BS EN 438-3:2016

BSI Standards Publication

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

Part 3: Classification and specifications for laminates less than 2 mm thick intended for bonding to supporting substrates

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National foreword

This British Standard is the UK implementation of EN 438-3:2016. It supersedes BS EN 438-3:2005 which is withdrawn.

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

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High-pressure decorative laminates (HPL) - Sheets based on thermosetting resins (usually called laminates) - Part 3: Classification and specifications for laminates less than 2 mm thick intended for bonding to supporting substrates

Stratifiés décoratifs haute pression (HPL) - Plaques à base de résines thermodurcissables (communément appelées stratifiés) - Partie 3: Classification et spécifications des stratifiés d'épaisseur inférieure à 2 mm destinés à être collés sur des supports

Dekorative Hochdruck-Schichtpressstoffplatten (HPL) - Platten auf Basis härtbarer Harze (Schichtpressstoffe) - Teil 3: Klassifizierung und Spezifikationen für Platten mit einer Dicke kleiner als 2 mm, vorgesehen zum Verkleben auf ein Trägermaterial

This European Standard was approved by CEN on 13 December 2015.

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European foreword

This document (EN 438-3:2016) 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of an identical text or by endorsement, at the latest by August 2016, and conflicting national standards shall be withdrawn at the latest by August 2016.

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.

This document supersedes EN 438-3:2005.

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

— *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*

— *Part 9: Classification and specifications for alternative core laminates*

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1 Scope

This European Standard applies to laminates less than 2 mm thick produced by using an high pressure process, normally intended for bonding to supporting substrates to produce HPL composite panels and establishes a classification system for high-pressure decorative laminates according to their performance and main recommended fields of application, including materials with special characteristics, for example formability or defined reaction to fire. This European Standard also specifies requirements for the properties of the various types of laminates covered by this classification system.

High-pressure decorative laminates are characterised by their qualities, durability and functional performance. HPL sheets are available in a wide variety of colours, patterns and surface finishes; they are resistant to wear, scratching, impact, moisture, heat and staining; and possess good hygienic and anti-static properties, being easy to clean and maintain.

EN 438-2 specifies the methods of test relevant to this European Standard. EN 438-4, EN 438-5, EN 438-6, EN 438-7, EN 438-8 and EN 438-9 are reserved for special types of HPL materials.

2 Normative references

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

EN 438-2:2016, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called laminates) — Part 2: Determination of properties*

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

EN 13722, *Furniture — Assessment of the surface gloss*

EN 61340-4-1, *Electrostatics — Part 4-1: Standard test methods for specific applications — Electrical resistance of floor coverings and installed floors (IEC 61340-4-1)*

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

EN ISO 11664-2, *Colorimetry — Part 2: CIE standard illuminants (ISO 11664-2)*

3 Terms and definitions, symbols and abbreviations

3.1 Terms and definitions

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

3.1.1
high-pressure decorative laminate(s)
HPL
sheet(s) consisting of decorative surface layer(s) and core layers bonded together by an high pressure process

Note 1 to entry: Typical values for the high pressure process are a temperature of ≥ 120 °C and a pressure of ≥ 5 MPa.

3.1.2
surface layer
upper decorative layer consisting in one or more sheets of fibrous material (usually paper) impregnated with aminoplastic thermosetting resins (usually melamine based resins)

Note 1 to entry: The back of the sheet(s) is made suitable for adhesive bonding to a substrate.

3.1.3
core layer
fibrous material (usually paper) impregnated with thermosetting resins (usually phenolic based resins)

3.2 Symbols

For the purposes of this document, the following symbol applies.

t nominal thickness

4 Material types

The material types are:

Type S - Standard grade decorative laminates.

Type P - Postformable decorative laminates; similar to type S but can also be formed at elevated temperature.

Type F - Decorative laminates with improved fire retardance; similar to types S or P but also meeting special requirements of specified fire tests which may vary according to the application (e.g. construction, marine, transport) and the country of use (see 6.4.3 and Annex A).

5 Requirements

5.1 General

Two different HPL classification systems are commonly used in Europe, and both have been included in this document as alternatives.

5.2 Numerical classification system

In this system the classification of a letter denoting material type (see Clause 4) followed by three index numbers showing the levels of performance for wear resistance, impact resistance and scratch resistance respectively.

Table 1 shows the performance levels corresponding to the index numbers.

Table 1 — Numerical classification

Initial Point (revs)	**First Index Number - Wear Resistance** [a]		
	2	**3**	**4**
	≥ 50	≥ 150	≥ 350
Small Diameter Ball (N)	**Second Index Number - Impact Resistance** [a]		
	2	**3**	**4**
	≥ 15	≥ 20	≥ 25
Scratch Resistance (Rating)	**Third Index Number - Scratch Resistance** [a]		
	2	**3**	**4**
	2	3	4
[a] Index numbers 2, 3, and 4 are specified to maintain consistency with EN 438:1991. Index number 1 represents a lower quality level that applies only for HPL Type VG (Table 2) with smooth finishes.			

5.3 Alphabetical classification system

This system uses three letters to classify laminates as shown in Table 2.

Table 2 — Alphabetical classification

First letter	**Second letter**	**Third letter**
H (horizontal grade) or V (vertical grade)	G (general purpose) or D (heavy duty)	S (standard grade) or P (postformable grade) or F (flame-retardant grade)

Table 3 compares the alternative classification systems and shows how different HPL products relate to some typical applications. The list of typical applications shown for each category is for guidance only and is not intended to be comprehensive.

Table 3 — Classification system and typical applications

Performance category	Material type	Numerical classification index numbers			Equivalent alphabetical classification	Examples of typical applications
		Wear resistance	Impact resistance	scratch resistance		
Very high resistance to surface wear Very high resistance to impact Very high resistance to scratching	S, F or P	4	4	4	HDS (horizontal heavy-duty standard) HDF (horizontal heavy-duty flame-retardant) HDP (horizontal heavy- duty postforming)	counter tops, institutional applications (prisons, military barracks, etc.)
High resistance to surface wear High resistance to impact High resistance to scratching	S, F or P	3	3	3	HGS (horizontal general-purpose standard) HGF (horizontal general-purpose flame-retardant) HGP (horizontal general-purpose postforming)	kitchen and office working surfaces, restaurant and hotel tables, doors and wall coverings in public areas, interior walls of public transport vehicles
Medium resistance to surface wear Medium resistance to impact Medium resistance to scratching	S, F or P	2	2	2	VGS (vertical general-purpose standard), VGF (vertical general- purpose flame-retardant) VGP (verticalgeneral-purpose postforming)	front panels for kitchen, office and bathroom furniture, wall coverings, ceiling panels, shelves , and furniture elements

Combinations of wear, impact and scratch resistance index numbers other than those shown in Table 3 are possible and can be specified using the numerical classification system. In such cases properties other than wear resistance, impact resistance and scratch resistance shall meet the requirements specified for type VG in Table 5.

5.4 Nomenclature

In addition to the abbreviation “HPL” and the number of this document, materials can be specified either by the numerical classification system, or by the alphabetical classification system. For example, horizontal general purpose postformable laminate can be specified as HPL/EN 438-3/P333 or HPL/EN 438-3/HGP.

6 Requirements

6.1 Compliance

Laminates classified in Table 3 shall meet all appropriate requirements specified in 6.2, 6.3 or 6.4. This applies to both full-size sheets and cut-to-size panels.

6.2 Inspection requirements

6.2.1 General

Inspection shall be carried out in accordance with EN 438-2:2016, Clause 4 at a distance between 750 mm to 1500 mm.

6.2.2 Colour and pattern

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

NOTE Where colour and surface finish are critical, it is advised that sheets be checked for colour and surface-finish compatibility before fabrication or installation.

6.2.3 Surface finish

When inspected at different viewing angles, there shall be no significant difference between the corresponding surface-finish reference sample held by the supplier and the specimen under test.

The maximum permitted deviations for the gloss value determined according to EN 13722 are:

Gloss surface	> 70	GU	maximum deviation ± 15 GU
Semi Gloss surface	30 – 70	GU	maximum deviation ± 10 GU
Semi Matt surface	10 – 30	GU	maximum deviation ± 5 GU
Matt surface	< 10	GU	maximum deviation ± 3 GU

GU = gloss units

The measurement shall be carried out with the same device as comparison between reference sample and specimen or between different lots of specimen.

NOTE Where colour and surface finish are critical, it is advised that sheets be checked for colour and surface-finish compatibility before fabrication or installation.

6.2.4 Reverse side

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

6.2.5 Visual inspection

6.2.5.1 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. It

shall be noted that 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.

6.2.5.2 Surface quality

The following surface defects are permissible:

a) dirt, spots and similar surface defects.

The admissible size of such defects is based on a maximum contamination area equivalent to 1,0 mm^2/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.

b) fibres, hairs and scratches

The admissible size of defects is based on a maximum contamination length equivalent to 10 mm/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.

6.2.5.3 Edge quality

Visual defects (e.g. moisture marks, lack of gloss, corner damage, etc.) 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.

6.3 Dimensional tolerance requirements

Dimensional tolerance requirements are specified in Table 4.

Table 4 — Dimensional tolerance requirements

PROPERTY	TEST METHOD (EN 438-2:2016, Clause No.)	REQUIREMENT
Thickness	5	0,5 ≤ t ≤ 1,0 mm: ± 0,10 mm maximum variation 1,0 < t < 2,0 mm: ± 0,15 mm maximum variation
Length and width [b]	6	+ 10 mm / - 0 mm
Edges straightness [b]	7	1,5 mm/m maximum deviation
Edges squareness [b]	8	1,5 mm/m maximum deviation
Flatness [a]	9	60 mm/m maximum deviation

NOTE t : nominal thickness

a Provided that the 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 438-2:2016, Clause 10.

b Tolerances for cut-to-size panels shall be agreed between supplier and purchaser.

6.4 Test requirements

6.4.1 General requirements

General requirements are specified in Table 5.

Table 5 — General requirements

Property	**Test method (EN 438-2:2016, Clause no. Unless otherwise stated)**	**Property or attribute**	**Unit (max or min)**	**Laminate grade**		
				HDS HDF HDP	HGS HGF HGP	VGS VGF VGP
				444	333	222
Resistance to surface wear	10	Wear resistance	revolutions (min) initial point	350	150	50
Resistance to immersion in boiling water	12	Appearance	Rating (min) gloss finish other finishes	 3 4	 3 4	 3 4
Resistance to water vapour	14	Appearance	Rating (min) gloss finish other finishes	 3 4	 3 4	 3 4
Resistance to dry heat (160 °C)	16	Appearance	Rating (min) gloss finish other finishes	 3 4	 3 4	 3 4
Dimensional stability at elevated temperature	17	Cumulative dimensional change	% (max) L [a] T [b]	 0,45 0,90	 0,55 1,05	 0,75 1,25
Resistance to wet heat (100 °C)	18	Appearance	Rating (min) gloss finish other finishes	 3 4	 3 4	 3 4
Resistance to impact by small diameter ball	20	Spring force	N (min)	25	20	15
Resistance to impact by large diameter ball (optional)	21	Drop height Indent diameter	mm (min) mm (max)	1000 10	800 10	600 10
Resistance to cracking under stress (optional)	23	Appearance	Rating (min)	4	4	4
Resistance to scratching	25	Force	Rating (min) smooth finishes textured finishes	 3 4	 2 3	 1 2
Resistance to staining	26	Appearance	Rating (min) groups 1 & 2 group 3	 5 4	 5 4	 5 4
Light fastness (xenon arc)	27	Contrast	Grey scale rating	4 to 5	4 to 5	4 to 5
Density	EN ISO 1183-1	Density	g/cm^3 (min)	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 laminate).
b T: in the cross-longitudinal (cross-machine) direction of the fibrous sheet material (at right angles to direction L).

6.4.2 Additional requirements for Type P laminates

In addition to meeting the appropriate requirements specified in Table 5, Type P postformable laminates of thickness ≤ 1,5 mm shall meet the values specified in Table 6 for formability and blister resistance.

Table 6 — Additional requirements for Type P laminates

Property	Test method (EN 438-2:2016, clause number)	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 ≥ 0,8 mm	 ≥10 ≥15
a L: axis of bending parallel to the fibre direction (usually parallel to the direction of sanding). b T: axis of bending at right angles to the fibre direction.				

6.4.3 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. The reaction-to-fire of construction products is classified in accordance with EN 13501-1. 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. No fire performance test is therefore included in this specification, however Annex A gives examples of how high-pressure laminates relate to EN 13501-1 and some of the more common European fire test methods.

6.5 Supplemental properties

For certain applications, information on some of the properties listed in Table 7 may be required. On request, this information shall be supplied by the laminate manufacturer and in this case shall have been derived using the test methods listed in Table 7.

Table 7 — Supplemental properties and test methods

Property	Test method
Electrostatic properties: - point to point resistance - vertical resistance	 EN 61340-4-1 EN 61340-4-1
Microscratch resistance	EN 438-2:2016, Clause 30 "Determination of microscratch resistance"

NOTE For certain applications, information on additional properties not specified in Table 7 may be required. For instance, information on thermal conductivity, water vapour permeability and fire behaviour of high-pressure laminates is given in EN 438-7.

Annex A
(informative)

Addendum to sub-clause 6.4.3, relating to fire performance

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.

Table A.1 shows typical EN 13501-1 reaction-to-fire classifications of HPL composite panels.

Table A.1 — Typical EN 13501-1 classifications of HPL composite panels in the field of building construction

Product type	Typical EN 13501-1 classification
Composite panels comprising HPL type F bonded to non combustible substrates	B-s2,d0
Composite panels comprising HPL type F bonded to FR wood-based substrates	C-s2,d0
Composite panels comprising HPL type S or P bonded to non-FR wood-based substrates	D-s2,d0
NOTE Fire test performance will depend on laminate thickness and construction, substrate type and thickness, and adhesive used. It is advised to contact the laminate manufacturer for details of test reports and certifications held, and for information on fire test methods and specifications.	

For applications other than construction, test methods and specifications may vary from one country to another. Table A.2 shows some examples of how high-pressure laminates typically relate to some of the more common European test methods.

Table A.2 — Examples of typical fire performance of high-pressure laminates not in the field of building construction

Application/Fire property	Test method	Typical performance levels	
		EN 438-3 HPL Type F	EN 438-3 HPL Types S and P
Smoke density and toxicity	NF F 16-101 [3]	F2 or better	F2 or better
Heat release	IMO Res.A653(16) [4] according to 96/98/EC	Pass	Pass
Railways applications [a]	EN 45545-2 [5]	-	-
Transport applications	Council Directive 96/98/EC [6]	-	-
NOTE Fire test performance will depend on laminate thickness and construction, substrate type and thickness, and adhesive used. It is advised to contact the laminate manufacturer for details of test reports and classification held, and for information on fire test methods and specifications. [a] Depending on the application and on the vehicle category.			

NOTE Flame-retardant additives used in high-pressure decorative laminates are not halogen based and remain effective throughout the service life of the product.

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 products subjected to direct impingement of flame — Part 2: Single-flame source test (ISO 11925-2)*

[3] NF F 16-101:1998, *Matériel roulant ferroviaire — Comportement au feu — Choix des matériaux*

[4] IMO Res.A653(16) Adopted on 19 October 1989 Agenda item 10 Recommendation on improved fire test procedures for surface flammability of bulkhead, ceiling and deck finish materials

[5] EN 45545-2, *Railway applications — Fire protection on railway vehicles — Part 2: Requirements for fire behavior of materials and components*

[6] Council Directive 96/98/EC of 20 December 1996 on marine equipment (OJ L 46, 17.2.1997, p. 25–56) and Corrigendum to Council Directive 96/98/EC of 20 December 1996 on marine equipment (Official Journal of the European Communities L 46 of 17 February 1997)

[7] EN 438-7, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called laminates) — Part 7: Compact laminate and HPL composite panels for internal and external wall and ceiling finishes*

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