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International Hardwood Veneer Grading Rules

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Introduction

The need for a transferable and comparative method (grading rules) to allow veneer to be traded requires the establishment of a grading system that will allow stakeholders to have confidence in the supply of graded veneers to meet their manufacturing and quality requirements.

The purpose of grading wood veneer is to sort material into groups desired for best utilisation and price/value category. This price/value relationship is set not only by the aesthetics of the wood, but also by the demand for the species.

Many countries have established standards used to grade veneer for different uses such as for face veneer (the outer most veneer), substrate veneer (internal veneer), plywood, laminated veneer lumber (LVL), formply etc. Additionally, non-standard veneer grading guidelines also exist for different countries and companies producing veneer. Different manufacturers using non-standard veneer grading rules classify the quality differently depending on the company and the customer‘s wishes, as well as on the wood species and type of veneer or the planned use.

The commonality between all veneer grading classifications is the use of a set of grading criteria used to classify material into different grade classes. Grade criteria can include natural wood veneer defects/features or man/machine made defects caused by the peeling process or handling. Natural wood defects include such defects as the number and size of knots, type of knots, natural splitting, discoloration, holes, insect attack, decay etc. Man and machine made defects can include splitting, knife marks, grain breakout, roughness etc. Grade classes also differ between grading standards and guidelines but are usually assigned either a letter alphabetically (i.e. A, B, C etc.) or numerical class (i.e. 1, 2, 3, etc.), where the best grade class is ‘A’ or ‘1’ where subsequent grades (in alphabetic or numerical order) are usually of progressively lower quality and value.

The review of grading standards and guidelines presented in this report refers only to peeled hardwood veneer and not sliced veneer. Hardwood veneer is the target product produced by Burapha agroforestry.

Definition of grade defects

The following review of international hardwood veneer grading standards refers to sets of criteria relating to natural wood defects or man/machine made defects. The following provides a definition of each defect, many of which can be found in AS/NZS 4491:1997-Timber-Glossary of terms in timber-related Standards (1997).

Sound knot

A knot solid across its face, as hard as the surrounding tissue and free from decay.

Loose knot

A knot which is not held firmly in place by growth and which cannot be relied upon to remain in place in the piece.

Hole

A hole extending partially or entirely through the piece and attributable to any cause.

Split

A longitudinal separation of wood fibres extending through a piece of timber from one surface to another in sawn timber or through round timber. In veneer, a separation of the fibres in the direction of the grain and extending through the thickness of the veneer.

Bark pocket

A patch of bark partly or wholly enclosed in the wood. Not to be confused with the bark associated with an encased knot.

Gum pocket

A cavity which contains gum or kino. Gum, also called kino is a natural exudation produced in trees as a result of fire or mechanical damage.

Gum vein

A deposit of gum or kino between growth rings which may be bridged radially at short interval by wood tissue.

Insect attack

Deterioration caused by borers or termites.

Discoloration

Areas of colour differing from the average colour of the surrounding piece or from the colour normally associated with the piece and occurring in either streaks or patches.

Grain tearout

Gouges in veneer surface

Cumulative defect

Aggregate length of defects over a given veneer sheet width

Roughness

Unevenness of the surface of the timber or veneer or plywood.

Pin knot

A very small knot.

Scratch

A surface split or gouge that does not penetrate through form one side to another on a veneer sheet.

Joint

The seam produced by jointing the edges of veneer sheets together.

Knife mark

Marks on the surface of a veneer usually caused by a chipped blade resulting in a raised strip along the veneer surface.

Patching (plug)

A filler or plastic composite or plug used to repair voids in veneer and plywood.

Fungal decay

Decomposition of wood by fungi.

Waviness

Excessive waviness in the veneer that is thought to cause waves to split and overlap during pressing into veneer based products.

Resin and gum streak

The exudation of natural gum, oil, resin and the like on the surface of timber.

Resin pocket

A cavity that contains or has contained resin.

International standards

Many countries have standard grading rules for peeled veneer and/or plywood faces. These are mostly used as a basis for pricing and value segregation. The United States of America (USA) use, *Voluntary Product Standard PS 1-95: Construction and Industrial Plywood (National Institute of Standards and Technology, 1996)*. Australia & New Zealand use *AS/NZS 2269.0:2012 Plywood – Structural – Specifications (Standards Australia, 2012)*. In Europe *EN 635-2: 1995 Plywood – Classification by surface appearance – Hardwood (European Standard, 1995)* is used. In Russia veneer is graded using the Government Standards *GOST 3916.1-96 - Plywood with outer layers of hardwood veneer for general use (Intergovernmental Standard, 1996)*. China uses peeled veneer grading standard LYT 1599:2011 Rotary Veneer (National Panel Standardization Technical Committee, 2011). The Vietnam standard *TCVN 10316:2014 Rotary Veneer (TCVN, 2014)* is a replica of the Chinese standard. The Finnish Standard for Birch veneer follows *SFS 2413* which complies with the *EN 635-2* standard but is stricter or more demanding.

Each of these standards differs in intended use, product specification, species and/or wood type (i.e. hardwood or softwood) and grade allocation. The following outlines these variables for each standard.

Australian and New Zealand Standard 2269.0:2012

The objective of this Standard is to provide minimum performance requirements and specifications for the manufacture and application of structural plywood, acceptable to users, specifiers, manufacturers, and building authorities in Australia and New Zealand. The standard is applicable to both hardwoods and softwoods.

There are five veneer qualities specified for plywood in these Standards. The veneer qualities specified are grades A, S, B, C and D. As described by Standards Australia (2012) and Engineered Wood Products Association of Australasia (2009) the general description of each grade category are:

A-grade veneer

A high quality appearance grade veneer suitable for clear finishing. This appearance grade quality should be specified for the face veneer in plywood where surface decorative appearance is a primary consideration.

S-grade veneer

Grade S veneer has similar specifications as for grade A veneer, however the following additional permissible characteristics (not permissible for grade A) are allowed when specified as a decorative feature: knots, holes, discoloration, hobnails, and other characteristics as agreed between manufacture and customer.

B-grade veneer

An appearance grade suitable for high quality paint finishing. This face veneer quality should be specified for applications requiring a high quality paint finish.

C-grade veneer

Defined as a non-appearance grade with a solid surface. All open defects such as knot holes or splits are filled. Plywood with a quality C face is designed specifically for applications requiring a solid non-decorative surface such as in plywood flooring which is to be overlaid with a decorative flooring surface.

D-grade veneer

Defined as a non-appearance grade with permitted open imperfections. Plywood manufactured with face veneer quality D is the lowest appearance grade of plywood. It is designed specifically for structural applications where decorative appearance is not a requirement e.g. structural plywood.

USA Standard PS 1-95

This standard specifies veneer grades for the manufacture of construction and industrial plywood. It was initiated by the American Plywood Association and has been developed under the Procedures for the Development of Voluntary Product Standards of the U.S. Department of Commerce. The standard is applicable to both hardwoods and softwoods where a list of desired species is specified and split into 5 groups depending on them being ‘closely related’ (relationship not specified).

All veneers in the finished plywood panel shall conform to one of the grades N, A, B, C, D. N grade is the highest classification. In accordance with PS 1-95 (National Institute of Standards and Technology, 1996)) the general descriptions of each veneer grade are:

N-grade veneer

Grade N veneer is intended for natural finish outer veneer. The veneer should be smoothly cut and either 100 percent heartwood or 100 percent sapwood, free from knots, knotholes, pitch pockets, open splits, other open defects, and stain. If jointed it should consist of not more than two pieces in 48 inch widths, not more than three pieces in wider panels and well matched for colour and grain.

A-grade veneer

Grade A veneer is suitable for painting as an outer veneer. The veneer should be firm, smoothly cut, and free of knots, pitch pockets, open splits, and other open defects and well joined when of more than one piece.

B-grade veneer

Grade B veneer should be solid and free from open defects and broken grain, except few some exceptions. Slightly rough grain is permitted. Minor sanding and patching defects, including sander skips, should not exceed 5 percent of panel area.

C-grade veneer

Sanding defects that will not impair the strength or serviceability of the panel are permitted.

D-grade veneer

For grade D veneer, except as otherwise required, any number of plugs, patches, shims, worm or borer holes, sanding defects, and other characteristics shall be permitted, provided they do not seriously impair the strength or serviceability of the panels.

European standard EN 635-2&3: 1995

European standard *EN 635-1: 1995 Plywood – Classification by surface appearance – General* (British-Adopted European Standard, 1995) establishes general rules for the classification of plywood by its surface appearance for both hardwoods and softwoods. The classification is made according to the number and the extent of certain natural characteristics of wood and the defects that arise from the manufacturing process. Five appearance classes are distinguished – E, I, II, III and IV. Application descriptions for each grade are unspecified.

Russian standard GOST 3916.1&2-96: 1995

The Russian standard uses the same notation for its five appearance classes to the European standard BS EN 635; namely E, I, II, III and IV. The standard applies to the outer plywood veneer face with separate criteria limits for hardwoods and softwoods provided. The application of the five appearance classes are explained.

E-grade veneer

A high-quality clear face veneer intended for a natural finish. No defects allowed.

I-grade veneer

Solid-piece surface has light and uniform color. A few small pin knots and some brown streaks are allowed. Veneer of this grade is intended for natural finishes. Patches are not allowed. The majority of Grade B veneers are the equivalent of the American “white birch” faces.

II-grade veneer

Solid-piece face has light and uniform color. A few sound tight knots are permitted. Open knots and defects are eliminated and replaced with small oval or round veneer patches before gluing. The veneer selected for the patch is of the same color as the basic face veneer. Generally, there are very

few patches per face and many users purchase this grade for natural finishes.

III-grade veneer

Solid-piece face is very close to Grade II in quality. Thin splits are allowed. The oval or round patch may have a different color than the face veneer. There are more patches per face allowed than in Grade II.

IV-grade veneer

Open defects such as open knots and veneer splits are allowed. Sanding is not required. Recommended for the building of containers and dust panels; can be used for crating and in manufacturing, where construction and strength are more important than the appearance.

Chinese standard LYT 1599:2011

The Chinese standard applies to rotary cut veneer and specifies grade criteria for hardwood face veneer, softwood face veneer and substrate or core veneer (can be either softwood or hardwood) for the construction of veneer-based panels.

The hardwood face veneer is classified into five grades, softwood face veneer into four grades and substrate veneer two grades. The grade nomenclature is I to V where I is considered the highest quality grade and V the lowest. Application descriptions for each grade are unspecified.

Vietnamese standard TCVN 10316:2014

The Vietnamese standard is a replica of the Chinese standard in Vietnamese language.

Finnish standard SFS 2413

The Finnish standard consists of four grades. From the best to least quality the grade names are: B, S, BB and WG where:

B-grade veneer

This premium grade was developed to better serve customers who want a light-coloured, high quality plywood surface for lacquering or varnishing.

S-grade veneer

S-grade veneer is a high-quality veneer suitable as a base for high quality painting.

BB-grade veneer

BB-grade veneer is meant to be used in applications where the surface is not visible as such or there are no special requirements, for example under veneering, in structures and components. Typical applications are ships, parquet and transportation. Internally the BB quality is used when the surface will be painted or coated.

WG-grade veneer

WG-grade veneer is used in applications where the surface will not be visible or does not have high visual requirements, for example in structures and in packaging. It is also used in applications where the technical qualities, such as strength, bondability and hardness of the surface, are more important than the appearance of the panel.

Comparative grades

A simplified guide equating hardwood veneer appearance grades for each standard is provided in Table 1.

Table 1. Comparative standard grade guide

Country	Aus. / NZ	USA	Europe	Russia	China	Finland
Standard	2269.0:2012	PS 1-95	EN 635.2	GOST 99-96.1&2	LYT-1519	SFS 2413
Grade	S & A	N & A	E & I	E & I	I	B
	B	B	II	II	II	S
	C	C	III	III	III	BB
	D	D	IV	IV	IV	WG
					V	

A compilation of the grade criteria for each defect, grade and standard is provided in

Table 2, where all measurements are taken across the grain unless otherwise specified and cells

SOUND KNOTS – measured as diameter, and number per sheet or m^2						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	sound knots < 2 mm, no limit 2 – 4 mm, ≤ 4 / sheet	N & A - not allowed	E- not allowed I – pin knots 3 / m^2 sound knots ≤ 15 mm	E- not allowed ≤ 15 mm ≤ 5 / m^2 knot split ≤ 0.5 mm	≤ 5 mm ≤ 5 / m^2 no knot splits	≤ 6 mm ≤ 12mm / m^2 aggregate
B (II, S)	Sound knots only < 25 mm, no limit. 25 – 40 mm, ≤ 4 / sheet	≤ 25.4 mm	≤ 35 mm (hardwood)	≤ 25 mm ≤ 10 / m^2 knot split ≤ 1.0 mm	≤ 50 mm allowed knot splits OK	≤ 20 mm ≤ 50 mm / m^2 aggregate
C (III, BB)	< 50 mm no limit	≤ 38.1 mm no limit	≤ 50 mm (hardwood)	allowed knot split ≤ 1.5 mm	allowed	≤ 25 mm ≤ 60 mm / m^2 aggregate
D (IV, WG)	< 75 mm	≤ 63.5 mm occasional ≤ 76.2 mm allowed	no limit provided the end use serviceability is not compromised	allowed knot split ≤ 1.5 mm	allowed	≤ 65 mm ≤ 600 mm / m^2 aggregate
(V)					permitted	

without data indicate no data exists for that particular standard.

Table 2. Compilation of international standards appearance-veneer grade criteria

SOUND KNOTS – measured as diameter, and number per sheet or m^2						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	sound knots < 2 mm, no limit 2 – 4 mm, ≤ 4 / sheet	N & A - not allowed	E- not allowed I – pin knots 3 / m^2 sound knots ≤ 15 mm	E- not allowed ≤ 15 mm ≤ 5 / m^2 knot split ≤ 0.5 mm	≤ 5 mm ≤ 5 / m^2 no knot splits	≤ 6 mm ≤ 12mm / m^2 aggregate
B (II, S)	Sound knots only < 25 mm, no limit. 25 – 40 mm, ≤ 4 / sheet	≤ 25.4 mm	≤ 35 mm (hardwood)	≤ 25 mm ≤ 10 / m^2 knot split ≤ 1.0 mm	≤ 50 mm allowed knot splits OK	≤ 20 mm ≤ 50 mm / m^2 aggregate
C (III, BB)	< 50 mm no limit	≤ 38.1 mm no limit	≤ 50 mm (hardwood)	allowed knot split ≤ 1.5 mm	allowed	≤ 25 mm ≤ 60 mm / m^2 aggregate
D (IV, WG)	< 75 mm	≤ 63.5 mm occasional ≤ 76.2 mm allowed	no limit provided the end use serviceability is not compromised	allowed knot split ≤ 1.5 mm	allowed	≤ 65 mm ≤ 600 mm / m^2 aggregate
(V)					permitted	

LOOSE KNOTS – measured as diameter, and number per sheet or m^2						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	not allowed	N & A - not allowed	E – not allowed I – ≤ 6 mm ≤ 2 / m^2	E– not allowed I – ≤ 6 mm ≤ 3 / m^2	≤ 2 mm ≤ 2 / m^2 < 2 mm diameter not counted	≤ 6 mm ≤ 12mm / m^2 aggregate
B (II, S)	not allowed	not allowed	≤ 10 mm 3 / m^2	≤ 6 mm 6 / m^2	≤ 6 mm ≤ 2 / m^2 < 4 mm diameter not counted	≤ 10 mm ≤ 25 mm / m^2 aggregate
C (III, BB)	not allowed	not allowed	≤ 40 mm	≤ 6 mm ≤ 10 / m^2	≤ 15 mm ≤ 4 / m^2	≤ 6 mm ≤ 25 mm / m^2 aggregate
D (IV, WG)	< 75 mm	not allowed	no limit provided the end use serviceability is not compromised	≤ 40 mm allowed	≤ 30 mm allowed	≤ 15 mm ≤ 100 mm / m^2 aggregate
(V)					allowed	

HOLES – measured as diameter, and number per sheet or m^2						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	< 6 mm 4 / sheet	N & A - not allowed	E – not allowed I – ≤ 6mm, 2 per m^2.	E– not allowed I – ≤ 6 mm ≤ 3 / m^2	not allowed	≤ 6 mm ≤ 12mm / m^2 aggregate
B (II, S)	< 20 mm ≤ 2 / sheet	≤ 1.6 mm	≤ 10mm, 3 per m^2 (hardwood).	≤ 6 mm ≤ 6 / m^2	≤ 5 mm 4 / m^2 < 2 mm diameter not counted	≤ 10 mm ≤ 25 mm / m^2 aggregate
C (III, BB)	< 50 mm allowed	≤ 25 mm every 305 mm width occasional ≤ 38.1 mm allowed plugged – ≤ 6.4 mm wide x 12.7 mm long	≤ 40mm diameter.	≤ 6 mm ≤ 10 / m^2	≤ 8 mm 8 / m^2	≤ 6 mm ≤ 25 mm / m^2 aggregate
D (IV, WG)	< 75 x 200 mm area	≤ 63.5mm	no limit provided the end use serviceability is not compromised	≤ 40 mm allowed	≤ 8 mm unlimited if not creating sieve	≤ 15 mm ≤ 100 mm / m^2 aggregate
(V)					≤ 8 mm unlimited if not creating sieve	

SPLITS – measured as diameter, and number per sheet or m^2						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	< 150 x 3 mm tapering to a point ≤ 2 / sheet	N- ≤ 50 x 1.6 mm A- ≤ 50 x 1.6 mm (face) or 4.5 x 50 mm (substrate)	E – not allowed I – ≤ 1/10th sheet length x 3 mm ≤ 3 / m of sheet width	≤ 200 x 1mm 2 / m of sheet width	≤ 250 x1.5 mm ≤ 2 / m of sheet width	≤ 100 mm long closed split / m width
B (II, S)	< 500 x 3 mm, tapering to a point. unlimited quantity	≤ 50 x 1.6 mm (face) or ≤ 50 x 4.5 mm (substrate)	≤ 5 mm ≤ 1/3 sheet length x 10 mm	≤ 200 x 2 mm 2 / m of sheet width splits ≤ 1 mm wide unlimited	≤ 400 x1.5 mm 4 / m of sheet width	≤ 2 mm wide and 200 mm long patched split / m width
C (III, BB)	< 1/2 sheet length x 9 mm or 1/3 length x 12mm unlimited quantity	measured 205 mm in from end; ≤ 12. 7 mm wide x ½ sheet Plugged. ≤ 3.2 mm wide	≤ 20 mm ≤ 1/2 sheet length x 15 mm	≤ 300 x 2 mm 2 / m of sheet width splits ≤ 1 mm wide unlimited	≤ 600 x 3 mm ≤ 4 / m of sheet width	≤ 2 mm wide and 200 mm long patched split / m width
D (IV, WG)	< full sheet length x 5 mm or 1/2 sheet. length x 15 mm or 1/3 of sheet length x 25mm unlimited	measured 205 mm from veneer end ≤ 25 mm wide x full sheet tapering to no greater than 1.6 mm	no limit, provided the end use serviceability is not compromised.	≤ full length x 10 mm wide unlimited quantity	> 5 mm need to be repaired	≤ 4 mm wide 2 / m width
(V)					> 5 mm need to be repaired	

BARK/GUM POCKETS – measured as area or width, and number per sheet or m^2						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	not allowed	N&A – ≤ 9.5 mm wide, colour blended	not allowed	black gum not allowed transparent gum allowed	not allowed	permissible but limited
B (II, S)	not allowed	≤ 25.4 mm wide,	≤ 5 mm	black gum allowed with same limits as sound knots transparent gum allowed	not allowed	permissible but limited
C (III, BB)	not allowed	allowed if solid	≤ 25 mm	black gum allowed with same limits as sound knots transparent gum allowed	≤ 50 x 4 mm wide ≤ 2 / m^2	permissible but limited
D (IV, WG)	< 75 x 200 mm area	allowed if solid	no limit, provided the end use serviceability is not compromised	black gum allowed unlimited; transparent gum allowed	allowed	allowed
(V)					allowed	

GUM VEINS – measured as area or width, and number per sheet or m^2						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	not allowed	N&A – ≤ 9.5 mm wide, colour blended.	not allowed			permissible but limited
B (II, S)	not allowed	≤ 9.5 mm wide	allowed if slight			permissible but limited
C (III, BB)	allowed if a resin streak only	allowed if solid	allowed			permissible but limited
D (IV, WG)	< 75 x 200 mm area	allowed if solid	allowed			allowed
(V)						

INSECT ATTACK – measured as area or width, and number per sheet or m^2						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	not allowed	not allowed.	not allowed	E– not allowed I – ≤ 6 mm ≤ 3 / m^2	vertical holes; ≤ 2 mm diameter 3 / m^2 horizontal holes not allowed	permissible but limited
B (II, S)	not Allowed	vertical holes; ≤ 1.6 mm diameter 1 / m^2 horizontal holes; ≤ 1.6 mm wide x 25 mm long 12 / m^2	borer holes only, ≤ 3 mm diameter 10 / m^2	≤ 6 mm 6 / m^2	vertical holes; ≤ 2 mm diameter 8 / m^2 horizontal holes; ≤ 2 mm wide x 10 mm long 15 / m^2	permissible but limited
C (III, BB)	if a thin streak only	allowed if they don't impair strength or serviceability	≤ 15 mm wide x 60 mm long 3 / m^2	≤ 6 mm ≤ 10 / m^2	vertical holes; ≤ 4 mm diameter 15 / m^2 horizontal holes; ≤ 3 mm wide x 15 mm long 15 / m^2	permissible but limited
D (IV, WG)	< 75 x 200 mm area	allowed if they don't impair strength or serviceability	no limit, provided the end use serviceability is not compromised	≤ 40 mm unlimited quantity	vertical holes; ≤ 5 mm diameter 15 / m^2 horizontal holes; ≤ 3 mm wide x 50 mm long unlimited quantity	allowed
(V)					quantity/size unlimited	

DISCOLOURATION – measured visually and subjectively						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	slight natural discolouration only	N - well matched for colour and grain. A – natural discolouration allowed	E – practically absent. I – allowed if low contrast.	not allowed	not allowed	slight natural discolouration only
B (II, S)	allowed	allowed	allowed if low contrast	≤ 5% of sheet area	≤ 5% of sheet area	allowed
C (III, BB)	allowed	allowed	allowed	allowed	≤ 30% of sheet area	allowed
D (IV, WG)	allowed	allowed	allowed	allowed	allowed	allowed
(V)					allowed	

GRAIN TEAROUT – measured as area or subjective						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	around allowed defect only	not allowed	E – practically absent. I – very slight.	not allowed	very slight	not allowed
B (II, S)	around allowed defect only	not allowed	slight	≤ 5% of the sheet area	slight	not allowed
C (III, BB)	around allowed defect only	limited	no limit, provided the end use serviceability is not compromised	≤ 15% of the sheet area	allowed if surface not rough	allowed - slight
D (IV, WG)	around allowed defect only	allowed	no limit, provided the end use serviceability is not compromised	allowed	allowed	allowed
(V)					very slight	

CUMULATIVE DEFECT – measured as aggregation of width over a distance						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	≤ 45 mm in any 300mm width (					≤ 12mm / m^2 aggregate
B (II, S)	≤ 45 mm in any 300mm width					≤ 50 mm / m^2 aggregate
C (III, BB)	≤ 75 mm in any 300 mm width					≤ 60 mm / m^2 aggregate
D (IV, WG)	≤ 75 mm in any 120 mm width					≤ 600 mm / m^2 aggregate
(V)						

ROUGHNESS – subjective or using a roughness meter						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	slight, around localized defect only	must be smooth	E – practically absent. I – very slight.	no more than 200 µm according to GOST 7016*		not allowed
B (II, S)	slight, around localized defect only	slight	slight	no more than 200 µm according to GOST 7016*		not allowed
C (III, BB)	slight, around localized defect only	no limit, provided the end use serviceability is not compromised.	Not allowed	no more than 200 µm according to GOST 7016*		allowed - slight
D (IV, WG)	permitted around localized defect only	no limit, provided the end use serviceability is not compromised.	no limit, provided the end use serviceability is not compromised	no more than 200 µm according to GOST 7016*		allowed
(V)						

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PIN KNOTS – measured as diameter or number per area						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)				E – not allowed I -≤ 3 / m^2	≤ 2 mm, quantity: unlimited	≤ 3 mm ≤ 3 / panel
B (II, S)				allowed	allowed	allowed
C (III, BB)				allowed	allowed	allowed
D (IV, WG)				allowed	allowed	allowed
(V)					allowed	

SCRATCHES – measured as area of sheet and severity						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)				not allowed	not allowed	not allowed
B (II, S)				allowed	≤ 1% sheet area and don't go through sheet	not allowed
C (III, BB)				allowed	≤ 2% sheet area and don't go through sheet	allowed - slight
D (IV, WG)				allowed	allowed if scratches don't go through sheet	allowed
(V)					allowed if scratches don't go through sheet	

JOINTS – measured as number joins / width or area, and joint gap width						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	open joints not allowed filled: ≤ 3 mm wide ≤ 450 mm^2 total area	different specifics for plywood, marine or decorative products	E&I – not allowed	E&I – not allowed	not allowed	core veneer only
B (II, S)	open joints not allowed filled: ≤ 3 mm wide ≤ 750 mm^2 total area	different specifics for plywood, marine or decorative products	≤ 3 mm wide 1 / m length must fill if ≥1 mm wide	≤ 1 mm wide 1 / m length	not allowed	core veneer only
C (III, BB)	open joints not allowed filled: ≤ 9 mm x ½ sheet length, or wide ≤ 12 mm x 600 mm length	different specifics for plywood, marine or decorative products	≤ 5 mm wide (can be unfilled	≤ 2 mm wide 1 / m length	not allowed	core veneer only
D (IV, WG)	open joints ≤ 5 mm total x full length, or ≤ 15 mm total x ½ sheet length, or ≤ 25 mm total x 1/3 sheet length	different specifics for plywood, marine or decorative products	≤ 25 mm wide unlimited can be unfilled	allowed	≤ 2 joins / sheet join gap < 1.5 mm join gap < 30% same colour, grain, species, thickness	core veneer only
(V)					unlimited joins join gap < 2 mm join gap < 30% same colour, grain, species, thickness	

KNIFE MARK – measured by feel						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)					not allowed	
B (II, S)					very slight	
C (III, BB)					slight, no sensation by hand	
D (IV, WG)					slight sensation by hand	
(V)					slight sensation by hand	

PATCHING – measured by aesthetics, area and number patches						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	not allowed	≤ 57 mm wide if ≥ 25 mm wide patch must be ≤ 180 mm long ≤ 2 / sheet	not allowed	not allowed	not allowed	not allowed
B (II, S)	not allowed	≤ 5% panel area ≤ 100 mm wide	permitted if tightly filled 3 / m^2	2 / m^2	not allowed	1 / m^2
C (III, BB)	≤ 75 mm wide adhering to cumulative defects	≤ 100 mm wide	permitted if tightly filled 6 / m^2	permitted	not allowed	Up to 3% surface area
D (IV, WG)	≤ 75 mm wide and adhering to cumulative defects	no limit, provided the end use serviceability is not compromised.	permitted	permitted	colour, grain and thickness of the patched veneers must be similar ≤ 1 mm wide x 600 mm long gap total length gaps ≤ 1,200 mm, ≤ 5 / sheets	Allowed (referred to as WGE or EW)
(V)					allowed	

FUNGAL DECAY – measured by size or subjectively						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)	not allowed	not allowed	not allowed	not allowed	not allowed	
B (II, S)	not allowed	not allowed	not allowed	not allowed	not allowed	
C (III, BB)	not allowed	not allowed	not allowed	not allowed	not allowed	
D (IV, WG)	not allowed	'white pocket' allowed ≤ 610 mm wide x 305 mm long	not allowed	not allowed	permitted if sheet strength not affected	
(V)					permitted if sheet strength not affected	

WAVINESS – subjective measurement						
Standard / Grade	AUS / NZ AS/NZS2269.0	USA PS1-95	Europe EN635.2	Russia GOST 99-96.1	Vietnam (China) TCVN 10316	Finland SFS 2413
A (S,N,E,I,B)				not allowed		
B (II, S)				not allowed		
C (III, BB)				permitted		
D (IV, WG)				permitted		
(V)						

Thickness tolerances

Thickness is a very important veneer property that should be confined to minimal variation. Veneer with high variation within and between sheets causes problems with the overall variation in thickness of veneer-based products such as plywood. Additionally, high thickness variation causes variations in the amount of adhesive spread on veneers when using an automated glue spreader. For instance, thinner veneers will tend to have more glue spread on their surface than thicker veneers with the same machine set-up.

Of the standards reviewed in this report, three provide thickness tolerances for peeled veneer for plywood production. American standard *PS 1-95* (National Institute of Standards and Technology, 1996) states a thickness tolerance of 5% of the nominal dried veneer thickness should be applied. Vietnamese standard *TCVN 10316:2014* (TCVN, 2014) and Chinese standard *LYT 1599:2011* (National Panel Standardization Technical Committee, 2011) provide a list of thickness tolerances dependent on the nominal thickness of the veneer as shown in Table 3.

Table 3. *TCVN 10316:2014* and *LYT 1599:2011* standards thickness tolerances for rotary peeled veneer for plywood production

Nominal thickness range (mm)	Thickness tolerance (mm)
0.55 – 0.65	± 0.03
0.66 – 1.00	± 0.04
1.01 – 1.60	± 0.06
1.61 – 2.00	± 0.08
2.01 – 3.20	± 0.10