

High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (Usually called Laminates)

Part 8: Classification and specifications for design laminates

ICS 83.140.20

National foreword

This British Standard is the UK implementation of EN 438-8:2009.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 438-8:2009) has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2009, and conflicting national standards shall be withdrawn at the latest by September 2009.

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

EN 438 consists of the following parts, under the general title *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (Usually called Laminates)*:

- *Part 1: Introduction and general information*
- *Part 2: Determination of properties*
- *Part 3: Classification and specifications for laminates less than 2 mm thick intended for bonding to supporting substrates*
- *Part 4: Classification and specifications for Compact laminates of thickness 2 mm and greater*
- *Part 5: Classification and specifications for flooring grade laminates less than 2 mm thick intended for bonding to supporting substrates*
- *Part 6: Classification and specifications for Exterior-grade Compact laminates of thickness 2 mm and greater*
- *Part 7: Compact laminate and HPL composite panels for internal and external wall and ceiling finishes*
- *Part 8: Classification and specifications for design laminates (this standard)*
- *Part 9: Classification and specifications for alternative core laminates¹*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 In preparation.

1 Scope

This part of EN 438 specifies performance requirements for high-pressure decorative laminates (HPL) intended for interior use with a design effect surface having a phenolic based core and a decorative surface, not covered by EN 438-3 to EN 438-6. Three surface material types (metal, wood veneer and pearlescent decor) are defined in this part of EN 438.

EN 438-2 specifies the test methods relevant to this part of EN 438.

2 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.

EN 438-2:2005, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called Laminates) — Part 2: Determination of properties*

EN 12721, *Furniture — Assessment of surface resistance to wet heat (ISO 4211-2:1993 modified)*

EN 12722, *Furniture — Assessment of surface resistance to dry heat (ISO 4211-3:1993 modified)*

EN ISO 178, *Plastics — Determination of flexural properties (ISO 178:2001)*

EN ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1:2004)*

ISO 11664-2, *Colorimetry -- Part 2: CIE standard illuminants*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 high pressure process
process for producing laminate(s) by simultaneous application of heat (temperature ≥ 120 °C) and high specific pressure (≥ 5 MPa), to provide flowing and subsequent curing of the thermosetting resins

3.2 high-pressure decorative design laminate(s) (HPL)
sheet(s) consisting of decorative surface layers supported by layers of cellulosic fibrous material (normally paper) impregnated with thermosetting resins and bonded together by a high pressure process

NOTE 1 For surface layers, see 3.3.

NOTE 2 The core layers are impregnated with phenolic based resins. The surface layers can appear on one or both side(s) of the laminate(s). They are not necessarily treated with thermosetting resin. In case of one-sided design laminates the back of the sheet(s) is made suitable for adhesive bonding to a substrate.

3.3 Types of high-pressure decorative design laminates according to the surface layer materials

3.3.1 pearlescent laminate
high-pressure decorative design laminate, the surface material of which consists of a pearlescent effect decorative paper, which is impregnated with melamine resin

NOTE 1 To achieve the optimum aesthetic effect from the pearlescent pigment a protective melamine layer is not used.

NOTE 2 As a result some surface properties are reduced (e.g. scratch, wear) therefore it is recommended that these products are used for vertical applications.

3.3.2

metal laminate

high-pressure decorative design laminate, the surface material of which consists of a thin layer of metal

NOTE 1 E.g. aluminium, steel or copper.

NOTE 2 It is often protected by a thin layer of lacquer or in the case of aluminium the surface can be anodized. The surface performance and appearance of these metal laminates is equivalent to that of thin metal sheet.

NOTE 3 As some surface properties are lower than that of melamine (e.g. scratch and wear), it is recommended that these products are used for vertical applications.

3.3.3

wood veneer laminate

high-pressure decorative design laminate, the surface material of which consists of a wood veneer, which is covered by a protective melamine layer. The surface appearance of these wood veneer laminates is similar to wood. Wood veneer laminates are not normally available in postforming grade

4 Material types and classification system

High-pressure decorative design laminates are defined using a three letter classification system as shown in Table 1.

Table 1 — High-pressure decorative design laminate classification system

First letter	Second letter	Third letter
A (Pearlescent laminate)	C (Compact)	S (Standard grade)
M (Metal laminate)	T (Thin laminate < 2 mm)	or P (Postformable grade)
W (Wood veneer laminate)		or F (Flame retardant grade)

Type S – Standard grade high-pressure decorative design laminates.

Type P – Postformable high-pressure decorative design laminates, similar to type S but can also be formed at elevated temperature.

Type F – High-pressure decorative design laminates with improved fire retardance similar to type S or P but also complying with special requirements of specified tests which may vary according to the application (e.g. construction, marine, transport) and the country of use (see 5.4.5).

In addition to the abbreviation "HPL" and the number of this European Standard, materials shall be specified by the alphabetical classification system.

EXAMPLE "Pearlescent Standard Grade Thin high-pressure decorative design laminate" is designated as HPL/EN 438-8 ATS.

5 Requirements

5.1 Compliance

High-pressure decorative design laminates classified in Table 1 shall comply with all appropriate requirements specified in 5.2, 5.3 and 5.4. This applies to both full-size sheets and cut-to-size panels.

5.2 Inspection requirements

5.2.1 General

Inspection shall be carried out in accordance with EN 438-2:2005, Clause 4, at a distance of 1,5 m.

5.2.2 Colour, pattern and surface finish

5.2.2.1 Pearlescent

When inspected in daylight or D65 standard illuminant, as specified in ISO 11664-2, and also under tungsten-filament lightning illuminant A as specified in ISO 11664-2, a slight difference between the corresponding colour reference sample held by the supplier and the specimen under test is acceptable.

As colour and surface finish are critical, it is recommended that sheets are checked for colour and surface-finish compatibility without protective film before fabrication or installation.

Some of these products are directional in surface finish or colour and they shall be installed in the correct orientation.

5.2.2.2 Metal

When inspected in daylight or D65 standard illuminant, as specified in ISO 11664-2, and also under tungsten-filament lightning illuminant A as specified in ISO 11664-2, a slight difference between the corresponding colour reference sample held by the supplier and the specimen under test is acceptable.

As colour and surface finish are critical, it is recommended that sheets are checked for colour and surface-finish compatibility without protective film before fabrication or installation.

Some of these products are directional in surface finish or colour and they shall be installed in the correct orientation. Small indentations in the surface are unavoidable.

5.2.2.3 Wood veneer

Due to the fact that wood is a natural product, each veneer may be considered as unique. Slight colour and structure differences are considered as normal. Singularities such as knots and resin inclusions are not considered as defects, but as a part of the decor. There are differences in light fastness performances depending on the wood species and the source of the wood.

5.2.3 Reverse side

The reverse side of single-sided sheets shall be suitable for adhesive bonding (e.g. sanded). In the case of sanded backs, slight chatter marks shall be permitted.

5.2.4 Visual inspection

5.2.4.1 General

The following inspection requirements are intended as a general guide, indicating the minimum acceptable quality for laminates. Cut-to-size panels and certain applications involving full-size sheets may call for special quality requirements which can be negotiated between supplier and purchaser; in such cases the following requirements may be used as a basis for agreement. Only a small percentage of sheets in a batch (the level to be agreed with the customer) shall contain defects of the minimum acceptable level.

5.2.4.2 Surface quality

The following surface defects are permissible:

Dirt, spots, dents and similar surface defects

The admissible size of such defects is based on a maximum contamination area equivalent to $1,0 \text{ mm}^2/\text{m}^2$ of laminate and is proportional to the sheet size under inspection.

The total admissible area of contamination may be concentrated in one spot or dispersed over an unlimited amount of smaller defects.

Fibres, hairs and scratches

The admissible size of defects is based on a maximum contamination length equivalent to $10 \text{ mm}/\text{m}^2$ of laminate and is proportional to the sheet size under inspection.

The total admissible length of contamination may be concentrated in one defect or dispersed over an unlimited amount of smaller defects.

5.2.4.3 Edge quality

Visual defects (e.g. moisture marks, lack of gloss, corner damage) can be present on all four edges of the laminate, providing the defect-free length and width are at least the nominal size minus 20 mm.

5.3 Dimensional tolerance requirements

5.3.1 Dimensional tolerance requirements for pearlescent laminates

Dimensional tolerance requirements for pearlescent laminates are specified in Tables 2 and 3.

Table 2 — Dimensional tolerance requirements for thin pearlescent laminates

Property	Test method (EN 438-2:2005 clause no.)	Requirement
Thickness	5	0,5 mm ≤ <i>t</i> ≤ 1,0 mm: maximum variation ± 0,10 mm 1,0 mm < <i>t</i> < 2,0 mm: maximum variation ± 0,15 mm (where <i>t</i> = nominal thickness of the pearlescent laminate)
Flatness ^a	9	maximum deviation: 60 mm/m
Length and width ^b	6	+ 10 mm / - 0 mm
Straightness of edges ^b	7	Maximum deviation: 1,5 mm/m
Squareness ^b	8	Maximum deviation: 1,5 mm/m
^a Provided that the pearlescent laminates are stored in the manner and conditions recommended by the manufacturer they shall comply with the flatness requirements specified in Table 2 when measured in accordance with EN 438-2:2005, Clause 9. ^b Tolerances for cut-to-size panels shall be agreed between supplier and purchaser.		

Table 3 — Dimensional tolerance requirements for compact pearlescent laminates

Property	Test method (EN 438-2:2005 clause no.)	Requirement
Thickness	5	2,0 mm ≤ <i>t</i> < 3,0 mm: maximum variation ± 0,20 mm 3,0 mm ≤ <i>t</i> < 5,0 mm: maximum variation ± 0,30 mm 5,0 mm ≤ <i>t</i> < 8,0 mm: maximum variation ± 0,40 mm 8,0 mm ≤ <i>t</i> < 12,0 mm: maximum variation ± 0,50 mm 12,0 mm ≤ <i>t</i> < 16,0 mm: maximum variation ± 0,60 mm 16,0 mm ≤ <i>t</i> < 20,0 mm: maximum variation ± 0,70 mm 20,0 mm ≤ <i>t</i> < 25,0 mm: maximum variation ± 0,80 mm 25,0 mm ≤ <i>t</i> : to be agreed between supplier and customer (where <i>t</i> = nominal thickness of the pearlescent laminate)
Flatness ^a	9	2,0 mm ≤ <i>t</i> < 6,0 mm: 8,0 mm/m maximum deviation 6,0 mm ≤ <i>t</i> < 10,0 mm: 5,0 mm/m maximum deviation 10,0 mm ≤ <i>t</i> : 3,0 mm/m maximum deviation (where <i>t</i> = nominal thickness of the pearlescent laminate)
Length and width ^b	6	+ 10 mm / - 0 mm
Straightness of edges ^b	7	Maximum deviation: 1,5 mm/m
Squareness ^b	8	Maximum deviation: 1,5 mm/m
^a Provided that the pearlescent laminates are stored in the manner and conditions recommended by the manufacturer they shall comply with the flatness requirements specified in Table 3 when measured in accordance with EN 438-2:2005, Clause 9. The flatness values specified in Table 3 apply to pearlescent laminates with two decorative faces. Limits for pearlescent laminates with one face sanded shall be agreed between supplier and customer. ^b Tolerances for cut-to-size panels shall be agreed between supplier and purchaser.		

5.3.2 Dimensional tolerances requirements for metal laminates

Dimensional tolerance requirements for metal laminates are specified in Tables 4 and 5

Table 4 — Dimensional tolerance requirements for thin metal laminates

Property	Test method (EN 438-2:2005 clause no.)	Requirement
Thickness	5	0,5 mm ≤ t ≤ 1,0 mm: maximum variation ± 0,15 mm 1,0 mm < t < 2,0 mm: maximum variation ± 0,18 mm (where t = nominal thickness of the metal laminate)
Flatness ^a	9	Maximum deviation: 100 mm/m
Length and width ^b	6	+ 10 mm / - 0 mm
Straightness of edges ^b	7	Maximum deviation: 1,5 mm/m
Squareness ^b	8	Maximum deviation: 1,5 mm/m
^a Provided that the metal laminates are stored in the manner and conditions recommended by the manufacturer they shall comply with the flatness requirements specified in Table 4 when measured in accordance with EN 438-2:2005, Clause 9.		
^b Tolerances for cut-to-size panels shall be agreed between supplier and purchaser.		

Table 5 — Dimensional tolerance requirements for compact metal laminates

Property	Test method (EN 438-2:2005 clause no.)	Requirement
Thickness	5	2,0 mm ≤ t < 3,0 mm: maximum variation ± 0,25 mm 3,0 mm ≤ t < 5,0 mm: maximum variation ± 0,40 mm 5,0 mm ≤ t < 8,0 mm: maximum variation ± 0,50 mm 8,0 mm ≤ t < 12,0 mm: maximum variation ± 0,70 mm 12,0 mm ≤ t < 16,0 mm: maximum variation ± 0,80 mm 16,0 mm ≤ t < 20,0 mm: maximum variation ± 0,90 mm 20,0 mm ≤ t < 25,0 mm: maximum variation ± 1,00 mm 25,0 mm ≤ t : to be agreed between supplier and customer (where t = nominal thickness of the metal laminate)
Flatness ^a	9	2,0 mm ≤ t < 6,0 mm: 8,0 mm/m maximum deviation 6,0 mm ≤ t < 10,0 mm: 5,0 mm/m maximum deviation 10,0 mm ≤ t : 3,0 mm/m maximum deviation (where t = nominal thickness of the metal laminate)
Length and width ^b	6	+ 10 mm / - 0 mm
Straightness of edges ^b	7	Maximum deviation: 1,5 mm/m
Squareness ^b	8	Maximum deviation: 1,5 mm/m
^a Provided that the metal laminates are stored in the manner and conditions recommended by the manufacturer they shall comply with the flatness requirements specified in Table 5 when measured in accordance with EN 438-2:2005, Clause 9. The flatness values specified in Table 5 apply to metal laminates with two decorative faces. Limits for metal laminates with one face sanded shall be agreed between supplier and customer.		
^b Tolerances for cut-to-size panels shall be agreed between supplier and purchaser.		

5.3.3 Dimensional tolerance requirements for wood veneer laminates

Dimensional tolerance requirements for wood veneer laminates are specified in Tables 6 and 7.

Table 6 — Dimensional tolerance requirements for thin wood veneer laminates

Property	Test method (EN 438-2:2005 clause no.)	Requirement
Thickness	5	(0,5 mm ≤ t ≤ 1,0) mm: maximum variation ± 0,15 mm (1,0 mm < t < 2,0) mm: maximum variation ± 0,18 mm (where t = nominal thickness of the wood veneer laminate)
Flatness ^a	9	Maximum deviation: 120 mm/m
Length and width ^b	6	+ 10 mm / - 0 mm
Straightness of edges ^b	7	Maximum deviation: 1,5 mm/m
Squareness ^b	8	Maximum deviation: 1,5 mm/m
^a Provided that the wood veneer laminates are stored in the manner and conditions recommended by the manufacturer they shall comply with the flatness requirements specified in Table 6 when measured in accordance with EN 438-2:2005, Clause 9. ^b Tolerances for cut-to-size panels shall be agreed between supplier and purchaser.		

Table 7 — Dimensional tolerance requirements for compact wood veneer laminates

Property	Test method (EN 438-2:2005 clause no.)	Requirement
Thickness	5	$2,0 \text{ mm} \leq t < 3,0 \text{ mm}$: maximum variation $\pm 0,25 \text{ mm}$ $3,0 \text{ mm} \leq t < 5,0 \text{ mm}$: maximum variation $\pm 0,40 \text{ mm}$ $5,0 \text{ mm} \leq t < 8,0 \text{ mm}$: maximum variation $\pm 0,50 \text{ mm}$ $8,0 \text{ mm} \leq t < 12,0 \text{ mm}$: maximum variation $\pm 0,70 \text{ mm}$ $12,0 \text{ mm} \leq t < 16,0 \text{ mm}$: maximum variation $\pm 0,80 \text{ mm}$ $16,0 \text{ mm} \leq t < 20,0 \text{ mm}$: maximum variation $\pm 0,90 \text{ mm}$ $20,0 \text{ mm} \leq t < 25,0 \text{ mm}$: maximum variation $\pm 1,00 \text{ mm}$ $25,0 \text{ mm} \leq t$: to be agreed between supplier and customer (where t = nominal thickness of the wood veneer laminate)
Flatness ^a	9	$2,0 \text{ mm} \leq t < 6,0 \text{ mm}$: 12,0 mm/m maximum deviation $6,0 \text{ mm} \leq t < 10,0 \text{ mm}$: 8,0 mm/m maximum deviation $10,0 \text{ mm} \leq t$: 5,0 mm/m maximum deviation (where t = nominal thickness of the wood veneer laminate)
Length and width ^b	6	+ 10 mm / - 0 mm
Straightness of edges ^b	7	Maximum deviation: 1,5 mm/m
Squareness ^b	8	Maximum deviation: 1,5 mm/m
^a Provided that the wood veneer laminates are stored in the manner and conditions recommended by the manufacturer they shall comply with the flatness requirements specified in Table 7 when measured in accordance with EN 438-2:2005, Clause 9. The flatness values specified in Table 7 apply to wood veneer laminates with two decorative faces. Limits for wood veneer laminates with one face sanded shall be agreed between supplier and customer.		
^b Tolerances for cut-to-size panels shall be agreed between supplier and purchaser.		

5.4 Test requirements

5.4.1 General requirements for pearlescent laminates

General requirements specified in Table 8.

Table 8 — General requirements for pearlescent laminates

Property	Test method (EN 438-2:2005 clause no. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Pearlescent laminate grade						
				ATS	ATP	ATF	ACS	ACF		
Resistance to impact by small diameter ball	20	Spring force	N (min.)	15	15	15	–	–		
Resistance to impact by large diameter ball	21	Drop height Indent diameter	mm (min.) mm (max.)	–	–	–	800 12	800 12		
Resistance to scratching	25 and EN 438-3:2005, Annex A	Force	Rating (min.)	2	2	2	2	2		
Dimensional stability at elevated temperature	17	Cumulative dimensional change	% (max.) $t < 2$ mm	L ^a T ^b	0,75 1,25	0,75 1,25	0,75 1,25	– –	– –	
			$2 \text{ mm} \leq t < 5$ mm	L ^a T ^b	– –	– –	– –	0,40 0,80	0,40 0,80	
			$t \geq 5$ mm	L ^a T ^b	– –	– –	– –	0,30 0,60	0,30 0,60	
Resistance to immersion in boiling water	12	Appearance	Rating (min.) gloss finish other finishes		3 4	3 4	3 4	3 4	3 4	
			Mass increase	% (max.) $2 \text{ mm} \leq t < 5$ mm $t \geq 5$ mm		– –	– –	– –	5,0 2,0	7,0 3,0
				Thickness increase	% (max.) $2 \text{ mm} \leq t < 5$ mm $t \geq 5$ mm		– –	– –	– –	6,0 2,0
		Resistance to staining	26		Appearance	Rating (min.) Groups 1 and 2 Group 3		5 4	5 4	5 4
				Light fastness (xenon arc)		27	Contrast	Grey scale rating (min.)	4 ^c	4 ^c
Resistance to water vapour	14	Appearance	Rating (min.)		3	3	3	3	3	
Resistance to cracking under stress (optional)	23	Appearance	Rating (min.)		4	4	4	–	–	

Table 8 (Continued)

Resistance to crazing	24	Appearance	Rating (min.)	–	–	–	4	4
Flexural strength	EN ISO 178 ^d	Stress	MPa (min.)	–	–	–	80	
Flexural modulus	EN ISO 178 ^d	Stress	MPa (min.)	–	–	–	9 000	
Density	EN ISO 1183-1	Density	g/cm ³ (min)	1,35	1,35	1,35	1,35	1,35
<p>^a L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the perlescent laminate).</p> <p>^b T = in the cross-longitudinal (cross-machine) direction of the fibrous sheet material (at right angles to direction L).</p> <p>^c Extraneous darkening and/or photocromism are due to the shock effect of accelerated exposure and are not characteristics of natural exposure.</p> <p>^d Machined crosshead speed: 2 mm/min.</p>								

5.4.2 General requirements for metal laminates

General requirements specified in Table 9.

Table 9 — General requirements for metal laminates

Property	Test method (EN 438-2:2005 clause no. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Metal laminate grade					
				MTS	MTP	MTF	MCS	MCF	
Resistance to scratching	25	Force	Rating (min.)	1	1	1	1	1	
Dimensional stability at elevated temperature	17	Cumulative dimensional change	% (max.)	L ^a	0,75	0,75	0,75	–	–
			$t < 2$ mm	T ^b	1,25	1,25	1,25	–	–
			$2 \text{ mm} \leq t < 5$ mm	L ^a	–	–	–	0,40	0,40
				T ^b	–	–	–	0,80	0,80
			$t \geq 5$ mm	L ^a	–	–	–	0,30	0,30
				T ^b	–	–	–	0,60	0,60
Resistance to immersion in boiling water	12	Appearance	Core delamination Pass or fail	Pass ^c	Pass ^c	Pass ^c	Pass ^c	Pass ^c	
Resistance to staining	26	Appearance	Rating (min.)						
			Groups 1 and 2	4	4	4	4	4	
			Group 3	4	4	4	4	4	
Light fastness (xenon arc)	27	Contrast	Grey scale rating (min.)	4 ^d	4 ^d	4 ^d	4 ^d	4 ^d	
Resistance to water vapour	14	Appearance	Rating (min.)	3	3	3	3	3	
Resistance to cracking under stress (optional)	23	Appearance	Rating (min.)	4	4	4	–	–	
Resistance to crazing	24	Appearance	Rating (min.)	–	–	–	4	4	
Flexural strength	EN ISO 178 ^e	Stress	MPa (min.)	–	–		80		
Flexural modulus	EN ISO 178 ^e	Stress	MPa (min.)	–	–		9 000		
Density	EN ISO 1183-1	Density	g/cm ³ (min.)	1,35	1,35	1,35	1,35	1,35	

^a L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the metal laminate).

^b T = in the cross-longitudinal (cross-machine) direction of the fibrous sheet material (at right angles to direction L).

^c No delamination of the core.

^d Extraneous darkening and/or photochromism are due to the shock effect of accelerated exposure and are not characteristics of natural exposure.

^e Machined crosshead speed: 2 mm/min.

5.4.3 General requirements for wood veneer laminates

General requirements specified in Table 10.

Table 10 — General requirements for wood veneer laminates

Property	Test method (EN 438-2:2005 clause no. unless otherwise stated)	Property or attribute	Unit (max or min)	Wood veneer laminate grade			
				WTS	WTF	WCS	WCF
Resistance to surface wear	10	Wear resistance	revolutions (min.)				
			initial point wear value	150	150	150	150
Resistance to impact by large diameter ball (optional)	21	Drop height Indent diameter	mm (min.)	600	600	800	800
			mm (max.)	12	12	10	10
Resistance to scratching	25	Force	Rating (min.)	2	2	2	2
Dimensional stability at elevated temperature	17	Cumulative dimensional change	% (max.) L ^a	0,75	0,90	–	–
			$t < 2$ mm T ^b	1,25	1,40	–	–
			$2 \text{ mm} \leq t < 5$ mm L ^a	–	–	0,55	0,55
			T ^b	–	–	0,90	0,90
			$t \geq 5$ mm L ^a	–	–	0,45	0,45
T ^b	–	–	0,75	0,75			
Resistance to immersion in boiling water	12	Appearance	Delamination pass or fail	Pass ^c	Pass ^c	Pass ^c	Pass ^c
Resistance to dry heat (100 °C)	EN 12722	Appearance	Rating (min.)	3	3	3	3
Resistance to wet heat (100 °C)	EN 12721	Appearance	Rating (min.)	3	3	3	3
Resistance to staining	26	Appearance	Rating (min.)				
			Groups 1 and 2 Group 3	4 4	4 4	4 4	4 4
Light fastness (xenon arc)	27	Contrast	Grey scale rating (min.)	2 ^d	2 ^d	2 ^d	2 ^d
Resistance to cracking under stress (optional)	23	Appearance	Rating (min.)	4	4	–	–
Resistance to crazing	24	Appearance	Rating (min.)	–	–	4	4
Flexural strength	EN ISO 178 ^e	Stress	MPa (min.)	–	–	65	
Flexural modulus	EN ISO 178 ^e	Stress	MPa (min.)	–	–	6 500	
Density	EN ISO 1183-1	Density	g/cm ³ (min.)	1,0	1,0	1,1	1,1

Table 10 (Continued)

a	L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the wood veneer laminate).
b	T = in the cross-longitudinal (cross-machine) direction of the fibrous sheet material (at right angles to direction L).
c	No delamination of the core.
d	See 5.2.2.3.
e	Machined crosshead speed: 2 mm/min.

5.4.4 Additional requirements for type P high-pressure decorative design laminates.

In addition to meeting the appropriate requirements specified in Tables 8 and 9, Type P postformable pearlescent laminates and metal laminates of thickness $\leq 1,5$ mm shall meet the values specified in Table 11 for formability and blister resistance.

NOTE Metal laminates are processed and tested at a lower temperature than typical postformable laminates.

Table 11 — Additional requirements for type P high-pressure decorative design laminates

Property	Test method (EN 438-2:2005, clause no.)	Property or attribute	Unit	Requirement
Formability	31 or 32	Radius	mm L ^a T ^b	≤ 10 x laminate nominal thickness ≤ 20 x laminate nominal thickness
Resistance to blistering	33 or 34	Time to blister ($t_2 - t_1$)	Seconds Nominal thickness < 0,8 mm Nominal thickness $\geq 0,8$ mm	≥ 10 ≥ 15
<p>a L = axis of bending parallel to the fibre direction (usually parallel to the direction of sanding).</p> <p>b T = axis of bending at right angles to the fibre direction.</p>				

5.4.5 Notes on requirements for reaction to fire

The requirements for reaction to fire are determined by the fire regulations of the country in which the material is to be used.

In Europe, laminate panels intended for construction applications are tested in accordance with EN 13823 [1] (SBI test) and EN ISO 11925-2 [2] (Small-burner test), and the resulting reaction-to-fire performance is expressed in accordance with EN 13501-1 [3].

For applications other than construction, fire test methods and performance requirements may vary from one country to another, and at present it is not possible, with any test, to predict compliance with all national and other requirements.

All the products covered by this part of EN 438 will have different reaction to fire performance depending on the composition and/or decorative surfaces. Reaction to fire will also depend on laminate thickness and construction of the element, substrate type and thickness, and adhesive used. The laminate manufacturer should be contacted for information on fire test methods, classifications and fire certification.

No fire performance test is therefore included in this part of EN 438.

Bibliography

- [1] EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*
- [2] EN ISO 11925-2, *Reaction to fire tests — Ignitability of building products subjected to direct impingement of flame – Part 2: Single-flame source test (ISO 11925-2:2002)*
- [3] EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*

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