine Major Maintenance procedures
- Section 14 – updated the term "calibration" with "spot-check" for test equipment as per changes to Section 13 in Nov 2010 and Feb 2013
- Section 14.2.1 – added note to QC sampling method
- Section 16 – updated EU Export Requirements
- Appendix V – corrections and clarifications to Flowcharts

1.0 SCOPE

1.1 PART A, PART B & PART C

This Standard consists of three parts.

PART A:

Product Specifications: specifies grade characteristics, standard sizes, visual grading and mechanical property requirements, property evaluation procedures, and grade stamping (marking) requirements for machine stress-rated lumber (MSR), machine evaluated lumber (MEL), and two types of E-LAM: E-rated structural laminations lumber and MSR/MEL tension lam lumber.

PART B:

Qualification and Quality Control Requirements: specifies minimum qualifications and quality control requirements for a facility producing MSR, MEL or E-LAM lumber in accordance with the requirements of PART A of this Standard.

PART C:

European Union export requirements for MGL: In order for the Machine Graded Lumber (MGL) graded under PARTS A & B of SPS 2 to be in compliance with European Standards legislation and to be able to CE mark MGL, producers must meet the additional requirements referenced in PART C.

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.

1.3 IMPERIAL UNITS

In case of a dispute, the values stated in imperial units shall take precedence.

1.4 DESIGN VALUES

For use in Canada, design values are assigned to the grades shown in Tables 2 and 3 by the CSA Technical Committee on Engineering Design in Wood. Design values are published in the current edition of CSA O86.

For use in the USA, design values are developed in accordance with ASTM D6570 and published in the NLGA Standard Grading Rules (Para. 910).

2.0 DEFINITIONS & REFERENCED PUBLICATIONS

2.1 DEFINITIONS

The following definitions shall apply to this Standard.

AGENCY: an 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: a representative of the Agency who is approved by the Agency to inspect facilities producing MSR, MEL and/or E-LAM lumber.

AGENCY VERIFICATION: a specific set of procedures used by an Agency to verify that an item of grade-stamped (marked) MSR, MEL or E-LAM lumber conforms to the requirements of this Standard.

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

CHARACTERISTIC PROPERTY VALUE: the value corresponding to a percentile in the assumed statistical distribution of a particular property of the material. For the purpose of this Standard, characteristic strength values (ie. MOR, UTS) are defined as the population 5th percentile values obtained under a short-term test load. Characteristic stiffness values (ie. E5th, E) are defined as the population 5th percentile or mean values obtained under a short-term test load.

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

CONTROL CHARTS: are 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.

E-LAM LUMBER: there are two types of E-LAM lumber, as follows:

a) **E-RATED STRUCTURAL LAMINATIONS (LAM) LUMBER:** is lumber that has been non-destructively evaluated by a grading machine and meets the E-Rated Structural Lam Lumber requirements of this Standard.

b) **MSR/MEL TENSION LAMINATIONS (LAM) LUMBER:** is lumber that has been non-destructively evaluated by a grading machine and meets the MSR/MEL tension lam lumber requirements of this Standard. Ultimate tensile strength (UTS) qualification and daily quality control that meets the requirements of this Standard is mandatory.

EVALUATION: an assessment of the manufacturing process and its quality control programs to determine whether a facility can produce an item that meets the requirements of this Standard.

FACILITY: is a manufacturing plant that produces MSR, MEL and/or E-LAM lumber.

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

GRADE STAMP (MARK): the grade identification applied on a piece of machine-graded lumber that includes the applicable information required in Section 9.0 of this Standard. The grade stamp (mark) indicates that the grading process meets the requirements of the Agency's qualification and quality control procedures.

HALF-WEIGHT: weight measured at one support when a beam is symmetrically supported. The beam is assumed to have a uniform weight per unit length.

IN-CONTROL: is when the production process continues to meet the mechanical property requirements of this Standard.

INDEPENDENT CALIBRATION LABORATORY: an organization that performs testing to verify and establish results for testing machines, 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: an organization operating in accordance with ISO/IEC 17065 and accredited by an Accreditation Body listed under the International Accreditation Forum (IAF).

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

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

LONG-SPAN (LS) MODULUS OF ELASTICITY: is the modulus of elasticity measured in a flat-wise test mode, using centre-point loading and a span-to-depth ratio (l/d) of 100.

MACHINE EVALUATED LUMBER (MEL): is lumber that has been non-destructively evaluated by a grading machine to predict specific mechanical properties. MEL shall meet the MSR requirements of this Standard with the exception of the minimum modulus of elasticity specification and shall meet the following requirements:

a) Ultimate tensile strength (UTS) qualification and daily quality control is a mandatory requirement; and

b) The process lower fifth percentile of edge bending modulus of elasticity (E_{5th} - minimum modulus of elasticity) shall equal or exceed 0.75 times the characteristic mean modulus of elasticity value for the grade E (E_g).

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

MAJOR MAINTENANCE: any 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. 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 device replacement; and software upgrades.

MINIMUM MODULUS OF ELASTICITY: is the characteristic fifth (5^{th}) percentile modulus of elasticity (E_{5th}).

MODULUS OF ELASTICITY (E): the ratio of stress to corresponding strain below the proportional limit. In this Standard, the modulus of elasticity is determined in edgewise bending at a span of 21 times the depth and based on ASTM D198. The dressed size (net finished size) is used in computing the modulus of elasticity.

NON-CONFORMANCE: a deficiency in a property, documentation or procedure that renders the quality of an item not to be in adherence to specified requirements of this Standard and therefore unacceptable. Examples that may cause non-conformance are: physical defects, test failures, incorrect or inadequate documentation, or deviations from prescribed processing, inspection or test procedures.

OUT-OF-CONTROL: occurs when the production process no longer meets the mechanical property requirements of this Standard.

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

QUALITY CONTROL MANUAL: a document which sets forth a specific set of instructions to describe the quality control functions to be carried out in the production of MSR, E-LAM and/or MEL at a specific facility.

RANDOM SAMPLING: a procedure by which a sample is generated from a population. The sample shall be representative of the population.

SAMPLING: the two types of sampling methods used in this Standard are as follows:

a) **INCREASED (DOUBLE) SAMPLING:** random sampling undertaken to generate two five-specimen samples from every four hours or less of production, for a period of three production shifts. Specimens thus obtained shall be tested, and test results analysed and recorded in accordance with the quality control requirements of this Standard.

b) **INTENSIVE SAMPLING:** random sampling undertaken to immediately generate six samples from an item, sequentially identified and consisting of five specimens each. Specimens thus obtained shall be tested, and test results analysed and recorded in accordance with the quality control requirements of this Standard.

SPECIFIC GRAVITY (SG): is the weight of the substance relative to the weight of an equal volume of water. This is also commonly known as relative density. The specific gravity (SG) is based on the mass and volume of the wood at oven-dry moisture content.

SPECIMEN: a piece of MSR, MEL or E-LAM lumber randomly selected from production for purposes of quality control, quality verification testing and any subsequent analysis.

SPOT CHECK: the verification that the calibration/device/machine is still within calibration tolerances.

TEST EQUIPMENT: equipment used by the facility to determine the modulus of elasticity (E), long-span (LS) E, modulus of rupture (MOR), and/or where applicable, the ultimate tensile strength (UTS) and specific gravity to determine conformance to the specified requirements of this Standard.

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

2.2 REFERENCED PUBLICATIONS

AITC

117:2015 Standard Specifications for Structural Glued Laminated Timber of Softwood Species

ASTM

D198-15 Standard Methods of Static Tests of Timbers in Structural Sizes

D245-06 (2011) Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber

D2395-14 Standard Test Methods for Specific Gravity of Wood and Wood-Base Materials

D2915-17 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

D6570-18a Standard Practice for Assigning Allowable Properties for Mechanically Graded Lumber

D7438-13 Standard Practice for Field Calibration and Application of Hand-Held Moisture Meters

E4-16 Standard Practices for Force Verification of Testing Machines

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

E83-16 Standard Practice for Verification and Classification of Extensometer Systems

Canadian Lumber Standards Accreditation Board

CLSAB Regulations (Nov 2018)

CSA

CSA O86-14 Engineering Design in Wood

CSA O141-05 (R2014) Softwood Lumber

ISO

ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories

ISO/IEC 17065: 2012 Conformity Assessment – Requirements for Bodies Certifying Products, Processes and Services

National Lumber Grades Authority

NLGA Standard Grading Rules
Standard Grading Rules for Canadian Lumber (Aug 2017)

PART A - GENERAL SPECIFICATIONS FOR MACHINE GRADED LUMBER

3.0 PRODUCT DESCRIPTION

3.1 MACHINE STRESS-RATED LUMBER (MSR)

Machine stress-rated lumber (MSR) is lumber that has been non-destructively evaluated by a grading machine.

MSR lumber is distinguished from visually graded lumber in that each piece is non-destructively tested and marked to indicate the grade classification (Fb-E). MSR lumber shall meet the visual requirements as set forth in this Standard and the current edition of the NLGA Standard Grading Rules.

Qualification and subsequent quality control of the modulus of elasticity (MOE) and modulus of rupture (MOR) are required for each item.

Specific gravity (SG) qualification and subsequent quality control are required when the SG value exceeds the value assigned to the grade set forth in Table 2.

When a S-P-F grade Eg of 2.0E is run in conjunction with a higher E grade(s) then specific gravity (SG) must be quality controlled for the 2.0E grade.

When applicable, qualification and subsequent quality control for ultimate tensile strength (UTS) are required as outlined in Table 2b.

3.2 MACHINE EVALUATED LUMBER (MEL)

Machine evaluated lumber (MEL) is lumber that has been non-destructively evaluated by a grading machine to predict specific mechanical properties.

The grading machine evaluates each piece and marks the piece to a strength classification. MEL shall meet the visual requirements described in this Standard.

Qualification and subsequent quality control are required for each of the following properties; modulus of elasticity (MOE), bending strength (F_b) and tensile strength (F_t).

Specific gravity (SG) qualification and subsequent quality control are required when the SG value exceeds the value assigned to the grade set forth in Table 3.

When a Spruce-Pine-Fir (S-P-F) grade E_g of 2.0E is run in conjunction with a higher E grade(s) then specific gravity (SG) must be quality controlled for the 2.0E grade.

3.3 E-RATED STRUCTURAL LAM LUMBER

E-Rated structural lam lumber is lumber that has been non-destructively evaluated by a grading machine.

E-Rated structural lam lumber is distinguished from visually graded lumber in that each piece is non-destructively tested and marked to indicate the long-span flat-wise grade E (LS E) classification. E-Rated structural lam lumber shall meet the visual requirements as set forth in this Standard and the current edition of the NLGA Standard Grading Rules.

Qualification and subsequent quality control for the long-span flat-wise grade E (LS E) is required for each item.

For E-Rated Structural Lam lumber, moisture content is subject to special agreement.

3.4 MSR/MEL TENSION LAM LUMBER

MEL tension lam lumber is lumber that has been non-destructively evaluated by a grading machine.

MSR/MEL tension lam lumber shall meet all the requirements of this Standard for MSR/MEL tension lam lumber including mandatory qualification and daily control for UTS.

Qualification and subsequent quality control are required for each of the following properties: Edge modulus of elasticity (MOE), long-span flat-wise modulus of elasticity (LS MOE), bending strength (F_b) and tensile strength (F_t).

For MSR/MEL tension lam lumber, moisture content is subject to special agreement.

4.0 GRADE DESCRIPTIONS

MSR lumber grades are designated by an Fb-E_g classification system, where F_b is the assigned bending strength class and E_g is the assigned modulus of elasticity for the grade.

The grades of MSR lumber produced in accordance with this Standard are listed in Table 2.

MEL grades are identified by a grade code that references a specific set of characteristic property values.

The grades of MEL produced in accordance with this Standard are listed in Table 3.

E-Rated structural lam lumber grades are designated by an E-LAM classification system, where the E rating is the average long-span flat-wise E (LS E) value expressed in millions of pounds per square inch.

The grades of E-Rated structural lam lumber produced in accordance with this Standard are listed in Table 4.

MSR/MEL tension lam grades are identified by the MSR, MEL and E-LAM classification system with the addition of the tensile strength (F_t) identification. The grades of MSR/MEL tension lam lumber are listed in Table 2 and Table 3.

Subject to revision of the NLGA Standard Grading Rules (Para. 910 for use in the USA), CSA O86 (for use in Canada) and Tables 2, 3 or 4 of this Standard, MSR, MEL and E-LAM grades may be produced in other characteristic property value combinations provided qualification procedures and subsequent quality control verification assure the assignment is appropriate.

5.0 STANDARD SIZES

Standard thickness and widths for MSR, MEL and E-LAM lumber produced in accordance with this Standard are shown in Table 1. Other thickness and widths may be used upon qualification.

Standard lengths are 6' (1.8 m) and longer in multiples of 1' (0.3 m).

TABLE 1 - STANDARD THICKNESS AND WIDTHS (FROM CSA O141)

Nominal Dimension	Specified Dimension			
	Imperial (inches)		Metric (mm)	
Thickness	**Dry**	**Green**	**Dry**	**Green**
1	¾	25/32	19	20
1-1/4	1	1-1/32	25	26
1-1/2	1-1/4	1-9/32	32	33
2	1-1/2	1-9/16	38	40
Width	**Dry**	**Green**	**Dry**	**Green**
2	1-1/2	1-9/16	38	40
3	2-1/2	2-9/16	64	65
4	3-1/2	3-9/16	89	90
5	4-1/2	4-5/8	114	117
6	5-1/2	5-5/8	140	143
8	7-1/4	7-1/2	184	191
10	9-1/4	9-1/2	235	241
12	11-1/4	11-1/2	286	292

TABLE 2 - CHARACTERISTIC PROPERTY VALUES FOR MSR LUMBER GRADES [1]

TABLE 2a) The following MSR grades do not require tension testing except when used for MSR/MEL tension lam lumber.

MSR GRADES	MEAN MODULUS OF ELASTICITY		MINIMUM MODULUS OF ELASTICITY		MODULUS OF RUPTURE		ULTIMATE TENSILE STRENGTH		COMPRESSION PARALLEL TO GRAIN	
	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)
1200Fb –1.2E	1,200,000	8,274	984,000	6,784	2,520	17.4	1,260	8.7	2,660	18.3
1350Fb -1.3E	1,300,000	8,963	1,066,000	7,350	2,835	19.6	1,575	10.9	3,040	21.0
1450Fb -1.3E	1,300,000	8,963	1,066,000	7,350	3,045	21.0	1,680	11.6	3,088	21.3
1500Fb -1.4E	1,400,000	9,653	1,148,000	7,915	3,150	21.7	1,890	13.0	3,135	21.6
1650Fb -1.5E	1,500,000	10,342	1,230,000	8,481	3,465	23.9	2,142	14.8	3,230	22.3
1800Fb -1.6E	1,600,000	11,032	1,312,000	9,046	3,780	26.1	2,467	17.0	3,325	22.9
1950Fb -1.7E	1,700,000	11,721	1,394,000	9,611	4,095	28.2	2,887	19.9	3,420	23.6
2100Fb -1.8E	1,800,000	12,411	1,476,000	10,177	4,410	30.4	3,307	22.8	3,562	24.6
2250Fb -1.9E	1,900,000	13,100	1,558,000	10,742	4,725	32.6	3,675	25.3	3,658	25.2
2400Fb -2.0E	2,000,000	13,789	1,640,000	11,307	5,040	34.7	4,042	27.9	3,752	25.9
2550Fb -2.1E	2,100,000	14,479	1,722,000	11,873	5,355	36.9	4,305	29.7	3,848	26.5
2700Fb -2.2E	2,200,000	15,168	1,804,000	12,438	5,670	39.1	4,515	31.1	3,990	27.5
2850Fb -2.3E	2,300,000	15,858	1,886,000	13,003	5,985	41.3	4,830	33.3	4,085	28.1
3000Fb -2.4E	2,400,000	16,547	1,968,000	13,569	6,300	43.4	5,040	34.8	4,180	28.8

[1] Specific gravity values are assigned as follows (See Section 3.1 of this Standard):

D Fir-L (N)	**SG values are a function of the grade E** **1.2E to 1.9E SG = 0.49** **2.0E to 2.2E SG = 0.53** **2.3E and higher SG = 0.57**	**S-P-F**	**SG values are a function of the grade E** **1.2E to 1.7E SG = 0.42** **1.8E to 1.9E SG = 0.46** **2.0E and higher SG = 0.50**
Hem-Fir (N)	**SG = 0.46 (all grades)**		

TABLE 2b) The following MSR grades provide a modulus of elasticity level with a corresponding higher strength requirement. For these MSR grades, qualification and daily quality control for tensile strength are required.

MSR GRADES	MEAN MODULUS OF ELASTICITY		MINIMUM MODULUS OF ELASTICITY		MODULUS OF RUPTURE		ULTIMATE TENSILE STRENGTH		COMPRESSION PARALLEL TO GRAIN	
	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)
1400F_b -1.2E	1,200,000	8,274	984,000	6,784	2,940	20.3	1,680	11.6	3,040	21.0
1600F_b -1.4E	1,400,000	9,653	1,148,000	7,915	3,360	23.2	1,995	13.8	3,183	22.0
1650F_b -1.3E	1,300,000	8,963	1,066,000	7,350	3,465	23.9	2,142	14.8	3,230	22.3
1800F_b -1.5E	1,500,000	10,342	1,230,000	8,481	3,780	26.1	2,730	18.8	3,325	22.9
2000F_b -1.6E	1,600,000	11,032	1,312,000	9,046	4,200	28.9	2,730	18.8	3,467	23.9
2250F_b -1.7E	1,700,000	11,721	1,394,000	9,611	4,725	32.6	3,675	25.3	3,658	25.2
2250F_b -1.8E	1,800,000	12,411	1,476,000	10,177	4,725	32.6	3,675	25.3	3,658	25.2
2400F_b -1.8E	1,800,000	12,411	1,476,000	10,177	5,040	34.7	4,042	27.9	3,752	25.9

[1] Specific gravity values are assigned as follows (See Section 3.1 of this Standard):

D Fir-L (N)	**SG** values are a function of the grade E **1.2E to 1.9E SG = 0.49** **2.0E to 2.2E SG = 0.53** **2.3E and higher SG = 0.57**	**S-P-F**	**SG** values are a function of the grade E **1.2E to 1.7E SG = 0.42** **1.8E to 1.9E SG = 0.46** **2.0E and higher SG = 0.50**
Hem-Fir (N)	**SG = 0.46 (all grades)**		

TABLE 3 - CHARACTERISTIC PROPERTY VALUES FOR MEL GRADES [2]

MEL GRADES	MEAN MODULUS OF ELASTICITY		MINIMUM MODULUS OF ELASTICITY		MODULUS OF RUPTURE		ULTIMATE TENSILE STRENGTH		COMPRESSION PARALLEL TO GRAIN	
	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)
M-10	1,200,000	8,274	900,000	6,206	2,940	20.3	1,680	11.6	3,040	21.0
M-11	1,500,000	10,342	1,125,000	7,758	3,255	22.4	1,785	12.3	3,135	21.6
M-12	1,600,000	11,032	1,200,000	8,275	3,360	23.2	1,785	12.3	3,230	22.3
M-13	1,400,000	9,653	1,050,000	7,241	3,360	23.2	1,995	13.8	3,230	22.3
M-14	1,700,000	11,721	1,275,000	8,793	3,780	26.1	2,100	14.5	3,325	22.9
M-15	1,500,000	10,342	1,125,000	7,758	3,780	26.1	2,310	15.9	3,325	22.9
M-18	1,800,000	12,411	1,350,000	9,310	4,200	29.0	2,520	17.4	3,515	24.2
M-19	1,600,000	11,032	1,200,000	8,275	4,200	29.0	2,730	18.8	3,515	24.2
M-21	1,900,000	13,100	1,425,000	9,827	4,830	33.3	2,940	20.3	3,705	25.6
M-22	1,700,000	11,721	1,275,000	8,793	4,935	34.0	3,150	21.7	3,705	25.6
M-23	1,800,000	12,411	1,350,000	9,310	5,040	34.7	3,990	27.5	3,800	26.2
M-24	1,900,000	13,100	1,425,000	9,827	5,670	39.1	3,780	26.1	3,990	27.5
M-25	2,200,000	15,168	1,650,000	11,376	5,775	39.8	4,200	29.0	3,990	27.5
M-26	2,000,000	13,789	1,500,000	10,344	5,880	40.6	3,780	26.1	4,085	28.2

[2] Specific gravity values are assigned as follows (See Section 3.2 of this Standard):

D Fir-L (N)	**SG** values are a function of the grade E **1.2E to 1.9E SG = 0.49** **2.0E to 2.2E SG = 0.53** **2.3E and higher SG = 0.57**	**S-P-F**	**SG** values are a function of the grade E **1.2E to 1.7E SG = 0.42** **1.8E to 1.9E SG = 0.46** **2.0E and higher SG = 0.50**
Hem-Fir (N)	**SG = 0.46 (all grades)**		

TABLE 4 - E-RATED STRUCTURAL LAM & MSR/MEL TENSION LAM LUMBER

LONG SPAN MODULUS OF ELASTICITY				
Grade	Mean Modulus of Elasticity		Minimum Modulus of Elasticity	
	(psi)	(MPa)	(psi)	(MPa)
2.6E LAM	2,600,000	17,926	2,260,000	15,586
2.5E LAM	2,500,000	17,236	2,160,000	14,897
2.4E LAM	2,400,000	16,547	2,060,000	14,207
2.3E LAM	2,300,000	15,858	1,960,000	13,517
2.2E LAM	2,200,000	15,168	1,860,000	12,828
2.1E LAM	2,100,000	14,479	1,770,000	12,204
2.0E LAM	2,000,000	13,789	1,670,000	11,517
1.9E LAM	1,900,000	13,100	1,580,000	10,897
1.8E LAM	1,800,000	12,411	1,480,000	10,207
1.7E LAM	1,700,000	11,721	1,390,000	9,586
1.6E LAM	1,600,000	11,032	1,300,000	8,966
1.5E LAM	1,500,000	10,342	1,210,000	8,345

6.0 VISUAL GRADING REQUIREMENTS

6.1 MACHINE STRESS-RATED LUMBER (MSR)

Machine stress-rated lumber shall be well manufactured and visually graded to limit defined characteristics even though the actual strength may not be affected.

Characteristics and limiting provisions shall be:

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

Insect Holes: Treat the same as NO. 2 dimension lumber.

Manufacture: Standard F (See NLGA Standard Grading Rules, Para. 722f.)

Shake: If through at ends, limited as splits. If away from ends, through shakes up to 2' long, well separated. If not through, single shakes shall not exceed 3' 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' or less in length. See NLGA Standard Grading Rules, Paras. 720 e), f) and g).

Slope of Grain: For grading machines not evaluating slope of grain [(1)], the limitation on the general slope of grain is based on the characteristic MOR value assigned to the grade and are the same as those listed in Table 6.

[(1)] *Machines that measure MOE by deflection indirectly evaluate slope of grain.*

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

Unsound Wood: Limited to a spot 1/12 the width and 2" in length or equivalent smaller.

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

Optional "1W" Wane Limitations: 1/4 the thickness and 1/4 the width full length, or equivalent on each face, provided that wane not exceed 1/2 the thickness or 1/3 width for up to 1/4 the length. See NLGA Standard Grading Rules, Para. 750.

Warp: Light. See NLGA Standard Grading Rules, Para. 752.

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

6.2 MACHINE EVALUATED LUMBER (MEL)

Machine evaluated lumber shall be well manufactured and visually graded to limit defined characteristics even though the actual strength may not be affected.

Characteristics and limiting provisions shall be:

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

Insect Holes: Treat the same as NO. 2 dimension lumber.

Manufacture: Standard F (See NLGA Standard Grading Rules, Para. 722f.)

Shake: If through at ends, limited as splits - away from ends through shakes up to 2' long, well separated. If not through, single shakes shall not exceed 3' long or 1/4 the length, whichever is greater.

Skip: Hit & miss, with a maximum of 5% of the pieces containing hit or miss or heavy skip 2' or less in length. See NLGA Standard Grading Rules, Paras. 720 e), f) and g).

Slope of Grain: For grading machines not evaluating slope of grain [(1)], the limitation on the general slope of grain is based on the characteristic MOR value assigned to the grade and are the same as listed in Table 6.

[(1)] *Machines that measure MOE by deflection indirectly evaluate slope of grain.*

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

Unsound Wood: Limited to a spot 1/12 the width and 2" in length or equivalent smaller.

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

Optional "1W" Wane Limitations: 1/4 the thickness and 1/4 the width full length, or equivalent on each face, provided that wane not exceed 1/2 the thickness or 1/3 width for up to 1/4 the length. See NLGA Standard Grading Rules, Para. 750.

Warp: Light. See NLGA Standard Grading Rules, Para. 752.

White Specks: Firm. 1/3 face or equivalent

6.3 E-LAM LUMBER

E-LAM lumber shall be well manufactured and visually graded to limit defined characteristics even though the actual strength may not be affected.

6.3.1 E-RATED STRUCTURAL LAM LUMBER

Characteristics and limiting provisions shall be:

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

Knots: Knots may be sound, unsound or not firmly fixed. A knot or knots shall not occupy more than 1/2 the cross- section. A knot of the permitted size may be anywhere on the piece.

Holes: Knot holes are interchangeable with knots in size and spacing. Other holes permitted if no more damaging in effect than the allowable knot hole.

Manufacture: Standard C. (See NLGA Standard Grading Rules, Para. 722c.)

Pitch or Bark Pockets: Medium - scattered.

Pitch Streaks: Not to exceed 1/6 the width.

Shake & Splits: Permitted if extending from wide faces into the thickness at an angle of 45 degrees or more from the wide face. Other restrictions are subject to special agreement.

Skip: **Face**: Hit & Miss, with a maximum of 5% of the pieces containing Hit or Miss.

Edge: Hit & Miss, with a maximum of 5% of the pieces containing Hit or Miss, or Heavy skip 2' or less in length (See NLGA Standard Grading Rules, Paras. 720e), f) and g) unless a more restrictive requirement is specified.)

Slope of Grain: For grading machines not evaluating slope of grain [(2)], the edge knot limits the slope of grain as follows:

1/3 displacement and larger:	1 in 10
1/4 displacement and smaller:	1 in 12

[(2)] *Machines that measure MOE by deflection indirectly evaluate slope of grain.*

Stain: Medium stained sapwood. Firm heart stain.

Torn Grain: Medium. Spots of heavy torn grain around knot areas or equivalent.

Warp: Light.

Wane: Not to exceed ¼" on the wide face by ¼" deep or equivalent on the edge unless a more restrictive requirement is specified.

White Specks: Firm. A combination of white speck and a knot in the same cross- section shall not occupy more than 1/2 the width or equivalent.

TABLE 5 - VQL LIMITS FOR LIMITS FOR MSR, MEL AND MSR/MEL TENSION LAM LUMBER

Edge Displacement	Characteristic MOR Value
1/2	1,890 psi & below (0 to 13.0 MPa)
1/3	1,995 psi to 3,045 psi (13.8 MPa to 21.0 MPa)
¼	3,150 psi to 4,305 psi (21.7 MPa to 29.7 MPa)
1/6	4,410 psi & over (30.4 MPa & over)

6.3.2 MSR/MEL TENSION LAM LUMBER

The visual requirements listed in Section 6.3.1 shall apply, except that 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 listed for the characteristic MOR values assigned in Table 5.

Note: *This product is intended to meet the requirements of AITC 117:2015*

6.4 VISUAL QUALITY LEVEL (VQL) FOR MSR & MEL

In addition to the visual limitations listed in Sections 6.1 or 6.2, as applicable, other 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 listed for the characteristic MOR values assigned in Table 5.

6.5 VISUAL GRADING REQUIREMENTS FOR THE UNTESTED PORTIONS OF MACHINE GRADED LUMBER

See Table 7 for the visual requirements for the untested portions of MSR, MEL and MSR/MEL Tension Lam lumber.

TABLE 6 - SLOPE OF GRAIN LIMITS FOR UNTESTED PORTIONS OF MSR AND MEL LUMBER

Slope of Grain	MOE	Characteristic UTS Value
1 in 8	< 1.4	1680 psi and below
1 in 10	1.4 to 1.7	1890 to 2887 psi
1 in 12	> 1.7	3307 psi and over

TABLE 7 - VISUAL REQUIREMENTS FOR THE UNTESTED PORTION OF MSR, MEL & MSR/MEL TENSION LAM LUMBER

The ends of the lumber, not tested by a grading machine, shall be limited as follows:	
Edge Knots	As limited in Section 6.4
Knots Other Than Edge Knots	Equal to the largest knot in the tested portion of the piece or the edge knot permitted in the next lower **Characteristic MOR Value category,** whichever is greater
Cross-Section Knots	The size or displacement of all knots in the same cross-section may not exceed the size of the permitted largest knot as described for **"Knots Other Than Edge Knots"** listed above
Slope of Grain	The limitation on the general slope of grain is based on the characteristic UTS value assigned to the grade and shall not exceed the slope of grain listed in Table 6.
Other Strength Reducing Characteristics	Such as knot holes, burls, distorted grain or decay shall be considered the same as knots.

6.6 ALTERNATE VISUAL QUALITY LEVELS

6.6.1 VISUAL GRADING REQUIREMENTS FOR ESTABLISHING ALTERNATE VISUAL QUALITY LEVELS FOR MSR OR MEL LUMBER

Strength-reducing characteristics larger than those listed in Sections 6.1 and 6.2 may be permitted provided the additional requirements in Section 12.1.2 are followed and ultimate tensile strength (UTS) qualification and daily quality control are performed.

In such cases, the limiting size of the strength-reducing characteristic shall be documented.

6.6.2 ALTERNATE VISUAL QUALITY LEVELS FOR E-RATED STRUCTURAL LAM LUMBER

A facility may elect to qualify E-Rated Structural Lam lumber to a more restrictive VQL than listed in Section 6.3.1. In such cases, strength reducing characteristics such as knots, knot holes, burls and abnormal grain distortion occurring at the edge of the wide faces shall

be qualified and graded to a specific size in relation to the E-LAM grade. In addition, the limiting size of the VQL shall be documented and included on the grade stamp.

(i.e. If a VQL of 1/3 the cross-section is qualified for a 1.9E-LAM grade, then the grade stamp for this product would read 1.9E-LAM-3. The 3 signifies the denominator of the allowable VQL.)

Note: *The inclusion of this provision in this Standard is intended to meet the requirements of AITC 117:2015*

7.0 MECHANICAL PROPERTY REQUIREMENTS

The following requirements shall apply to the characteristic property values listed in Tables 2, 3 and 4. Mechanical property descriptions are described in Appendix III.

7.1 MEAN MODULUS OF ELASTICITY

7.1.1 MSR AND MEL GRADES

The process mean edge bending modulus of elasticity (E) tested in accordance with Section 8.1.1 shall equal or exceed the characteristic mean modulus of elasticity value for the grade E (E_g).

$$E \geq E_g$$

7.1.2 E-LAM GRADES

The process mean long span flat-wise modulus of elasticity (LS E) tested in accordance with Section 8.1.2 shall equal or exceed the characteristic mean long span modulus of elasticity value for the E-LAM grade (E_g).

$$LS\,E \geq E_g$$

7.2 MINIMUM MODULUS OF ELASTICITY

7.2.1 MSR GRADES

The process lower fifth percentile for edge bending modulus of elasticity (E_{5th}) for standard MSR grades tested in accordance with Section 8.1.1 shall equal or exceed 0.82 times the characteristic mean modulus of elasticity value for the grade E (E_g).

$$E_{5th} \geq 0.82\,E_g$$

7.2.2 MEL GRADES

The process lower fifth percentile for edge bending modulus of elasticity (E_{5th}) for MEL grades tested in accordance with Section 8.1.1 shall equal or exceed 0.75 times the characteristic mean modulus of elasticity value for the grade E (E_g)

$$E_{5th} \geq 0.75\,E_g$$

7.2.3 E-LAM GRADES

The process lower fifth percentile for long span modulus of elasticity (E_{5th}) for E-LAM grades tested in accordance with Section 8.1.2 shall equal or exceed the minimum modulus of elasticity values listed in Table 4.

7.3 MODULUS OF RUPTURE

The process lower fifth percentile for edge modulus of rupture (MOR) shall equal or exceed the characteristic bending strength (MOR) value for the grade when subjected to a short-term test load and tested in accordance with Section 8.2.

$$MOR_{5th} \geq MOR_g$$

7.4 ULTIMATE TENSILE STRENGTH (UTS)

7.4.1 MSR GRADES

When ultimate tension strength (UTS) qualification and daily quality control is required, the process lower fifth percentile for tensile strength shall equal or exceed the characteristic ultimate tensile strength (UTS) value for the grade when subjected to a short-term test load and tested in accordance with Section 8.3.

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

7.4.2 MEL AND MSR/MEL TENSION LAM GRADES

Ultimate tension strength (UTS) qualification and daily quality control are required to grade stamp (mark) MEL or MSR/MEL tension lam grades.

The process lower fifth percentile for tensile strength shall equal or exceed the characteristic ultimate tensile strength (UTS) value for the grade when subjected to a short-term test load and tested in accordance with Section 8.3.

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

7.5 SPECIFIC GRAVITY

When qualification and daily quality control for specific gravity (SG) are required, the process mean specific gravity shall equal or exceed the assigned characteristic specific gravity (SG) value for the grade.

8.0 PROPERTY EVALUATION PROCEDURES

The test methods described in this section conform to either ASTM Standards D198 or D2395.

8.1 MODULUS OF ELASTICITY (E)

8.1.1 MSR AND MEL GRADES

Specimens shall be tested on edge using third point loading and a span to depth ratio of 21 whenever possible. The specimen depth is the surfaced dry width as provided in Section 5, Table 1.

If a span to depth ratio of 21 cannot be achieved, the span shall be the maximum span possible. The modulus of elasticity value shall be adjusted to a span to depth ratio of 21 in accordance with Appendix II.

Modulus of elasticity 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 edge which is to be subjected to tension stress, shall be randomly selected.

8.1.2 E-LAM GRADES

Specimens shall be randomly tested flat-wise over a simple span using centre point loading and a span-to-depth ratio of 100, whenever possible. The specimen depth is the surfaced dry thickness as provided in Section 5, Table 1.

If a span to depth ratio of 100 cannot be achieved, the span shall be the maximum span possible.

The support system for testing the grade E shall provide unrestrained support at both ends.

The device used to measure deflection shall be placed at the mid-span of the test span.

Modulus of elasticity 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.

A pre-load of 5 lbs (22.24 N) shall be applied before the long-span E (LS E) test is performed.

Incremental loading should be sufficient to produce approximately 0.2-inch (5 mm) deflection in a specimen with a long-span E of 2.0 million psi (13,789 MPa). Recommended loads are listed in Table 8.

8.2 MODULUS OF RUPTURE (MOR)

Modulus of rupture (MOR) shall be determined by applying a test load that will induce a maximum stress not less than the characteristic bending strength value for the grade under consideration.

Specimens shall be tested on edge using third point loading and a span to depth ratio of 21 whenever possible. The specimen depth is the surfaced dry width as provided in Section 5, Table 1. If a span to depth ratio of 21 cannot be achieved the span shall be the maximum span possible.

The maximum strength-reducing characteristic as determined by visual grading shall be located in the middle third of the test span wherever possible, or as close to the middle third as possible.

For test equipment where the load is applied vertically, when there is more than 5 inches (127 mm) of lumber overhanging beyond either of the reaction supports, the calculated MOR shall be corrected for the weight of the overhanging portions. Corrections are not required provided it can be demonstrated that neglecting the correction ensures a lower MOR value. Corrections are not required where specimens are tested with the load applied in a horizontal direction.

8.3 ULTIMATE TENSILE STRENGTH (UTS)

The ultimate tensile strength (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 not less than 8 feet (2.44 m) wherever the test sample lengths permit.

The maximum strength-reducing characteristic, as determined by visual grading requirements shall be positioned within the test span and, wherever possible, within a minimum of two times the nominal test specimen width away from the grips. In no case shall the strength-reducing characteristic be located partially or wholly within the grips.

The load shall not induce a rate of stress increase that will exceed 4000 pounds per square inch per minute (0.46 MPa/sec).

TABLE 8 - RECOMMENDED E-LAM TEST LOADS

NOMINAL SIZE	LOAD in lbs (N)	NOMINAL SIZE	LOAD in lbs (N)
2x4	10 (45)	**2x10**	15 (70)
2x6	10 (45)	**2x12**	20 (90)
2x8	15 (70)		

8.4 SPECIFIC GRAVITY (SG)

When qualification and quality control for SG are required for a grade, SG shall be measured using procedures such as ASTM D2395 Method A or Method B, or as outlined in Section 8.4.1. The procedures used for qualification and quality control testing shall be described in the quality control manual.

8.4.1 FULL SPECIMEN DENSITY

Specimen dimensions shall be measured at three locations along the specimen and averaged to ensure the accuracy of the volume.

The moisture content shall be determined for each specimen at the time of weighing. Since the SG is derived from the oven dry weight and oven dry volume of the specimen, the SG shall be adjusted to the oven dry basis using the appropriate equation from ASTM D2395, Appendix XI.

If used, moisture meter readings shall be taken at three locations along the specimen and averaged. The readings shall be taken at least 2 feet (600 mm) from either end and in the centre of the wide face.

8.5 ENVIRONMENTAL CONDITIONS

8.5.1 MOISTURE CONTENT

At the time of testing, the moisture content of the specimens shall be measured and recorded.

8.5.2 TEMPERATURE

At the time of testing, the temperature of the specimen and the test equipment shall be between 10^{O} to 30^{O}C (50^{O} to 90^{O}F) inclusive. For temperatures other than those specified herein, it will be mandatory to make corrections for the effect of temperature on the modulus of elasticity (E).

9.0 GRADE STAMPING REQUIREMENTS

For lumber produced in conformance with the requirements of this Standard, the grade stamp (mark) on each piece shall contain the items for each product as noted in Table 9.

When the grade stamp on Machine Graded Lumber includes the designation "1W", it signifies that the lumber has been visually graded to meet or exceed the optional "1W" wane limitations as described in Section 6 of this Standard.

TABLE 9 – GRADE-STAMPING (MARKING) REQUIREMENTS BY MGL PRODUCT

ITEM	MSR (Table 2a)	MSR (Table 2b)	MEL	E -Rated Structural LAM	MSR/MEL Tension LAM	EXAMPLE
Agency Identification	X	X	X	X	X	**CLSAB / ALSC Accredited Agency Identification**
Facility Identification	X	X	X	X	X	**00**
Species or Species Combination	X	X	X	X	X	**S-P-F**
Seasoning Designation	X	X	X	X	X	**S-DRY or KD**
"MACHINE RATED" or "MSR"	X	X	-	-	X *(3)*	**MSR**
"MACHINE EVALUATED" or "MEL"	-	-	X	-	X *(3)*	**MEL**
"E-LAM"	-	-	-	X	X	**E-LAM**
MEL Grade Code	-	-	X	-	-	**M-10**
LS E Rating	-	-	-	X	X	**2.0E-LAM**
MSR Grade	X	X	X	-	X	**2400Fb-2.0E or 2400Fb 2.0E or 2400Fb 2.0E**
F_t Rating	Optional	X	X	-	X	**1925Ft**
Specific Gravity *(1)*	Optional	Optional	Optional	Optional	Optional	**0.50 SG**
Alternate VQL *(2)*	Optional	Optional	Optional	Optional	Optional	**1.9E-LAM-3**
Optional 1W wane *(4)*	Optional	Optional	Optional	-	-	**1W**

(1) When the value is higher than the assigned value for species or grade.

(2) The maximum VQL if the requirements of Section 6.6 are met.

(3) Either MSR or MEL

(4) When 1W wane limitations are met

***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

10.0 EQUIPMENT

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

10.1 GRADING MACHINE

A grading machine (if applicable) shall be of a make and model for which Agency application to the Canadian Lumber Standards Accreditation Board (CLSAB) has been made and approval has been granted.

10.2 QUALITY CONTROL TEST EQUIPMENT

The test equipment shall be capable of accurately measuring the mechanical properties described in PART A of this standard. An independent calibration laboratory shall calibrate the test equipment.

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

10.2.1 MOE TEST EQUIPMENT ACCURACY

The test span and the location of the load points shall be capable of being set to within $\pm^{1}/_{16}$ inch (1 mm). The device used to measure deflection shall be capable of measuring to the nearest 0.001 inch (0.01 mm).

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

The load shall be applied through a crosshead. The rate of crosshead movement shall not exceed 5 inches per minute (2 mm/second) during specimen testing.

10.2.2 MOR TEST EQUIPMENT

The test span and location of the load points shall be capable of being set to within $\pm^{1}/_{16}$ inch (1 mm).

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

The load shall be applied through a crosshead. The rate of the crosshead movement shall not exceed 5 inches / minute (2 mm/second) during specimen testing.

10.2.3 UTS TEST EQUIPMENT

The test span shall be set to within ±3 inches (75 mm) of the specified test span.

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

The rate of load application shall not exceed 4000 psi/minute (0.46 MPa/second) during specimen testing.

10.2.4 SG TEST EQUIPMENT

The specimen dimensions shall be measured to within ±0.3% of the actual thickness, width and length. The specimen weight shall be measured to within ±0.2% of the actual full weight or ±0.1% of the actual half-weight.

10.2.5 E-LAM LUMBER TEST EQUIPMENT

The device used to measure deflection shall be capable of measuring to the nearest 0.001 inch (0.01 mm).

The E-LAM test equipment shall be capable of testing at a span to depth ratio of 100.

Note: *The support system should be capable of accommodating twisted lumber.*

Weights for pre-load and deflection measurements shall be accurate to within ±0.05 lbs (0.22 N). The weight shall be chosen to provide a precision of ±1% or better at an E value of 2.0 million psi (13,789 MPa).

Note: *Dynamic E equipment (ie. E-computer) can be used for daily quality control in lieu of the load/deflection method described in Section 8.1.2 provided it can be demonstrated that the results of the tests using the dynamic E equipment are consistent with results using the load/deflection method described above.*

11.0 QUALITY CONTROL MANUAL (PLANT STANDARD)

11.1 PREPARATION, REVISION AND APPROVAL

Each facility shall:

a) Prepare a Quality Control (QC) Manual in compliance with this Standard and shall submit the QC Manual to the Agency for approval;

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

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

11.2 CONTENTS

11.2.1 GENERAL

The QC Manual shall:

a) Define 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. Their relationships shall be shown on organizational charts;

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

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

i) Identify and record non-conformance to quality;

ii) Recommend or provide solutions through designated positions in the organization;

iii) Confirm implementation of solutions; and

iv) Oversee further processing of a non-conforming item(s) until the deficiency or unsatisfactory condition has been corrected.

11.2.2 AGENCY

The QC Manual shall identify the Agency.

11.2.3 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;

b) Test equipment operation 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. .

12.0 QUALIFICATION AND SAMPLING REQUIREMENTS

12.1 INITIAL QUALIFICATION

12.1.1 GENERAL

A facility requesting initial qualification shall provide the Agency with evidence that all the requirements of Part A of this Standard 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 its QC Manual;

b) The facility personnel possess ability to undertake the requirements described in Section 11.2.3; and

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

12.1.2 QUALIFICATION REQUIREMENTS FOR AN ALTERNATE VQL

a) To qualify an alternate VQL that is larger than those listed in Section 6, a maximum VQL shall be specified that has the potential of being qualified. Prior to selecting the qualification samples, six (**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 six (**6**) specimens shall satisfy the required tension test load for the grade under consideration.

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

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

12.1.3 QUALIFIED ITEM(S)

Each item shall be qualified before issuing grade stamps (marks). Grades shall be qualified in the grade combination in which they will be produced.

12.2 QUALIFICATION SAMPLING

The Agency Supervisor shall select a minimum of fifty-three (**53**) machine-graded specimens. The specimens shall be representative of the item to be qualified. Each specimen shall meet the visual requirements of Section 6 of this Standard for the grade being qualified.

Note: *At the discretion of the Agency supervisor, specimens rejected from a higher grade may be permitted in the **53**-specimen sample provided the supervisor confirms that the specimens have been rejected due to visual override.*

When ultimate tensile strength (UTS) qualification is required, an additional fifty-three (**53**) machine-graded specimens shall be selected. These samples shall meet the visual requirements of Section 6 of this Standard for the grade being qualified.

The Agency Supervisor shall confirm the visual grade of all specimens in this sample rejected from a higher grade due to visual override.

A maximum of three (**3**) additional samples to increase the total of specimens to **78**, **102** or **125** may be selected to qualify the minimum modulus of elasticity, modulus of rupture (MOR) and/or tensile strength.

When MSR/MEL tension laminations lumber is to be qualified, long-span MOE shall be qualified using either the fifty-three (**53**) specimen sample selected for the edge E test or the fifty-three (**53**) specimen sample selected for the UTS tests (if applicable) or a separate fifty-three (**53**) specimen sample may be generated.

The long-span E testing shall be performed before any MOR or UTS test are conducted.

When specific gravity is to be qualified, the specific gravity shall be determined for each specimen from the fifty-three (**53**) specimen bending samples prior to conducting the MOR test.

Note: *The minimum sample sizes and decision rules are based on non-parametric estimates of the lower tolerance limit for the population 5th percentile at a 75% confidence level.*

12.3 QUALIFICATION TESTING

Table 10 designates the properties for which qualification and daily quality control are required for each category of Machine Graded Lumber.

All testing shall be performed in accordance with the procedures described in Section 8.0 of this Standard.

12.4 ANALYSIS OF QUALIFICATION TESTS

Results of the all required tests shall determine whether grade stamps (marks) will be issued for each item qualified.

For strength evaluations, specimens that satisfy the test load without fracture or with only partial failure shall be deemed to meet the test requirements. The test load shall be recorded.

If a specimen fails before the test load has been achieved, the load at failure shall be recorded.

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

a) The mean modulus of elasticity of the **53**-specimen sample, equals or exceeds E_g minus 0.258 times the sample standard deviation when edge E or long-span E is qualified; and

b) The minimum modulus of elasticity:

- **i)** for MSR grades (Table 2), not more than **1** of the specimens have a modulus of elasticity value less than 82% of E_g ; or
- **ii)** for MEL grades (Table 3), not more than **1** of the specimens have a modulus of elasticity value less than 75% of E_g ; or
- **iii)** for E-rated structural lam grades, not more than **1** of the specimens have a long-span modulus of elasticity value less than the minimum E values listed in Table 4; or
- **iv)** for MSR/MEL tension lam grades not more than **1** of the specimens have a long-span modulus of elasticity value less than the minimum E values listed in Table 4 and not more than **1** of the specimens have an edge modulus of elasticity value less than 82% of E_g listed in Table 2 or 3, as applicable; and

c) When MOR evaluation is required, not more than **1** of the specimens have a modulus of rupture less than the characteristic MOR value;

d) When tensile strength evaluation is required, not more than **1** of the specimens have a tensile strength less than the characteristic UTS value; and

e) When specific gravity is to be qualified, the mean specific gravity of the **53**-specimen sample equals or exceeds 0.98 times the grade characteristic SG.

When the additional sampling procedure referred to in Section 12.2 is used to qualify for minimum modulus of elasticity, modulus of rupture or, when required, tensile strength, the number of specimens in Clauses b), c) and d) above shall not exceed **2** in a **78**-specimen sample, **3** in a **102**-specimen sample or **4** in a **125**-specimen sample.

When the test results do not meet the above requirements, the facility may elect to qualify at a lower grade of the same visual quality level.

Alternatively, adjustments to the grading machine settings may be made. New samples shall be selected and tested until the above requirements are satisfied.

12.5 INCREASED (DOUBLE) SAMPLING FOLLOWING QUALIFICATION

Immediately following qualification, increased (double) sampling shall be performed on the grades qualified. Test results shall satisfy the quality control requirements of this Standard.

TABLE 10 - PROPERTY TEST REQUIREMENTS FOR QUALIFICATION AND DAILY QUALITY CONTROL FOR EACH MGL PRODUCT

Property	MSR (Table 2a)	MSR (Table 2b)	MEL	E-Rated Structural LAM	MSR/MEL Tension LAM
Average Edge E	X	X	X	-	X
Min Edge E	X	X	X	-	X
Average Long-span E	-	-	-	X	X
Min Long-span E	-	-	-	X	X
Bending Strength (MOR)	X	X	X	-	X
Tensile Strength (UTS)	Optional	X	X	-	X
Alternate VQL	Optional	Optional	Optional	Optional	Optional
Specific Gravity	Optional	Optional	Optional	Optional	Optional
Note: *If the "optional" items are marked on the grade stamp, the facility must follow additional quality control procedures.*					

12.6 SUBSEQUENT QUALIFICATION

Separate qualification tests are required for each new item for which grade stamps (marks) are desired. When a facility qualified to produce a given grade or grade combination wishes to add a new grade, the following tests shall be performed:

a) Qualification tests on the new grade;

b) Intensive sampling on the adjacent lower grade of the existing combination; and

c) Increased (double) sampling, following qualification of the new grade, on both the new grade and the adjacent lower grade of the existing combination.

For Clauses b) and c) above, test results shall meet the quality control requirements of this Standard.

12.7 MACHINE ADJUSTMENT (FINE-TUNING) FOLLOWING QUALIFICATION

Upon qualification of an item, the grade boundary settings of the grading machine may be adjusted as follows:

a) Agency notification is required when adjustments consist of lowering the settings.

b) Intensive sampling shall be performed on the grade for which the boundary settings were lowered and for the adjacent lower grade. Test results shall satisfy the quality control requirements of this Standard.

c) When adjustments consist of lowering the settings by more than 3%, singular or cumulatively within any three consecutive production shifts, then increased (double) sampling shall be performed on the grade for which the boundary settings were lowered, and the adjacent lower grade being selected in combination.

12.8 NON-PRODUCTION OF QUALIFIED GRADES

When a facility does not produce a particular MSR, MEL, or E-LAM grade (s) for a period exceeding one year, subsequent production of that grade shall only be permitted after intensive sampling is performed on the grade. The test results shall satisfy the quality control requirements of this Standard.

When a qualified facility does not produce any MSR, MEL, or E-LAM lumber for a period exceeding one year, item(s) in the start-up grade combination shall be subject to qualification testing and increased sampling, and all other grade combinations shall be subject to intensive and increased sampling. The Agency shall be satisfied that the requirements of Section 12.1.1 are met prior to start-up of production.

12.9 NOTIFICATION REQUIREMENTS FOR DISCONTINUANCE OF QUALITY CONTROL PROCEDURES

When a grade has been qualified under the procedures for quality control of tensile strength, specific gravity or alternate VQL's, discontinuance of the procedure requires written notification from the facility to the Agency at least one week prior to the action being taken.

12.10 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.

13.0 EQUIPMENT CALIBRATION

Records of all calibration and spot-check verifications shall be maintained for at least six (6) years.

13.1 GRADING MACHINE

A grading machine shall be calibrated in accordance with 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 four (**4**) hours of grading machine operation or as prescribed by the grading machine manufacturer thereafter;

c) After any adjustment to the grading machine; and

d) After any maintenance to the grading machine.

13.2 TEST EQUIPMENT

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

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 and this Standard.

The test equipment shall be spot-checked in accordance with procedures set forth in the QC Manual and with the applicable sections in ASTM E4, ASTM E83 and/or other applicable nationally recognized standards.

Note: *Along with the listed standards, there are other acceptable test standards and procedures for calibrating measuring devices and equipment. These standards must be nationally recognized and acceptable to CLSAB.*

Spot-checks shall be performed at a frequency level listed in Table 11 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, which may result in a re-calibration of the test equipment or spot-check devices by an independent calibration laboratory.

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.

TABLE 11 - TEST EQUIPMENT SPOT-CHECK FREQUENCY

Equipment	Minimum Spot-Check Frequency
Bending Proof Loader	At least once a shift with a proof bar and once a week with a proof ring or load cell.
Tension Tester	At least once a week
Other Test Equipment	As per manufacturer's specifications

13.2.1 INDEPENDENT CALIBRATION LABORATORY REPORTING REQUIREMENTS

The report of the independent calibration laboratory must 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 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.

13.3 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.

14.0 QUALITY CONTROL REQUIREMENTS

14.1 QUALITY CONTROL PROCEDURES

The quality control procedures described herein are intended to detect non-conformance. All properties required to be qualified under Section 12.0 must be quality controlled.

This Standard utilizes the Cumulative Sum (CUSUM) control chart method as one method of maintaining statistical control of a process. The criterion is based on using all the data and not just the last few samples. 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 described in this Standard are based on the CUSUM method. CUSUM parameters are included in APPENDIX IV.

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

14.2 QUALITY CONTROL SAMPLING

14.2.1 SAMPLING METHOD

The Agency shall approve the sampling method. Specimens shall be sampled from grade stamped (marked) production.

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

14.2.2 SAMPLING FREQUENCY

A minimum of one five (**5**) specimen sample for each period of four (**4**) hours or less of production shall be selected and tested for modulus of elasticity and modulus of rupture for MSR and MEL grades and long-span E for E-LAM grades.

When tensile strength evaluation is required, an additional five (**5**) specimen sample shall be obtained for each period of four (**4**) hours or less.

When specific gravity evaluation is required, the specimen density shall be determined for each specimen in the sample selected for MOE and MOR evaluation.

14.3 QUALITY CONTROL TESTING

Testing for modulus of elasticity, modulus of rupture and, as required, tensile strength and specific gravity, shall be performed in accordance with the procedures described in PART A, Section 8.0 of this Standard.

14.4 ANALYSIS OF QUALITY CONTROL TESTS

Test results shall be entered on Agency approved control forms. The control forms shall be designed so that the properties qualified under Section 12.4 are recorded and "**IN-CONTROL**" and "**OUT-OF-CONTROL**" situations shall be readily detectable.

14.4.1 IN-CONTROL

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

14.4.2 OUT-OF-CONTROL (ALSO SEE APPENDIX V)

The requirements of this section relate to the conditions described in APPENDIX V.

When any of the process properties described in Section 14.4.1 goes **OUT-OF-CONTROL**, the item from which the quality control sample was drawn shall be held pending results of the following tests:

a) Visual grade;
b) Moisture content;
c) Calibration of the grading machine;
d) Grade boundary settings; and
e) Spot-check of the test equipment.

The results of the tests shall determine the course of action that shall be taken in the following manner:

RESULT A

When the accuracy of the visual grade, moisture content and all equipment calibrations/spot-checks are confirmed, intensive 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 MSR, MEL or E-LAM lumber 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.

RESULT B

When the accuracy of the visual grade or the moisture content is found in error and all equipment calibrations/spot-checks have been confirmed, the facility has the option of either immediately re-grading the held item for visual grade and/or moisture content or performing intensive sampling on the held item.

When the intensive 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.

Intensive sampling shall be performed on the residual of the re-graded MSR, MEL or E-LAM lumber 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 go to either **ACTION 1** or **ACTION 2,** as applicable.

RESULT C

When the grading machine calibration or test equipment spot-check is 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 five (**5**)-specimen sample shall be selected and tested from the held item.

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

When the test results confirm that the "**IN-CONTROL**" requirements have been regained, the production of MSR, MEL or E-LAM lumber 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 go to either **ACTION 1** or **ACTION 2,** as applicable.

ACTION 1

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

When the test results confirm that the "**IN-CONTROL**" requirements have been regained, MSR, MEL or E-LAM production may resume, and the held item shall be evaluated in accordance with **ACTION 3** if the equipment calibration/spot-check needed adjustment.

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

ACTION 2

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 (marks) shall be obliterated from the MSR, MEL or E-LAM lumber.

Only after appropriate action has been taken to correct the process and intensive 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 continued production of the item.

ACTION 3

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 required adjustment, the held item shall be considered to comply with the mechanical property requirements of this Standard; or

b) When the grading machine calibration is adjusted by more than 2%, intensive 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 MSR, MEL or E-LAM lumber.

14.5 IDENTIFICATION AND TRACEABILITY

Each package of MSR, MEL or E-LAM lumber leaving the facility production line shall be identified with the time and date it left the production line.

The reason for this is traceability of an item in the event that further testing is required or in the event of an "**OUT-OF-CONTROL"** condition.

14.6 QUALITY CONTROL RECORDS

Facility quality control records shall include:

a) Grading machine calibration and maintenance data (if applicable);

b) Test equipment calibration, spot-check and maintenance data;

c) Grade boundary settings and subsequent changes to the grade level boundary settings;

d) Quality control tests;

e) All MSR, MEL and E-LAM production stoppages as a result of quality control requirements and a report of the corrective actions taken; and

f) A record of the temperature near the test equipment at the time of the spot checks.

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

All records shall include the date when performed and shall be retained for at least six (**6**) years.

These records shall be made available to the Agency upon request.

15.0 RE-INSPECTION PROVISIONS

15.1 GENERAL

Response to complaints on MSR lumber, MEL or E-LAM involving visual grade, size, moisture content, tally 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 Standard Grading Rules (See Section 1.2 of this Standard).

Note: *For E-LAM lumber, moisture content, surfacing and wane provisions may be subject to special agreement between the buyer and seller. Specifications for these provisions should be defined in the contract prior to the purchasing of E-LAM lumber.*

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 sample sizes and conformance requirements are provided in Table 12 for MSR Lumber, E-LAM and MSR tension lam lumber, and in Table 13 for MEL and MEL tension lam lumber.

In cases of complaints pertaining to conformance to assigned design values, an **80**-specimen sample representing the item shall be randomly selected.

The properties, for which conformance are required shall include: the mean flexural stiffness and the minimum flexural stiffness. Testing and reporting of the modulus of elasticity for computing flexural stiffness shall meet the requirements of APPENDIX I. Testing shall be performed in accordance with PART A, Section 8.0 of this Standard.

Since a change in the moment of inertia (I) due to shrinkage and swelling of lumber is largely offset by changes in modulus of elasticity (E), changes to flexural stiffness (EI), in the range of 12 to 18 percent moisture content are considered to be insignificant for the purposes of re-inspection.

When tests show that an item is in non-conformance, all re-inspection and testing costs shall be borne by the seller and the item shall become the property of the seller. If tests show that the item is in conformance, these costs shall be borne by the buyer and the item shall be the property of the buyer.

When a complaint involves more than one item in a shipment, re-inspection and testing costs shall be borne proportionally to the volume of non-conforming items in the entire shipment.

The original grade stamp (mark) shall be obliterated from non-conforming lumber.

TABLE 12 - CONFORMANCE CRITERIA FOR MSR, E-LAM & MSR TENSION LAM LUMBER RE-INSPECTION

PROPERTY	SAMPLE SIZE	CONFORMANCE CRITERIA
Mean E (E or LS E, as applicable)	**80 Specimens**	The mean value of the sample E shall equal or exceed 0.97 times the assigned grade E value.
Min E		**For MSR**: Not more than **6** specimens have an E value less than 0.82 times the assigned grade E value. **For E-LAM & MSR Tension Lam**: Not more than **6** specimens have a long-span E of less than the minimum MOE values listed in Table 4.

TABLE 13 - CONFORMANCE CRITERIA FOR MEL & MEL TENSION LAM RE-INSPECTION

PROPERTY	SAMPLE SIZE	CONFORMANCE CRITERIA
Mean E (E or LS E, as applicable)	**80 Specimens**	The mean value of the sample E shall equal or exceed 0.97 times the assigned grade E value.
Min E		**For MEL**: Not more than **6** specimens have a grade E value less than 0.75 times the assigned grade E value. **For MEL Tension Lam**: Not more than **6** specimens have a long-span E of less than the minimum MOE values listed in Table 4.

PART C – EUROPEAN UNION EXPORT REQUIREMENTS FOR MACHINE GRADED LUMBER

16.0 EU EXPORT REQUIREMENTS FOR MGL

For Machine Graded Lumber (MGL) graded in accordance with PARTS A & B of this Standard to be in compliance with European Standards legislation and to be able to apply a CE mark to MGL, producers must meet the additional requirements referenced below.

16.1 REFERENCED PUBLICATIONS

EN 336 Structural timber – Coniferous and poplar – Sizes, permissible deviations

EN 338 Structural timber – Strength classes

EN 384 Structural timber – Determination of characteristic values of mechanical properties and density

EN 408 Timber structures – Structural timber and glued laminated timber – Determination of Some Physical and Mechanical Properties

EN 14081-1 Timber structures – Strength Graded Structural Timber with Rectangular Cross Section – Part 1: General Requirements

EN 14081-2 Timber structures - Strength Graded Structural Timber with Rectangular Cross Section - Part 2: Machine Grading - Additional requirements for initial type testing.

EN 14081-3 Timber structures - Strength Graded Structural Timber with Rectangular Cross Section – Part 3: Machine Grading – Additional Requirements for Factory Production Control.

16.2 VISUAL GRADES REQUIREMENTS

All sections of PART A, Section 6 shall apply except for those specific Sections listed in PART C that exceed the NLGA minimum requirements.

16.2.1 SIZE TOLERANCES

In EN 336, provisions are made for dimensional deviation within two tolerance classes. These tolerances are provided in Table 14.

TABLE 14 - EU SIZE TOLERANCES

Thickness & Widths	Tolerance Class 1	Tolerance Class 2
≤ 100 mm	(+3, -1) mm	(+1, -1) mm
>100 mm	(+4, -2) mm	(+1.5, -1.5) mm
Note: *The Tolerance Class to which the lumber has been produced should be indicated on the contract documents. NLGA provisions shall apply to dressed lumber.*		

16.2.2 MEASUREMENT

For the purpose of determination of cross-section deviations for lumber ordered to Tolerance Class 1 or 2, the reference moisture content is taken at 20% MC.

The term "Target Size" may appear on order contracts. The EN 336 clause 3.1 definition for "Target Size" is: "Size used to indicate the size desired (at 20% moisture content), and to which the deviations, which would ideally be zero are to be related."

16.2.3 BIOLOGICAL CHARACTERISTICS

No active insect infestation permitted. Wood wasp holes are not permitted.

16.2.4 UNSOUND WOOD AND DOTE

Unsound wood and dote (excluding white specks) not permitted in NO. 2 & higher grades.

16.2.5 WANE

The maximum wane permitted shall not reduce the edge and face dimensions to less than 2/3 of the basic dimensions of the piece.

Note: *can also be stated as: the maximum wane permitted shall not exceed 1/3 the thickness and 1/3 the width.*

16.2.6 DISTORTION (WARP)

The maximum limits for distortion (warp) are provided in Table 15. The maximum distortion is measured over 2 m of length.

TABLE 15 - EU DISTORTION

Distortion Type	Maximum permissible distortion for each Strength Class	
	C18 and below	Above C18
Bow	20 mm	10 mm
Spring (Crook)	12 mm	8 mm
Twist	2 mm per 25 mm width	1 mm per 25 mm width
Cup	As per NLGA Grade Rules for the grade	

16.2.7 FISSURES (SHAKE, CHECKS AND SPLITS)

Fissure limits are specified in Table 16.

TABLE 16 - EU FISSURES (SHAKE, CHECKS AND SPLITS)

Strength Class as per EN 338		C18 and below	Above C18
Maximum permitted length of fissures	**Fissures – Not going through the thickness**	Not greater than 1.5 m or ½ the length of the piece, whichever is the lesser	Not greater than 1 m or ¼ the length of the piece, whichever is the lesser
	Fissures Going through the thickness	Not greater than 1 m or ¼ the length of the piece, whichever is the lesser. If at the ends, a length not greater than 2 times the width of the piece	Only permitted at the ends with a length not greater than the width of the piece
Note: *Fissures less than half the thickness may be ignored*			

16.2.8 ABNORMAL DEFECTS

Where the reduction in strength caused by the abnormal defect is obviously less than caused by other defects permitted, the piece may be accepted provided the defect is of a type that will not increase after conversion and drying.

16.3 FACTORY PRODUCTION CONTROL (FPC) AND DECLARATION OF PERFORMANCE (DoP)

Once compliance is established in accordance with Sections 6.3 and ZA.2.2 of EN 14081-1 and the certificate of conformity of the FPC has been issued by the Agency accredited by the Notified Body, each individual mill shall draw up and retain applicable Declarations of Performance (DoP).

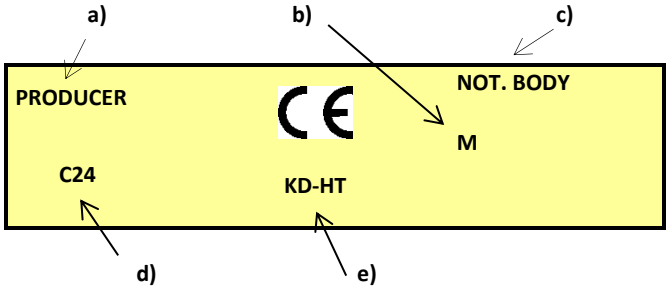
16.4 GRADE STAMP REQUIREMENTS

In order to distinguish NLGA structural lumber that complies with the additional EN 14081-1 requirements from NLGA structural lumber that complies to only CLSAB/ALSC requirements, it is necessary that:

In addition to the grade stamp information required under Section 9 of this Standard, a grade stamp is required to identify lumber graded in accordance with EN 14081-1 and shall include the minimum information shown in Figure 1.

FIGURE 1 – EXAMPLE OF THE MINIMUM CE MARKING GRADE MARK REQUIREMENTS

Figure 1 is an example of the minimum information required on a CE grade mark for untreated machine graded timber (from EN 14081-1).

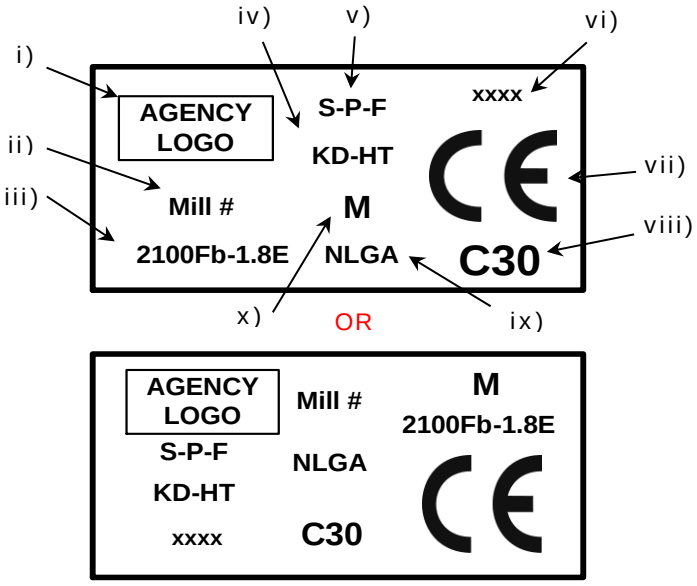


- **a)** Producer identification;
- **b)** Symbol 'M' to signify machine graded;
- **c)** Identification number of Notified Body;
- **d)** Strength class (e.g. C24) or grade and grading standard; and
- **e)** Seasoning symbol 'DG' or alternative symbol [(1)].

[(1)] ***Note:*** *"KD" is acceptable for lumber dried prior to grading so that the requirements related to dry-graded lumber are fully met but must be defined by the manufacturer in the documentation accompanying the product.*

16.4.1 ITEMS THAT MUST APPEAR ON CLSAB ACCREDITED AGENCY / NLGA MEMBER GRADE STAMP FOR CE MARKING

FIGURE 2 – EXAMPLES OF MGL - EU EXPORT GRADE STAMP



Where:

- **i)** Agency logo (CLSAB/ALSC accredited Agency);
- **ii)** Mill number;
- **iii)** Grade (e.g. 2100Fb-1.8E);
- **iv)** Moisture Condition (e.g. KD-HT or S-GRN-HT);
- **v)** Species (e.g. S-P-F);
- **vi)** Notified Body number;
- **vii)** CE Logo;
- **viii)** Strength Class (e.g. C30);
- **ix)** Grading rule (i.e. NLGA); and
- **x)** The letter 'M' to signify that the lumber is 'Machine Graded'.

16.5 GRADE & STRENGTH CLASS DESIGNATIONS

Table 17 identifies the North American softwood species and grade combinations which satisfy the requirements for various EN 338 strength classes for lumber graded in accordance with this Standard.

TABLE 17 - EU STRENGTH CLASS DESIGNATIONS

Strength Class (1)	C16	C20	C24
MGL Grade	1200Fb-1.2E	1450Fb-1.3E	1650Fb-1.5E
Strength Class (1)	C27 (2)	C30 (3)	C35
MGL Grade	1800Fb-1.6E	1950Fb-1.7E 2100Fb-1.8E 2400Fb-2.0E	2700Fb-2.2E
(1) **Note:** *Strength class allocations are only applicable to the D Fir-L (N), Hem-Fir (N) and S-P-F species combinations:*			
(2) **Note:** *2x3 (38 x 64) 1800fb-1.6E is allocated to strength class C24*			
(3) **Note:** *2x3 (38 x 64) 1950fb -1.7E is allocated to strength class C27*			

16.6 RECORDS

All records shall be kept for at least ten (10) years.

16.7 ADDITIONAL QUALIFICATION (EN 14081-2) & QUALITY CONTROL REQUIREMENTS (EN 14081-3)

16.7.1 QUALIFICATION SAMPLING & TESTING

a) Proof load to F_b

Specimens shall be tested edgewise with the tension edge selected at random and the estimated weakest cross section positioned where possible within the centre third of the span. (The 21 span to depth ratio in SPS 2 meets the span to depth ratio of 18±3 of EN 408).

b) Determine the Actual Modulus of Elasticity (E_p)

In accordance with Clause 10 in EN 408, by measuring the deflection at the span centre relative to the supports, with the tension edge selected at random and the estimated weakest cross section positioned where possible within the centre third of the span. (The 21 span to depth ratio in SPS 2 meets the span to depth ratio of 18±3 of EN 408).

c) Rate of Applied Stress:

The Rate of Applied Stress shall be 110 N/mm^2/min. If more than one strength class is to be graded in one pass through the machine in production, then these classes shall also be graded in one pass to obtain specimens for the assessment tests.

Note: *Rate of applied stress 110 N/mm^2/min is significantly slower than SPS 2. It's also not an upper limit. To be equivalent, SPS 2 will need, for example, to specify cross-head speeds of 2.5"/min for 1450f-1.3E and 1.7"/min for 2400f-2.0E*

APPENDICES

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) shall be determined in accordance with *ASTM D198 Standard Method of Static Test of Timbers in Structural Sizes*. The modulus of elasticity data shall be adjusted to 15% moisture content, and to a 21 to 1 span-to-depth ratio, which is in accordance with the Standard *ASTM D2915 Standard Methods for Evaluating Allowable Properties for Grades of Structural Lumber*.

APPENDIX II - CORRECTION FACTORS FOR EDGE MODULUS OF ELASTICITY

In cases where the length of the test specimen is such that only a span to depth ratio of less than 21 is possible, the following correction factors shall be applied to the edge modulus of elasticity. For span-to-depth ratios between 10 and 21, other than those in Table 18, factors can be obtained by linear interpolation.

TABLE 18 - CORRECTION FACTORS FOR MOE

Correction Factors for Edge Modulus of Elasticity	
Span to Depth Ratio	**Multiply MOE Value by: (1)**
20	1.003
19	1.007
18	1.012
17	1.017
16	1.023
15	1.032
14	1.041
13	1.053
12	1.069
11	1.086
10	1.113

(1) Values adapted from ASTM D2915, Section X4.

APPENDIX III - MECHANICAL PROPERTY DESCRIPTIONS

The fibre stress in bending (F_b) is derived from the lower fifth percentile of short-term bending strength assigned to a MSR grade. The F_b is indicated by a value in pounds per square inch preceding the symbol F_b. The E_g is the mean modulus of elasticity assigned to the MSR grade. The E_g is indicated by a value in units of one million pounds per square inch, followed by the symbol "**E**". The tensile strength (F_t) is derived from the lower fifth percentile of short-term tensile strength assigned to the MSR grade. The F_t is indicated by a value in pounds per square inch preceding the symbol F_t.

The **E** rating is the rated modulus of elasticity in millions of pounds per square inch for the grade when measured on edge.

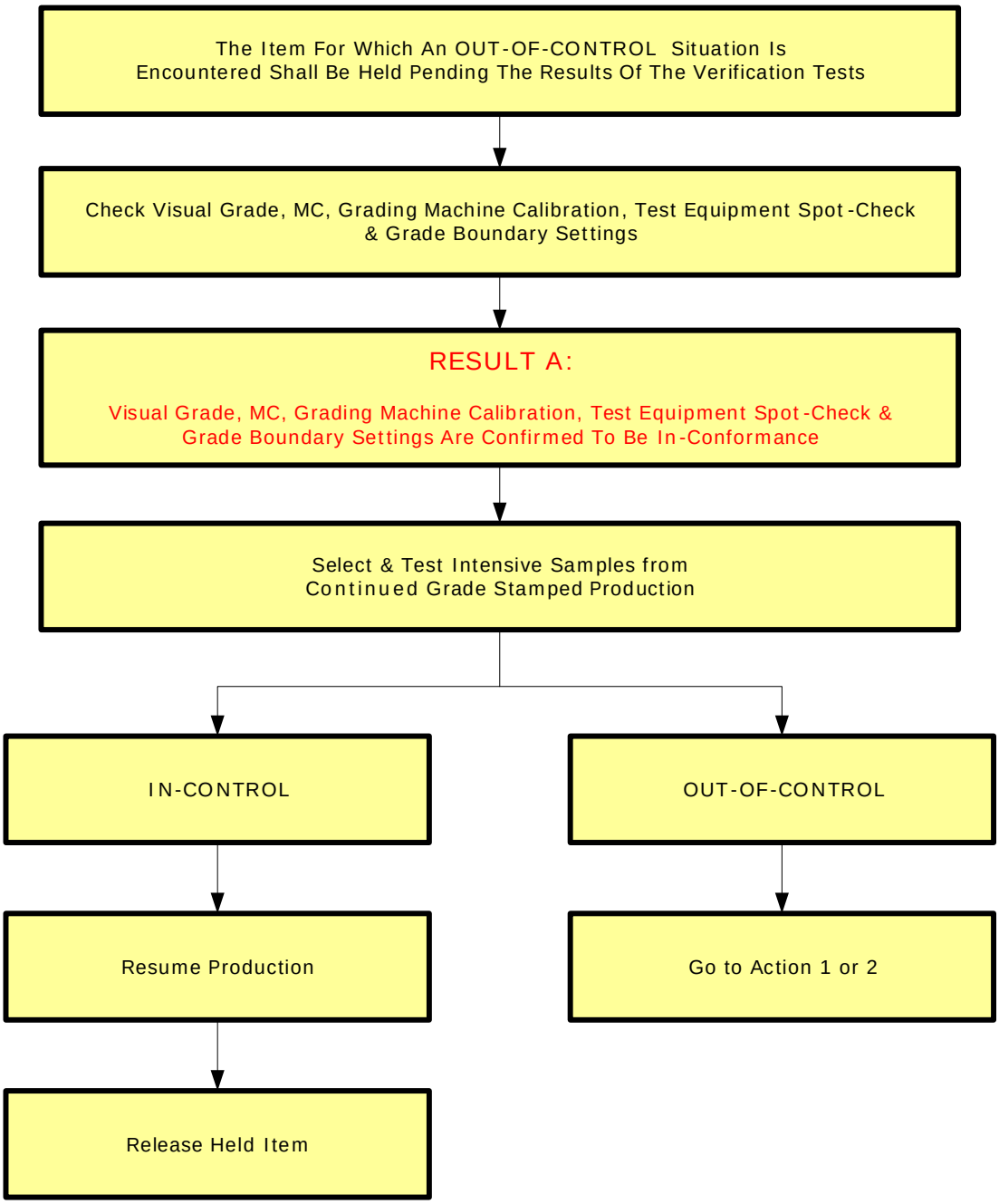
Grading machines are adjusted so that the mean E of the output will equal or exceed the E level shown on the grade mark. F_b indicates the fibre stress in bending applicable to lumber loaded on edge. Fibre stress in bending design values are based on the correlation of the modulus of rupture to E. Grading machine output is controlled by testing pieces and adjusting the grading machine so that the minimum assigned fibre stress in bending value, derived from a 5% exclusion level of modulus of rupture is met after applying the same reduction factors as are applied to visually graded lumber in accordance with ASTM D245. Design values in Tables 2 and 3 for compression parallel to grain (F_{cll}) and (F_t) are based on the testing of MSR lumber. Horizontal shear (F_v) values for MSR lumber and MEL are the same as assigned by ASTM methods to visually graded No. 2 lumber of the appropriate species or species combination

APPENDIX IV - CUSUM PARAMETERS

E Value ($\times 10^6$)	E Designation	W			X	Y	Z
		MSR	MEL	E-LAM			
1.2E	120	98	90	-	1150	120	333
1.3E	130	107	98	-	1250	141	356
1.4E	140	115	105	-	1350	163	378
1.5E	150	123	113	121	1450	186	402
1.6E	160	131	120	130	1550	211	428
1.7E	170	139	128	139	1650	236	455
1.8E	180	147	135	148	1750	262	483
1.9E	190	156	143	158	1850	288	511
2.0E	200	164	150	167	1950	316	542
2.1E	210	172	158	177	2050	344	574
2.2E	220	180	165	186	2150	372	606
2.3E	230	189	173	196	2250	400	638
2.4E	240	197	180	206	2350	428	670
2.5E	250	205	187	216	2450	456	702
2.6E	260	213	195	226	2550	484	734

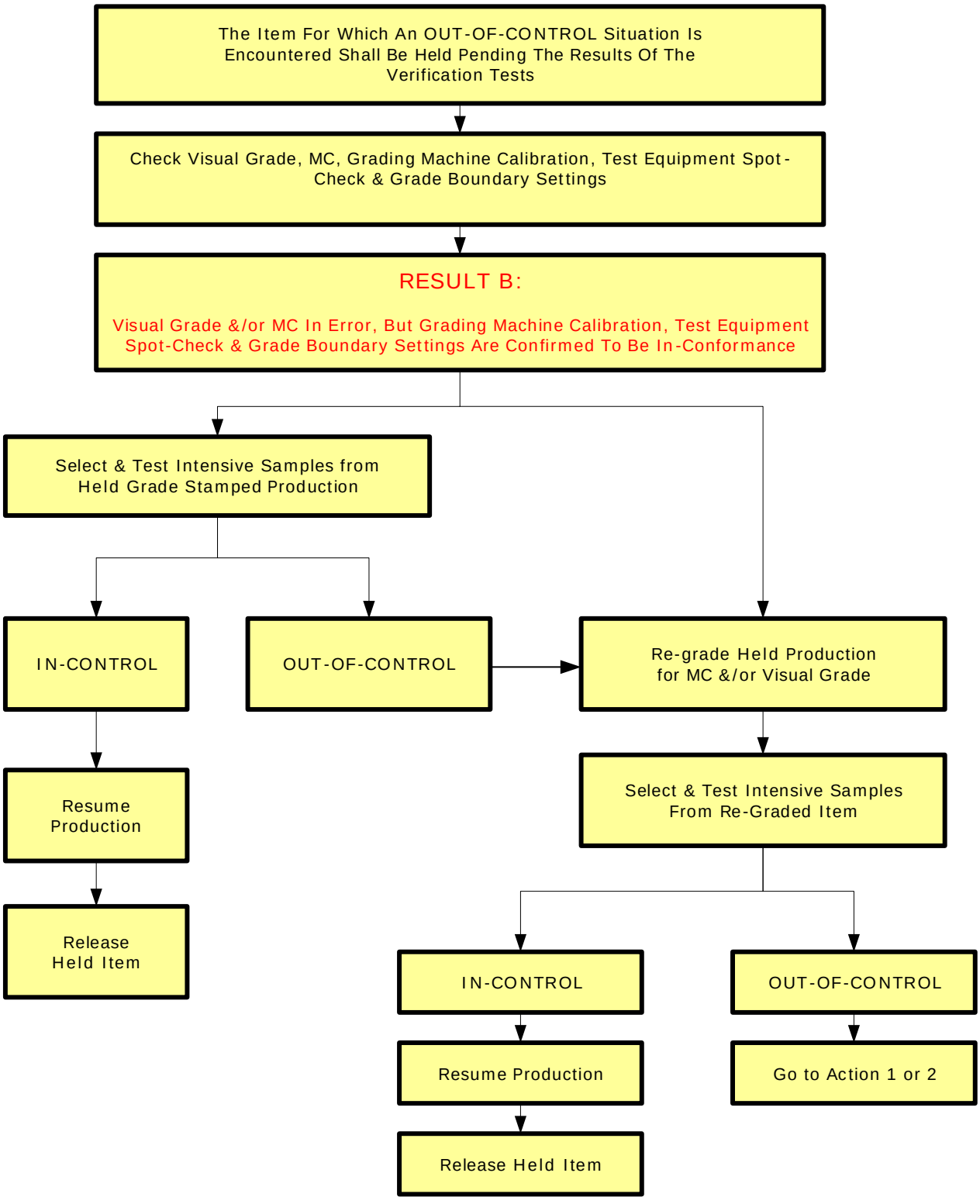
APPENDIX V - OUT-OF-CONTROL FLOW CHART (A):

FIGURE 3 – RESULT A



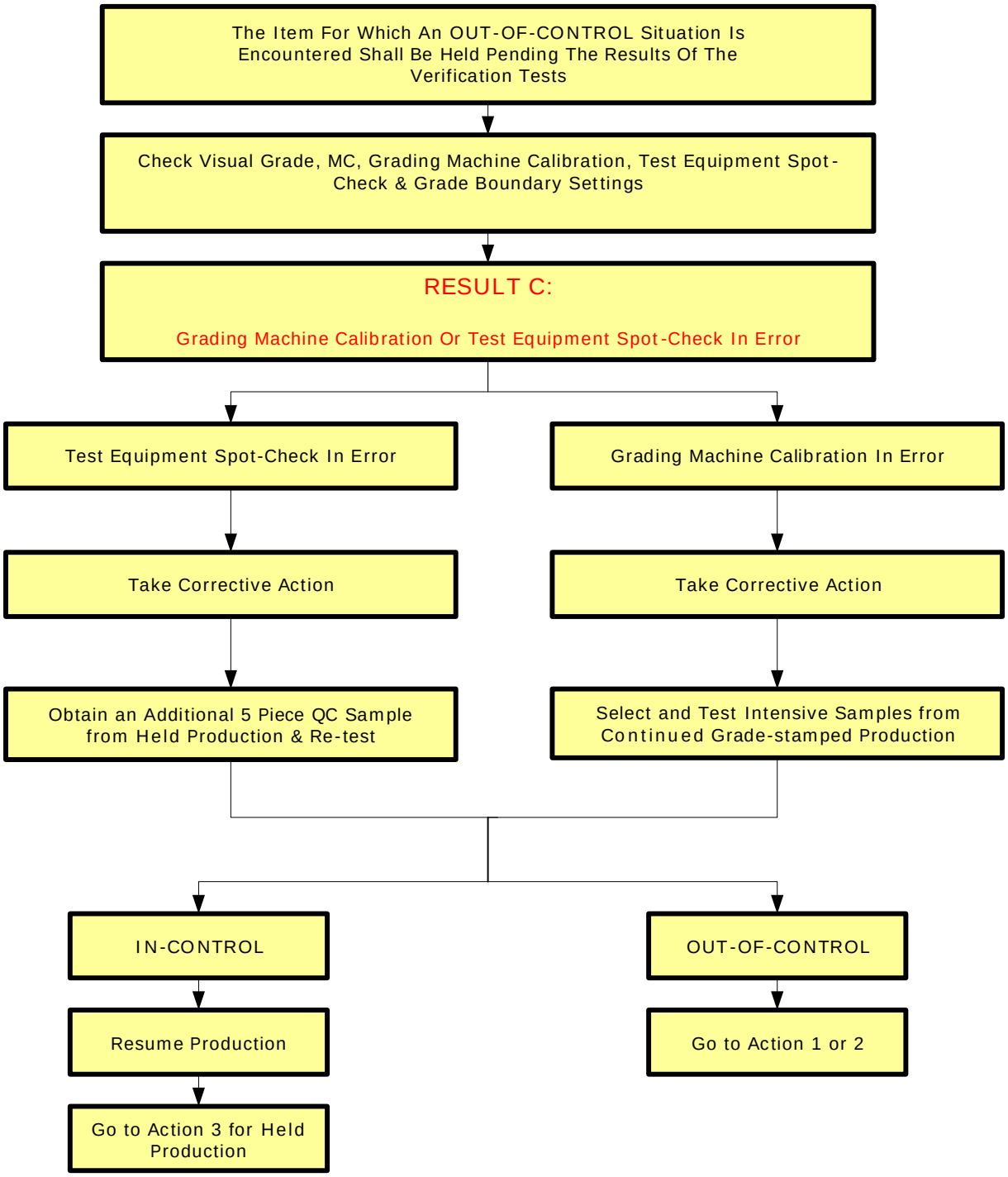
APPENDIX V (CONT.) - OUT-OF-CONTROL FLOW CHART (B):

FIGURE 4 – RESULT B



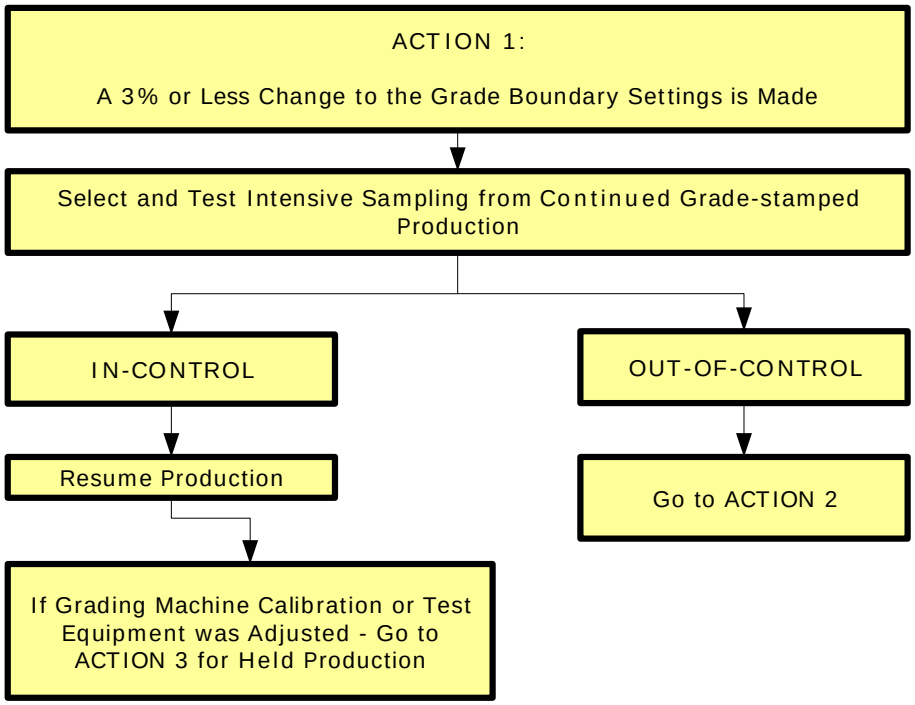
APPENDIX V (CONT.) - OUT-OF-CONTROL FLOW CHART (C):

FIGURE 5 - RESULT C



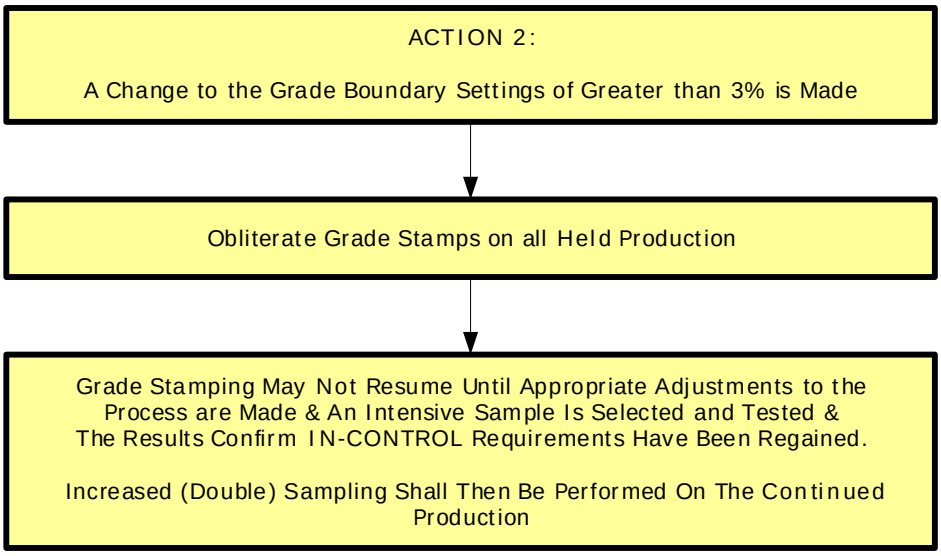
APPENDIX V (CONT.) - OUT-OF-CONTROL FLOW CHART (D): ACTION 1

FIGURE 6 – ACTION 1



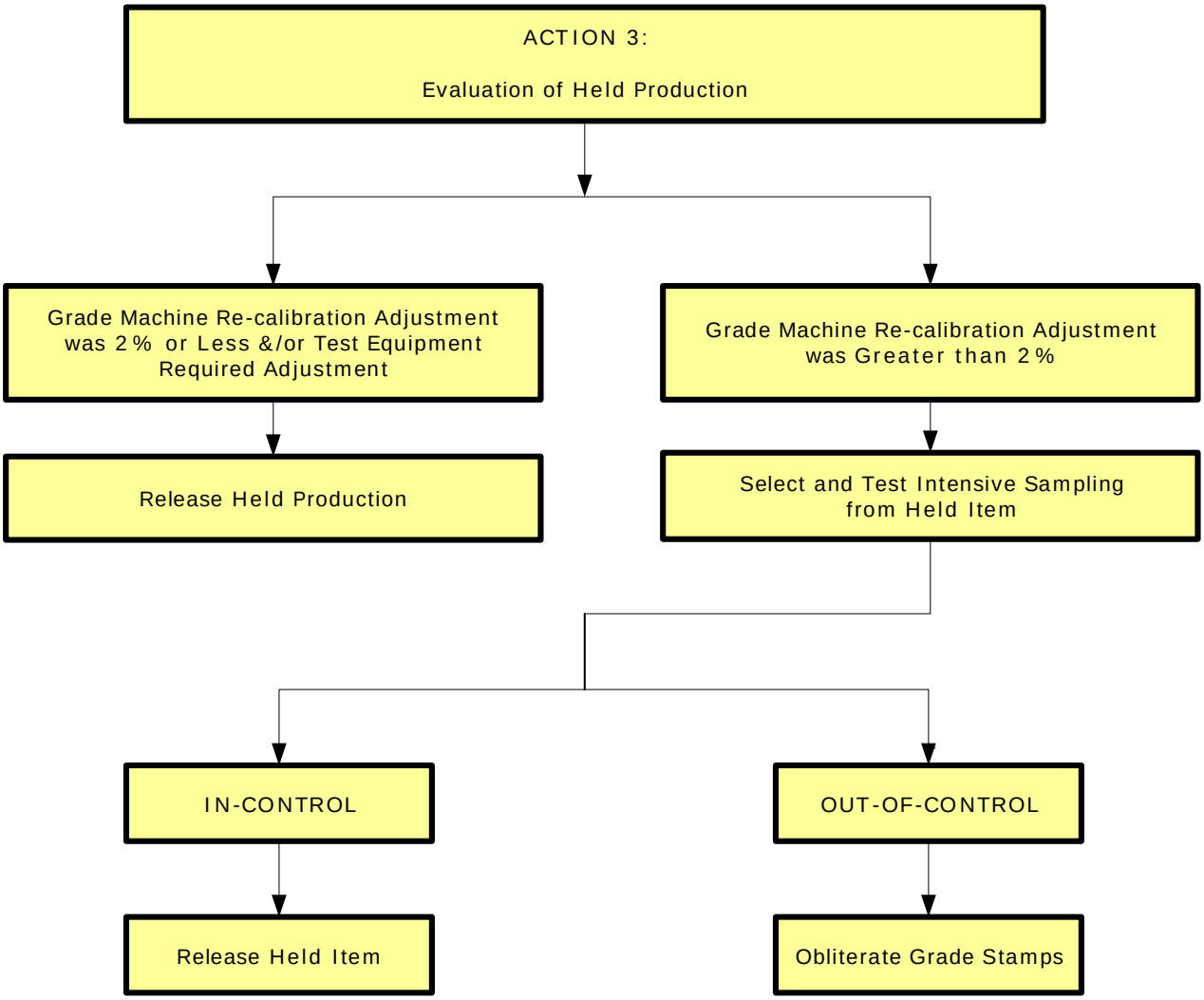
APPENDIX V (CONT.) - OUT-OF-CONTROL FLOW CHART (E): ACTION 2

FIGURE 7 – ACTION 2



APPENDIX V (CONT.) - OUT-OF-CONTROL FLOW CHART (F): ACTION 3

FIGURE 8 – ACTION 3



General Instruction No. 1

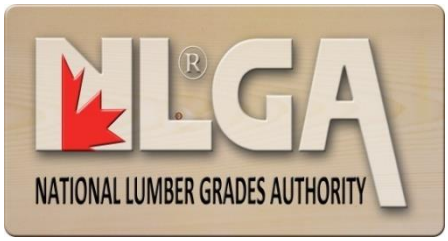
NLGA / SPS 2

April 1, 2019

The NLGA Special Product Standard 2 (**SPS 2**) consists of 35 pages; each dated "**April 1, 2019**"

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

Please check the publication section of the NLGA website (www.nlga.org) for the date of the latest edition.



SPS 2

Questions
and
Ratified Staff Responses

March 2020

SPS 2 – Machine Graded Lumber

QUESTIONS AND RATIFIED RESPONSES

DATE ISSUED / RATIFIED	CLAUSE NO.	QUESTIONS	RATIFIED NLGA STAFF RESPONSE
Sep 1996	**Reworked Lumber - Cut in Two**	**Q.** Can MSR lumber be reworked without running it through a grading machine?	**A.** NLGA Board of Directors approved that the NLGA allow for the practice of cross-cutting MSR/MEL lumber that has been passed through and been sorted by machine grading without re-running the cross-cut pieces through the grading machine provided that both halves of the resultant product are quality controlled**.**
Sep 2003		• It was agreed that the Sep 1996 ratified response be revised as follows:	• NLGA allows for the practise of cross-cutting MSR/MEL lumber that has passed through and been sorted by machine grading without re-running the cross-cut pieces through the grading machine provided: **1.** The resultant pieces are on-grade; **2.** The resulting packages are labelled as to the date and shift of the original production; **3.** There is no further sorting or withdrawal of material; and **4.** Whoever is doing the cross-cutting is doing it under the authorization of the original facility. • It was noted that this response does not apply to cross-cutting at a customer's plant and that the cross-cut pieces are subject to re-inspection.
May 2018	**Section 2.1 Definitions** Increased (Double) Sampling	**Q.** The definition of <u>Increased (Double) Sampling</u> states that two 5-piece samples must be generated from every 4 hours or less of production, for a period of 3 production shifts. If the production is on 12-hour shifts, does this mean: **a)** 60 samples (2 x 5 x 6 half shifts) based on 3 x 8-hour shifts (over 24 hours), <u>or</u> **b)** 90 samples (2 x 5 x 9 half shifts based on 3 x 12-hour shifts (36 hours)?	**A.** Increased (Double) Sampling as defined in SPS 2, Section 2.1 is based on standard 8-hour shifts. Since the definition specifies 3 production shifts, the following reasoning applies: 1. A standard production shift is 8 hours which is **two** 4-hour sampling periods 2. Three 8-hour production shifts is **six** 4-hour sampling periods over 24 hours 3. The sampling target for increased (double) sampling is two samples for each of the **six** 4-hour sampling periods yielding 60 specimens (2 samples x 5 specimens x 6 periods) Therefore, in this scenario of 12-hour production shifts, the mill facility would collect 2 samples of 5 specimens for each 4-hour period of the first 12-hour production shift (= 30 specimens) and the same for the second 12-hour production shift (= 30 specimens) for a total of 60 specimens over 24 hours.

SPS 2 – Machine Graded Lumber

QUESTIONS AND RATIFIED RESPONSES

DATE ISSUED / RATIFIED	CLAUSE NO.	QUESTIONS	RATIFIED NLGA STAFF RESPONSE
May 2019	**Section 2.1 Definitions** Increased (Double) Sampling	**Q1.** A mill only produces an MSR item for not more than 2 shifts each month. When increased sampling is required and the production lasts only two shifts, can all the samples be taken in one production period of two shifts? (i.e. taking the required 60 specimens in two shifts rather than the required 3 shifts)	**A1.** Yes, in the situation where the production period does not run for the required three shifts under increased sampling, the required total number of specimens shall all be taken in the shorter production period.
		Q2. Can production of an item be released if the increased sampling is not completed?	**A2.** No, increased sampling must be completed before production of that item can be released.
May 2010	**Section 3.1** MSR Spray	**Q.** Is it still permissible to produce MSR lumber without a colour spray on it (i.e. disappearing ink)? .	**A.** Disappearing ink is OK provided the MGL lumber individual piece can be traced to the grade that the machine assigned it to. As noted in Clause 3.1 of SPS 2 "MSR lumber is distinguished from visually grade lumber in that each piece is non-destructively tested and marked to indicate the grade E classification." An Agency needs to be confident that the mill has practices in place to assure that all pieces that are grade stamped as MSR have been accepted in the proper grade by the grading machine and that the MSR lumber meets the visual criteria for the grade. Therefore, acceptance of disappearing ink is left to the discretion of the Agency.
Sep 2004	**Section 5** Standard Lengths	**Q.** Can 5' lumber be produced under SPS 2?	**A.** Yes. SPS 2 outlines the standard lengths for MGL but does <u>not</u> restrict lengths to 6' and longer.
Sep 2003	**Section 6** Timber Breaks	**Q.** The question was raised whether timber breaks are permitted in MSR lumber.	**A.** No
Sep 2005	***Note*: The above Timber Breaks ratified response is now included in the NLGA Grade Rule Interpretations (Section 2.7.3)**		

SPS 2 – Machine Graded Lumber

QUESTIONS AND RATIFIED RESPONSES

DATE ISSUED / RATIFIED	CLAUSE NO.	QUESTIONS	RATIFIED NLGA STAFF RESPONSE
Apr 1999	**Sections 6.2** White Specks	**Q.** How are white specks assessed for SPS 2 graded lumber?	**A.** In the same manner as No. 2 grade, 1/3 the volume of the piece.
Sept. 2005	***Note: The above White specks response is now included in SPS 2 (Section 6) and Para. 128 of Grade Rule***		
Aug 2001	**Section 6.1** Slope of grain	**Q.** If slope of grain is 1 in 8 in the tested portion of a piece of 1650F_b machine graded lumber, can the piece have a slope of grain of 1 in 8 in the untested portion of the piece?	**A.** Yes
Note: The above Slope of Grain response is now incorporated in SPS 2, Table 6			
Apr 1999	**Sections 6.2** Grub holes	**Q.** How are grub holes assessed for SPS 2 graded lumber?	**A.** In the same manner as No. 2 grade. Refer to NLGA (NGR) Interpretations.
Sep 2005	***Note: The above Grub Hole response is now included in SPS 2 (Section 6)***		
Sep 2003	**Section 12** Qualification	**Q.** You indicated that since the mill is already producing MSR, they might not have to go through the whole certification process but just do an intensive sample with the new machine at the new boundary settings. Did I get this correct? (do you mean intensive sample or a double sample)?	**A.** For a new machine, the whole certification process is required.
Sep 2003	**Section 12.6** Qualification	**Q.** If the mill is certifying a 3-grade combination, say 2400, 2100 and 1650, they do not need to certify or do double sampling for the two-grade combination of 2100, 1650 or the one grade combination 1650, as long as they keep the same boundary settings as they used for the 3-grade combination. Do I understand this correctly?	**A.** Correct, as long as you already did the double sampling on the 3-grade combination. If they used different boundary settings for the two-grade combination, this would require certification and double sampling.
Sep 2003	**Sections 12.1.3/12.6** Qualification	**Q.** If you certify a multi-grade combination, you can drop an item and not have to certify the remaining items (as long as the boundary settings remain the same). One question, does it matter which item you drop? For example, it sounds like I can drop the 2400 and not certify the 2100 and 1650 grades. What if I dropped the 2100, leaving a 2400, 1650 combination - Do I have to certify that combination? I guess a more generic question would be is there any circumstance where I would have to certify the same grades in different combinations? (i.e. if the boundary settings were different).	**A.** See response immediately above. Section 12.6 of the SPS 2 also deals with adding grades to an existing combination.

SPS 2 – Machine Graded Lumber

QUESTIONS AND RATIFIED RESPONSES

DATE ISSUED / RATIFIED	CLAUSE NO.	QUESTIONS	RATIFIED NLGA STAFF RESPONSE
May 2018	**Section 12.6** Subsequent Qualification	**Q.** We are producing the following MSR item (single grade) in our facility: 2x4, SPF, 1650Fb-1.5E In order to optimize our MSR yield: a) We would like to machine grade a dense sort of SPF (mostly Black spruce) separately with a different set point on our MSR machine, and b) We would like to machine grade the shorter lengths (9 feet and shorter) with a different set point on our MSR machine. We will keep independent CUSUM records for each sort. Since it will be the same item produced, do I have to re-qualify?	**A.** In this case, the SPS 2 definition for "**Item**" applies, where it is defined as "*lumber of a given grade, size (without reference to length), species or species combination and moisture content*". Assuming the initial qualification in this case was for 2x4, SPF, 1650Fb-1.5E, then: • In Scenario a), since the item is now basically a new "species" sort, different than the SPF item which was originally qualified, this new item would require a subsequent qualification. • In Scenario b) this item would <u>not</u> require a separate qualification because the item size is without reference to length
May 2019	**Section 12.10** Major Maintenance	**Q1.** One of our mill facilities is moving its MSR machine to a new building. Is this a major change?	**A1.** Moving the existing grading machine to a new building is not a major change but rather like major maintenance. It is still the same machine with all the same parts. You would be required to do intensive sampling on the first item produced.
		Q2. Is moving the proof-loader also a major change?	**A2.** Unless you have reason to believe the proof-loader was damaged during the move, spot-checks would be adequate. Spot-checks must be carried out on the size configuration(s) of the proof loader for which the mill facility is qualified.
Sep 2004	**Section 13.1** Grading Machine	**Q.** How does "Approximately" apply to 10-hour shifts at a mill. Specifically, how long after 4 hours would one consider as being "Approximately every 4 hours ....."	**A.** "Up to and not exceeding 5 hours of production" would be considered acceptable.
Sep 2006	**Section 13.1b**	***Note:*** *It was also agreed that because calibration currently is based on ½ shifts (4 or 5 hours) if the calibration was only performed once a shift or at less frequency than the ½ shift then, in the event of an Out-of-Control situation, due to Result C (Section 14.4.2), lumber shall be held since the time of the last machine calibration.*	
May 2018		*The text in red was added to the above Note for further clarification.*	

SPS 2 – Machine Graded Lumber

QUESTIONS AND RATIFIED RESPONSES

DATE ISSUED / RATIFIED	CLAUSE NO.	QUESTIONS	RATIFIED NLGA STAFF RESPONSE
Jun 2006	**Section 13.1d** Grading Machine	**Q. 1)** If I change a bearing on the grade machine, does that affect the machine and am I required to calibrate the machine? **2)** If I change the load cell on the grade machine, is the calibration the only thing I must do, are we required to Intensive Sample the first item run after the load cell change?	**A. 1)** Yes. **2)** "Intensive sampling shall take place after any Major Maintenance which includes any part of the grading machine that could affect the grade determining performance of the grading machine including software changes"
Mar 2019	***Note:*** *Major Maintenance is now defined in the SPS 2 Definitions and procedures are specified in Section 12.10*		
May 2014	**Section 13.2** Test Equipment	**Q.** How much grace period is allowed between a 2013 and 2014 annual calibration? Would a 6 to 8-month extension be acceptable?	**A.** As per Section 13.2 of SPS 2, once a year is interpreted as approximately 12 months (+ one month) for recertification of the test equipment. Any extension to the 12-month requirement must be authorized in writing by the independent calibration laboratory.
May 2019		**Q.** Table 11 states that the bending proof loader must be spot-checked once a shift with a proof bar and once a week with a proof ring or load cell. If the spot-check with the proof bar passes, can we continue using the proof loader even if the proof ring or load cell spot-check fails?	**A.** No. <u>Both</u> spot-check verifications must pass for the bending proof loader to be considered acceptable for QC testing purposes.
Sep 2005	**Sections 13.2 & 13.3** Calibration of Test Equipment	**Q.** Is it necessary for the calibration agency to go on-site to calibrate the test equipment?	**A.** Yes. Test equipment (Sec. 13.2) and calibration devices (Sec. 13.3) such as weights and bars for spot checks need to be certified by an independent organization acceptable to CLSAB every year. • Whether the "certification" actually involves calibrating the device/equipment against a traceable standard is at the discretion of the independent organization. What is required by the Standard is that the independent organization certifies the accuracy of the device/equipment. If the device or equipment requires calibration, then the calibration is required to be done in accordance with the applicable ASTM standard.
Sep 2003	**Section 14** SG CUSUM Guidelines	See **Attachment #1** for MSR SG Guidelines for Use and SG CUSUM Parameters	

SPS 2 – Machine Graded Lumber QUESTIONS AND RATIFIED RESPONSES			
DATE ISSUED / RATIFIED	**CLAUSE NO.**	**QUESTIONS**	**RATIFIED NLGA STAFF RESPONSE**
May 2019	**Section 14.2** Quality Control Sampling	**Q.** Can we collect QC samples (segregated by production period) and then test them later? The production would be held and not released until the test results proved acceptable.	**A.** There is no requirement to immediately test the QC samples, but it is good practice to do so. If samples are accumulated, the mill facility must institute procedures to maintain the specimen moisture content until testing. Also, if an "Out-of-Control" situation is encountered with a QC sample, all subsequent production must be held until test results indicate the process is back "In-Control".
Sep 2004		**Q.** What happens with mills that run 12-hour shifts?	**A.** During normal production (once the qualification period is over) a minimum of one-five (5) specimen sample is required for each period of four (4) hours or less of production (ie. If a mill runs two 10-hour shifts, at least 25 specimens shall be tested for the grade under consideration. The mill could test 12 samples in the first ten-hours and 13 in the second ten-hour shift or visa-versa). It is important to remember that lumber represented by the five-specimen sample cannot be shipped until the sample has been tested and shown to be "In-Control".
Dec 2015	**Section 14.2.2** Sampling Frequency	**Q.** Currently it states in Section 14.2.2 that "A minimum of one five (5) specimen sample for each period of four (4) hours or less of production shall be selected and tested…". Can a minimum time be set for production runs that run into the next ½ shift for which no sampling is required (similar to Section 13.1 using "up to 5 hours" to define "approximately" when calibrating test equipment every 4 hours)?	**A.** If at the end of a "production run", the production item carries over into the next ½ shift, additional quality control sampling is not required provided the extra run lasts no longer than 1 hour. The 5-piece sample from the previous ½ shift satisfies the quality control requirements for this production.
May 2016		To clarify a further question, the following sentence was added to the above ratified response.	The reason and length of time the production run carries over into the next ½ shift shall be documented.

SPS 2 – Machine Graded Lumber QUESTIONS AND RATIFIED RESPONSES			
DATE ISSUED / RATIFIED	**CLAUSE NO.**	**QUESTIONS**	**RATIFIED NLGA STAFF RESPONSE**
Sep 2003	**Section 14.6** Qualification	**Q.** I am not sure what is meant by keeping separate records. If you mean that the CUSUM records for the 2100 run in combination with 2400 and 1650 should be kept on separate CUSUM forms from 2100 run with 1650 only (no 2400), I understand and that is what they are doing per section 14.6. If you mean something else, like keeping separate certification records for each combination, I am unclear as to what you are looking for since it sounds like we don't have to certify all the combinations.	**A.** CUSUM records shall be kept for each item, but if you are running a 2-grade combination versus a 3-grade combination each having 1650 and 2100 then the CUSUM records combinations should be kept together (though each grade is separate) ie. in one folder keep the 2400, 2100 and 1650 CUSUM records and in another folder keep 2100 and 1650 grades and if you run a single 1650 grade, keep it in a third separate folder. This will allow the mill to change grade boundaries on the specific combination they are running and do the intensive and increased as required. If they a running the single grade and wish to then run the 2 or 3-grade combinations, they simply revert to the grade boundary settings they were running when they last ran that combination and continue the record keeping in that folder. The dates on each CUSUM form will tell you when they ran the 3-grade or other combinations.
May 2019	**Section 14.6f** Quality Control Records	**Q.** SPS 2, Section 14.6f requires that facility QC records shall include a record of the temperature near the test equipment at the time of the spot-checks. Does this address the requirements of Section 8.5.2?	**A.** No, the purpose of Section 14.6f is to ensure that the test equipment was spot-checked at normal operating temperatures. (i.e. in the case of the metal proof bar being used at below-zero temperatures where the spot-check readings will be affected). This is different than the intent of Section 8.5.2 where the bending test results can be affected by the temperature of the specimens and the test equipment.
Sep 2005	**Machine-rating SPS 1 FJ lumber**	**Q.** Can a SPS 1 fingerjoint facility MSR its fingerjoint product using SPS 2?	**A.** No, SPS 2 does not deal with fingerjoined lumber. See SPS 4.

NLGA SPS 2 Attachment #1

Development of Recommended Quality Control Limits for MSR Lumber Specific Gravity & Guidelines for Use

Development of Recommended Quality Control Limits for MSR Lumber Specific Gravity & Guidelines for Use

1 Introduction

Since the recognition of specific gravity (SG) qualitifation and quality control testing in the NLGA SPS 2, numerous individual requests have been made to the NLGA to provide CUSUM parameters for monitoring proprietary SG levels. Whenever a request is made, and before the CUSUM parameters can be computed, a number of assumptions are made and adjusted to consider what generic and proprietary SG levels are currently recognized. This adjustment needs to be made in order to ensure that the CUSUM parameters computed for the new SG level can be monitored and distinguished from an existing SG level for the species. Otherwise, there would be no reason for developing a new set of CUSUM parameters and no point in producing at a different SG level. While it is theoretically possible to develop CUSUM parameters to detect minute differences between SG levels, this could potential lead to two problems:

1) A proliferation of grades that for, practical reasons, do not have any significant difference in end-use performance; and

2) Differences in claimed SG levels that appear to be irrational when compared to the accuracy of the test method and the grade qualification rules.

Therefore, it was recommended by the NLGA Standards Committee to investigate the development of standardized mill specific SG levels. The decision was to establish these levels at intervals of 0.02 in SG. The purpose of this document is to present the assumptions made in the development of the CUSUM parameters and to provide guidelines for their use.

2 CUSUM Assumptions

The NLGA SPS 2 specific gravity Cumulative Sum (CUSUM) variables control chart parameters[1] were developed based on the following assumptions:

The *coefficient of variation* (CoV) over time is 12%

- Typically within any given sample of MSR lumber the coefficient of variation is lower. However, if the specific gravity were sampled over time from a process that is maintained at a given modulus of elasticity, the coefficient of variation is expected to be closer to 12%. An estimate of this can be obtained by examining the coefficient of variation of a sample collected from a number of mills producing the same MSR lumber grade.

The *acceptable quality level* (AQL)

- The acceptable quality level is a calibration point for determining the CUSUM parameters. It is the furthest level below the target level at which it would still be acceptable for the control charts run for a long period of time without indicating an out-of-control situation (i.e. suggest a downward shift in the process). If the process were to go out of control at this level, it would be doing so only by chance and indicating a false positive for non-conformance.

[1] When using CUSUM, it is assumed that the response is a normally distributed parameter.

The *rejectable quality level* (RQL)

- The rejectable quality level is a calibration point for determining the CUSUM parameters. It is the furthest level below the target level at which there is a desire to quickly indicate an out-of-control condition or a downward shift in the process. If the process were to continue to operate at this level, it would be doing so only by chance and indicating a false negative for non-conformance.

The *average run length (ARL) at the acceptable quality level (AQL)* is 150

- This is the average number of samples before the process with the assumed coefficient of variation and operating at the AQL will go out-of-control by chance. In an ideal system, the ARL at the AQL should be infinity (i.e. never indicates an out-of-control condition).

The *average run length (ARL) at the rejectable quality level (RQL)* is 5

- This is the average number of samples before the process with the assumed coefficient of variation and operating at the RQL will go out-of-control by chance. In an ideal system, the ARL at the RQL should be zero (i.e. indicates an out-of-control condition immediately).

Sample size of 5

- This sample size corresponds to that use for the other NLGA SPS 2 quality control tests. A different sample size (say 10) would require a different set of CUSUM parameters, even for the same assumptions.

3 Guidelines for Using the CUSUM Parameters

3.1 General

The CUSUM parameters are used the same way as those developed for monitoring the modulus of elasticity of MSR lumber. These parameters are used for "variables charts" where the objective is to detect when the value of a process property is falling below an acceptable target value.

3.2 Quality Control Forms and Test Procedures

Forms developed for the monitoring the mean modulus of elasticity may be adapted for monitoring the specific gravity (SG). Test procedures are as described in the NLGA SPS 2.

3.3 Selection of the Standardized CUSUM Parameters

Standardized CUSUM parameters for monitoring the specific gravity of MSR lumber produced under the NLGA SPS 2 are shown in Table 1. Although values are provided at SG intervals of 0.01, they have been developed in accordance with the NLGA Standards Committee's recommended interval of 0.02. The following recommendations have been implemented in Table 1:

1. The minimum specific gravity that can be qualified for a given species group is the default value for visual grades of that species group plus 0.02.

2. Higher levels of specific gravity may be qualified at intervals of 0.02.

Table 1: Recommended CUSUM Parameters for Monitoring MSR Lumber Specific Gravity

S-P-F (0.42)	D.fir-L (N) (0.49)	Hem-Fir (N) (0.46)	N. Species (0.38)	Normal location, zero start n = 5 CoV = 12% AQL Int = 0.005 RQL Int = 0.040 L = 150 L* = 5					X	Y		Z
				Mean	Std Dev	AQL	Std Err	RQL	k	h (DI)	h* (DI)	h + h*
0.42				0.420	0.050	0.415	0.022	0.380	0.398	0.049	0.074	0.123
			0.43	0.430	0.052	0.425	0.023	0.390	0.408	0.051	0.074	0.125
0.44				0.440	0.053	0.435	0.023	0.400	0.418	0.053	0.074	0.127
			0.45	0.450	0.054	0.445	0.024	0.410	0.428	0.056	0.074	0.130
0.46		0.46		0.460	0.055	0.455	0.024	0.420	0.438	0.058	0.074	0.133
			0.47	0.470	0.056	0.465	0.025	0.430	0.448	0.061	0.075	0.136
0.48		0.48		0.480	0.058	0.475	0.025	0.440	0.458	0.063	0.075	0.138
	0.49		0.49	0.490	0.059	0.485	0.026	0.450	0.468	0.064	0.075	0.139
0.50		0.50		0.500	0.060	0.495	0.027	0.460	0.478	0.069	0.075	0.144
	0.51		0.51	0.510	0.061	0.505	0.027	0.470	0.488	0.071	0.076	0.147
0.52		0.52		0.520	0.062	0.515	0.028	0.480	0.498	0.074	0.076	0.149
	0.53		0.53	0.530	0.064	0.525	0.028	0.490	0.508	0.077	0.077	0.153
0.54		0.54		0.540	0.065	0.535	0.029	0.500	0.518	0.079	0.076	0.155
	0.55		0.55	0.550	0.066	0.545	0.029	0.510	0.528	0.082	0.077	0.159
0.56		0.56		0.560	0.067	0.555	0.030	0.520	0.538	0.085	0.077	0.162
	0.57		0.57	0.570	0.068	0.565	0.030	0.530	0.548	0.087	0.077	0.164
0.58		0.58		0.580	0.070	0.575	0.031	0.540	0.558	0.090	0.077	0.168
	0.59		0.59	0.590	0.071	0.585	0.031	0.550	0.568	0.093	0.077	0.171
0.60		0.60		0.600	0.072	0.595	0.032	0.560	0.578	0.096	0.078	0.173