BS EN 438-4:2016

BSI Standards Publication

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

Part 4: Classification and specifications for compact laminates of thickness 2 mm and greater

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National foreword

This British Standard is the UK implementation of EN 438-4:2016. It supersedes BS EN 438-4:2005 which is withdrawn.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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Stratifiés décoratifs haute pression (HPL) - Plaques à base de résines thermodurcissables (communément appelées stratifiés) - Partie 4: Classification et spécifications des stratifiés compacts d'épaisseur égale ou supérieure à 2 mm

Dekorative Hochdruck-Schichtpressstoffplatten (HPL) - Platten auf Basis härtbarer Harze (Schichtpressstoffe) - Teil 4: Klassifizierung und Spezifikationen für Kompakt-Schichtpressstoffe mit einer Dicke von 2 mm und größer

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European foreword

This document (EN 438-4:2016) 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of an identical text or by endorsement, at the latest by August 2016, and conflicting national standards shall be withdrawn at the latest by August 2016.

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This document supersedes EN 438-4:2005.

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 specifies performance requirements for two types of compact laminate of thickness 2 mm or greater produced by using a high pressure process intended for interior use .

High-pressure decorative Compact laminates are characterised by their aesthetic qualities, strength, durability and functional performance. Compact HPL sheets are available in a wide variety of colours, patterns and surface finishes; they are extremely strong, and resistant to wear, impact, scratching, 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.

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

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, 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 surface layers can appear on one or both side(s) of the laminate(s). In case of one-sided laminates, the back of the sheet(s) may be 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 and classification system

Compact laminates are defined using a three letter classification system as shown in Table 1

Table 1 — Compact laminate classification system

First letter	Second letter	Third letter
C (compact grade)	G (general purpose)	S (standard grade) or F (flame-retardant grade)

Type CGS Standard grade decorative Compact laminates are specified as HPL/EN 438-4/CGS.

Type CGF Decorative Compact laminates with improved fire retardance are similar to type CGS but also meeting special requirements of specified tests which may vary according to the application (e.g. construction, marine, transport) and the country of use (see 6.4.2 and Annex A). Specified as HPL/EN 438-4/CGF.

Other laminates having special characteristics are also available but these products are outside the scope of this part of the standard.

5 Characteristics and applications

HPL Compact laminates have the following characteristics:

— Attractive aesthetic qualities;

— High mechanical strength;

— Durability (high resistance to impact, wear and scratching);

— Good dimensional stability;

— High resistance to the effects of water, steam, heat and frost;

— Non-corrosive;

— Good colour fastness;

— Easy to clean and maintain (good anti-graffiti properties);

— Hygienic;

— Good chemical resistance;

— No dust attraction;

— Ease of installation;

— Good fire performance.

Typical applications include wall cladding, partitions, doors, cubicles, lockers, laboratory bench tops, and various self-supporting components in construction, marine and transport industries.

When Compact laminates are self-supporting they are ready for installation and only require cutting to size, drilling, etc. to suit the application.

6 Requirements

6.1 Compliance

Compact laminate types CGS and CGF shall meet all appropriate requirements specified in 6.2, 6.3, and 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 Visual inspection

6.2.4.1 General

The following inspection requirements are intended as a general guide, indicating the minimum acceptable quality for each decorative face of a laminate supplied as a full-size sheet.

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 should be noted that only a small percentage of sheets in a batch (the level to be agreed with the customer) should contain defects of the minimum acceptable level.

It may be agreed between purchaser and supplier that the visual quality standard applies to one decorative face only.

6.2.4.2 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.

6.2.4.3 Edge quality

Edge chipping up to 3 mm on each side is permissible.

6.3 Dimensional tolerance requirements

Dimensional tolerance requirements are specified in Table 2.

Table 2 — Dimensional tolerance requirements

Property	Test method (EN 438-2:2016, Clause no.)	Requirement	
		thickness	maximum variation
Thickness	5	$2{,}0 \leq t < 3{,}0$ mm: $3{,}0 \leq t < 5{,}0$ mm: $5{,}0 \leq t < 8{,}0$ mm: $8{,}0 \leq t < 12{,}0$ mm: $12{,}0 \leq t < 16{,}0$ mm: $16{,}0 \leq t < 20{,}0$ mm: $20{,}0 \leq t < 25{,}0$ mm: $25{,}0 \leq t$	± 0,20 mm ± 0,30 mm ± 0,40 mm ± 0,50 mm ± 0,60 mm ± 0,70 mm ± 0,80 mm to be agreed between supplier and customer
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	maximum deviation $2{,}0 \leq t < 6{,}0$ mm: $6{,}0 \leq t < 10{,}0$ mm: $10{,}0 \leq t$:	 8,0 mm/m 5,0 mm/m 3,0 mm/m

[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 2 when measured in accordance with EN 438-2:2016, Clause 9. The flatness values specified in Table 2 apply to laminates with two decorative faces. Limits for 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.

6.4 Test requirements

6.4.1 General requirements

General requirements are specified in Table 3.

Table 3 — General requirements

Property	Test method (EN 438-2:2016, Clause no. Unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				CGS	CGF
Resistance to surface wear	10	Wear resistance	Revolutions (min) Initial point	 150	 150
Resistance to immersion in boiling water	12	Mass increase Thickness increase Appearance	% (max) 2 mm ≤ t < 5 mm t ≥ 5 mm % (max) 2 mm ≤ t < 5 mm t ≥ 5 mm Surface rating (min) Gloss finish other finishes Edge rating (min)	5,0 2,0 6,0 2,0 3 4 3	7,0 3,0 9,0 6,0 3 4 3
Resistance to water vapour	14	Appearance	Rating (min) Gloss finish Other finishes	 3 4	 3 4
Resistance to dry heat (160 °C)	16	Appearance	Rating (min) gloss finish other finishes	 3 4	 3 4
Dimensional stability at elevated temperature	17	Cumulative Dimensional Change	% (max) 2 mm ≤ t < 5 mm L [b] T [c] t ≥ 5 mm L [b] T [c]	 0,40 0,80 0,30 0,60	 0,40 0,80 0,30 0,60
Resistance to wet heat (100 °C)	18	Appearance	Rating (min) gloss finish other finishes	 3 4	 3 4
Resistance to impact by large diameter ball	21	Drop height [a]	mm (min) 2 ≤ t < 6 6 ≤ t	1400 1800	1400 1800
Resistance to crazing	24	Appearance	Grade (min)	4	4
Resistance to scratching	25	Force	Rating (min) smooth finishes textured finishes	 2 3	 2 3
Resistance to staining	26	Appearance	Rating (min) Groups 1 & 2 Group 3	 5 4	 5 4
Light fastness (xenon arc)	27	Contrast	Grey scale rating	4 to 5	4 to 5
Flexural	EN ISO 178 [d]	Stress	MPa (min) L [b] and T [c]	9000	9000

modulus [e]					
Flexural strength [e]	EN ISO 178 [d]	Stress	MPa (min) L [b] and T [c]	80	80
Density	EN ISO 1183-1	Density	g/cm^3 (min)	1,35	1,35

[a] When tested at the specified drop height, the diameter of indentation shall not exceed 10 mm.

[b] L: in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminate)

[c] T: in the cross-longitudinal (cross-machine) direction of the fibrous sheet material (at right angles to direction L)

[d] Machine crosshead speed 10 mm/min

[e] The test results can be affected by the sample handling and by the humidity absorption from the air during the step previous to the conditioning

6.4.2 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. 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 Compact 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 4 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 4.

Table 4 — 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 4 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 6.4.2, 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 Compact laminates.

Table A.1 — Typical EN 13501-1 classifications of Compact laminates in the field of building construction

Product type	EN 13501-1 classification
CGF ≥ 6mm thick	B-s2,d0
CGF < 6mm thick	C-s2,d0 or better
CGS	D-s2,d0 or better
NOTE It is advised to contact the laminate manufacturer for details of fire 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 Compact laminates typically relate to some of the more common European test methods.

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

Test method	Test standard	Typical performance levels	
		CGF	CGS
Smoke density and toxicity	NF F 16-101 [3]	F2 or better	F2 or better
Railways applications [a]	EN 45545-2 [4]	-	-
Transport applications	Directive 95/28/EC	-	-
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 Compact 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] EN 45545-2, *Railway applications — Fire protection on railway vehicles — Part 2: Requirements for fire behavior of materials and components*

[5] Directive 95/28/EC of the European Parliament and of the Council of 24 October 1995 relating to the burning behaviour of materials used in the interior construction of certain categories of motor vehicle (OJ L 281, 23.11.1995, p. 1–30)

[6] 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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