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Laminated veneer lumber (LVL) — Specifications

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18776 was prepared by Technical Committee ISO/TC 89, *Wood-based panels*, Subcommittee SC 3, *Plywood*.

Laminated veneer lumber (LVL) — Specifications

1 Scope

This International Standard specifies the requirements for Laminated Veneer Lumber (LVL) for general purposes and structural applications, in dry, tropical-dry/humid or high humidity/exterior conditions. Laminated Veneer Lumber (LVL) is a general description for an assembly of veneers laminated with an adhesive in which the grain direction of the outer veneers and most other veneers is in the longitudinal direction.

This International Standard specifies requirements for

— the quality of veneers,

— bond durability,

— tolerances on dimensions, and

— structural characterization.

Characteristic values, to be used for design purposes, are based on testing and evaluation of laminated veneer lumber.

2 Conformance

2.1 Quality system requirements

Products conforming to this International Standard shall be manufactured to a formalised manufacturing specification covering all relevant process variables under a quality system which includes

— in-plant process quality control and internal auditing procedures, and

— external auditing of plant process control and end-product quality.

The system shall be consistent with the requirements of ISO/IEC Guide 65.

2.2 Manufacturing specifications

The manufacturing specifications shall set the limits on all variables that affect or correlate with final product properties, including

a) materials (see Clause 5),

b) bonding quality (see Clause 6),

c) lay-up (construction) (see Clause 7),

d) manufacturing process, and

e) secondary processes and treatment (see, for example, Clause 10).

NOTE The above list is not necessarily exhaustive.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC Guide 65, *General requirements for bodies operating product certification systems*

ISO 2074, *Plywood — Vocabulary*

ISO 9427, *Wood-based panels — Determination of density*

ISO 12460-1, *Wood-based panels — Determination of formaldehyde release — Part 1: Formaldehyde emission by the 1-cubic-metre chamber method*

ISO 12460-2, *Wood-based panels — Determination of formaldehyde release — Part 2: Small-scale chamber method*

ISO 12460-3, *Wood-based panels — Determination of formaldehyde release — Part 3: Gas analysis method*

ISO 12460-4, *Wood-based panels — Determination of formaldehyde release — Part 4: Dessicator method*

ISO 12466-1, *Plywood — Bonding quality — Part 1: Test methods*

ISO 12466-2, *Plywood — Bonding quality — Part 2: Requirements*

ISO 16978, *Wood-based panels — Determination of modulus of elasticity in bending and of bending strength*

ISO 16979, *Wood-based panels — Determination of moisture content*

ISO 21887, *Durability of wood and wood-based products — Use classes*

ISO 27567, *Laminated veneer lumber — Measurement of dimensions and shape — Method of test*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2074 and the following apply.

4.1
laminated veneer lumber
LVL
product made of an assembly of veneers, laminated with an adhesive, in which the grain direction of the outer veneers and most other veneers are parallel and run in the longitudinal direction

4.2
dry conditions
conditions in which the LVL attains an equilibrium moisture content not exceeding 12 % except for only a few weeks per year (e.g. ambient temperature of 20 °C and relative humidity of 65 %)

NOTE 1 LVL, suitable for use in these conditions, is considered as suitable for use in biological-use class 1 of ISO 21887.

NOTE 2 LVL, under these conditions, is appropriate for dry internal applications, excluding any extended direct exposure to water.

4.3
tropical-dry/humid conditions
conditions in which the LVL attains an equilibrium moisture content not exceeding 18 %, except for only a few weeks per year (e.g. ambient temperature of 30 °C and relative humidity of 85 %)

NOTE 1 LVL, suitable for use in these conditions, is considered as suitable for use in biological-use class 1 and class 2 of ISO 21887.

NOTE 2 LVL, under these conditions, is appropriate for protected external applications (e.g. behind cladding or under roof coverings), but is also capable of resisting weather exposure for short periods (e.g. when exposed during the construction). It is also suitable for interior situations where the service moisture condition is raised above the humidity of dry conditions.

4.4
high humidity/exterior conditions
conditions leading to higher equilibrium moisture content than in tropical-dry/humid conditions or prolonged exposure to weather

NOTE LVL, suitable for use in these conditions, is considered as suitable for use in biological-use class 1, 2 and 3 of ISO 21887.

4.5
structural use
load-bearing application for which predictable and reliable material structural-design properties are required

5 Materials

The following characteristics shall form part of the manufacturing specifications:

5.1 Veneer

5.1.1 General

The following requirements apply at the time of pressing:

The species, species group, mechanical property group or predictor shall be identified.

NOTE The notional veneer stiffnesses obtained via calibrated electronic or other techniques, such as sound waves, are considered as acceptable predictors.

In LVL for structural use, the position of veneers in the assembly/construction shall be identified (see Annex B).

5.1.2 Species

Any wood species is permitted.

5.1.3 Thickness

Unless otherwise stated, veneer thickness shall be a maximum of 6,0 mm.

Other thicknesses are permitted, provided they meet the structural and serviceability requirements for the intended application.

5.1.4 Quality

The minimum quality (grade) of each face, back and inner ply shall be specified in accordance with Annex A.

5.1.5 Jointing

Edge joints parallel to the grain are permitted, either glued or unglued.

End joints shall be defined in the manufacturing specification in regard to the type of joint (i.e. scarfed, crushed, butt or other) and the geometrical distribution and frequency of joints.

5.2 Adhesives

The adhesive, in combination with the veneers used, shall provide a bond of the strength, durability and integrity necessary to meet the requirements for the bond type as specified in Clause 6.

6 Bonding quality

The bonding quality shall be established in accordance with ISO 12466-1 (Chisel test) and ISO 12466-2.

NOTE Awaiting a new document, specifically for LVL (ISO/AWI 10033).

7 Lay-up (arrangement of veneers)

The lay-up (arrangement) of veneers within the LVL construction, including the type and frequency of end joints, shall be specified in accordance with Annex B.

8 Dimensions, shape and tolerances

Unless stated otherwise by the contract, dimensions and tolerances apply at a moisture content of (10 ± 4) %.

The moisture content shall be measured in accordance with ISO 16979.

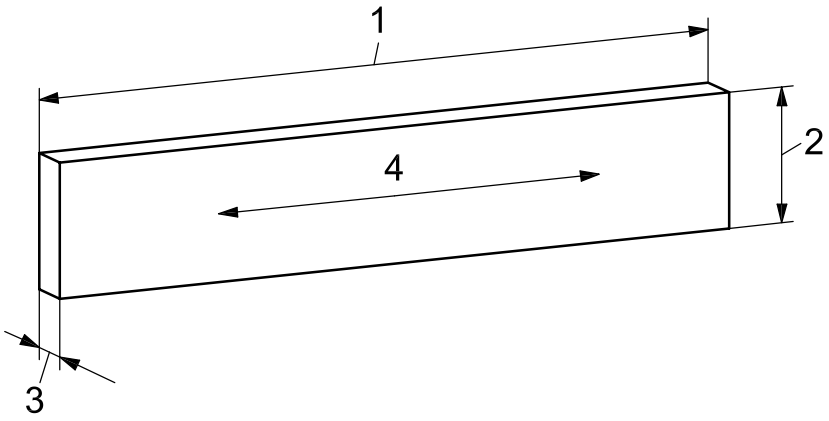
8.1 Dimensions

Length, width and thickness, measured in accordance with ISO 27567, shall be specified, where:

— length is defined as the dimension in the direction along the grain of the majority of veneers in the LVL;

— width is defined as the dimension in the plane of the LVL normal to the length;

— thickness is defined as the dimension, through the LVL, normal to the length and width.



Key

1 length
2 width
3 thickness
4 major grain direction

Figure 1 — Dimensions of LVL

8.2 Shape

Requirements for twist, spring, bow, squareness of section and cupping shall be specified.

Twist, spring, bow, squareness of section and cupping are defined in ISO 27567.

8.3 Tolerances

Unless otherwise stated by the contract, the dimensions of LVL measured in accordance with ISO 27567 shall not differ from specified/declared dimensions, by more than the tolerances given in 8.3.1 and 8.3.2.

8.3.1 Dimensions

Tolerances on dimensions are given in Table 1:

Table 1 — Tolerances on dimensions

Dimension	Tolerances
Thickness (t)	$\pm$ 5 %
Width (b) —	$\pm$ 1 %
Length (L)	$^{+2}_{0}$ %

8.3.2 Shape

Tolerances on shape are given in Table 2:

Table 2 — Tolerances on shape

Shape	Tolerances
Spring	It shall not exceed 1 mm in 1 000 mm
Bow	It shall not exceed 1 mm in 1 000 mm
Twist (F)	It shall not exceed the value calculated by the following equation: $F_{\text{twist}} = \frac{L \times b}{3\,500 \times t}$ where L, b and t are the length, width and thickness, expressed in millimetres.
Squareness of section	The sides of a nominally rectangular cross-section of LVL shall not deviate from a square by more than 1 mm in 50 mm
Cupping	It shall not exceed 1 mm in 100 mm

9 Determination of properties

9.1 Physical properties

9.1.1 if required, moisture content shall be determined in accordance with ISO 16979.

9.1.2 if required, density shall be determined in accordance with ISO 9427.

9.2 Mechanical properties

9.2.1 General

For general purposes, if required, bending strength and modulus of elasticity (MOE) shall be determined in accordance with ISO 16978.

9.2.2 Structural applications

Structural properties and capacities appropriate for the intended application shall be determined by structural testing and evaluation methods for laminated veneer lumber.

For each structural LVL product, the structural properties on the edge and/or flat shall be determined as appropriate for the intended application. Table C.1 of Annex C defines properties to be determined for some specific applications.

9.3 Supplementary properties

For certain applications, information on some supplementary properties shall be required. A number of these supplementary properties are listed in Annex D. On request, information on these required supplementary properties shall be produced by the supplier. Where available, the properties shall be determined in accordance with the relevant International Standards. If there is no International Standard available, the method used shall be described fully in the test report.

10 Preservative and chemical treatments

10.1 Natural or confered biological durability

Where LVL is foreseen to be exposed to wood-destroying biological agents, as defined in ISO 21887:2007, Table 3.1, it shall be protected naturally or by a conferred treatment for the service conditions considered.

Regional or national standards may provide a list of natural durability characteristics of species.

NOTE Treatment processes, involving harsh wetting and drying regimes, can cause internal checking and consequent loss of structural integrity.

Under prolonged conditions of full weather exposure, the exposed surface of the LVL should be adequately protected.

10.2 Effect of chemical treatments

Where LVL is required to be chemically treated, some types of chemical products combined with some treatment processes may affect physical and structural properties. Consequently, the possible effects shall be considered. Strength effects of the treatment process and any subsequent drying shall be evaluated.

11 Formaldehyde release

Formaldehyde release of LVL for non-interior exposed applications, e.g. built-in floor joists, rafters or formwork applications is not required to be determined. In this case, information shall be provided that the LVL shall be used only for these applications.

Coated, uncoated or overlaid LVL glued with resins emitting either no formaldehyde or negligible amounts of formaldehyde after production, e.g. isocyanate, need not be evaluated for formaldehyde release.

When required, formaldehyde release shall be carried out in accordance with ISO 12460-1, ISO 12460-2, ISO 12460-3 or ISO 12460-4.

12 Marking (identification)

Each piece of LVL shall have the following information legibly affixed thereon, at least once, by the manufacturer at the point of manufacture:

a) the manufacturer’s name or registered mark;

b) a reference to this International Standard (ISO 18776);

c) the letter corresponding to the intended application “S” for a structural application or “NS” for a general application;

d) if intended for structural application, the registered brand or marking that, in conjunction with published literature, clearly identifies the structural properties that apply to the specific product;

e) any limitations on end use;

f) if it is treated with preservative, marking in accordance with ISO 21887;

g) the bonding class;

h) the formaldehyde release class, where applicable.

The marking may also contain

— the nominal dimensions, in millimetres,

— the quality label and the certification, if any, or

— the batch number or date of production for traceability.

Further documents, if requested, may be provided by the manufacturer.

Annex A
(normative)

Veneer quality

Table A.1 — Veneer grade

	Characteristic/Feature	Specified max. size/area (individual characteristic)	Maximum per sheet
1	Knots – sound (live) Knots – checked (dead)		
2	Knot holes		
3	Grain irregularities (e.g. rough, sloped, torn grain)		
4	Splits (tapering to a point)		
5	Bark-resin pockets		
6	Borer holes		
7	Fungal decay		
8	Wane (missing wood)		
9	Sum of characteristics measured across piece		
10	Repairs/patches		

NOTE 1 The characteristics listed in Table A.1 are not intended to be exhaustive.

NOTE 2 In the event that non-visual, electronic or other techniques, such as sound waves, are used to establish veneer characteristics, e.g. Notional E, the non-relevant characteristics listed in Table A.1 can be ignored.

Annex B
(normative)

Panel construction (Veneer arangement)

The arrangement of veneers through the LVL assembly shall be specified with regard to veneer thickness; species or species group; veneer quality; orientation of veneer parallel or perpendicular, in structural LVL, structural characterization (e.g. notional stiffness or density or other structural predictor); and any other characteristic affecting the serviceability of the LVL, such as the type and position of butt joints.

This Annex provides an example for an LVL assembly with 15 plies. It is applicable to all LVL products, regardless of the number of plies. Each ply in the assembly shall be included in Table B.1.

Table B.1 — Panel construction

Position of veneer	Species or species group	Veneer quality	Panel orientation: parallel or perpendicular	Structural predictor (e,g. notional p(E)	Type and position of end joints
Face					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
Back					

Annex C
(informative)

Properties to be determined depending on end use

Table C.1 — Properties to be determined depending on end use

Intended application	Strength and stiffness										Joint strength			
	Bending, shear and bearing								Axial		Nails	Bolts	Self-drilling screws	Nail plates
	On flat				On edge									
	E	f_b	f_s	f_p	E	f_b	f_s	f_p	f_t	f_c				
General beams used on edge only					√	√	√	√			√	√	√	
Scaffold planks or other applications involving flat-wise bending only	√	√	√	√										
General structural use	√	√	√	√	√	√	√	√	√	√	√	√	√	
Nail-plate jointed trusses					√	√	√	√	√	√	√	√		√

where

E = Modulus of elasticity in bending

f_b = Characteristic strength in bending

f_s = Characteristic strength in shear parallel to grain (beam shear)

f_p = Characteristic strength in compression perpendicular to grain

f_t = Characteristic strength in tension parallel to grain

f_c = Characteristic strength in compression parallel to grain

Annex D
(informative)

Supplementary properties

The following properties are considered supplementary:

Table D.1 — Supplementary properties

Property	International Standard
Effect of temperature	
Chemical resistance	
Thermal conductivity	
Abrasion resistance	
Vapour permeability	
Acoustical properties	
Modulus of elasticity – General LVL	
Bending strength - General LVL	

Bibliography

[1] ISO 16572, *Timber structures — Wood-based panels — Determination of structural properties*

[2] ISO 10033, *Laminated Veneer Lumber — Bond quality testing and evaluation methods*

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