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

Part 6:

**Classification and specifications for
exterior-grade compact laminates of
thickness 2 mm and greater**

*Stratifiés décoratifs haute pression (HPL, HPDL) — Plaques à base de
résines thermodurcissables (communément appelées stratifiés) —*

*Partie 6: Classification et spécifications des stratifiés compacts pour
usage en extérieur d'épaisseur égale ou supérieure à 2 mm*



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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This second edition cancels and replaces the first edition (ISO 4586-6:2015), which has been technically revised.

The main changes compared to the previous edition are as follows:

- correction of errors due to typographical, formatting, and omission issues.

A list of all parts in the ISO 4586 series can be found on the ISO website.

Introduction

Exterior-grade compact laminates are characterized by their high tensile strength, high impact resistance, thermal shock resistance, and resistance to weather and corrosion. They are available in a variety of decorative colours, with high resistance to colour change and aging in outdoor applications. When they are self-supporting exterior-grade compact laminates are ready for installation, and only require cutting to size, drilling, etc. to suit the application.

In an effort to harmonize ISO 4586 with other high-pressure decorative laminate standards, multiple methods may be published that demonstrate similar properties. In these instances, the same test method title is given and is annotated as either “Method A” or “Method B”. This is the case in the following tests: Edge squareness — 8/9, Dry heat — 17/18 Dimensional stability at elevated temperatures — 19/20, Dimensional stability at ambient temperature — 21/22, Staining — 30/31, Lightfastness — 32/33, Formability — 38/39, and Blistering — 40/41. In these instances, either method may be utilized in testing. Compliance to both methods is not required. While these tests are similar they are by no means identical and results of one method do not necessarily correspond to the results of the accompanying test. In these situations, it is intended that the documentation in specific parts of ISO 4586 for performance requirements be consulted. Each specific method has performance requirements particular to that method for individual grades of high-pressure decorative laminate.

This document has been harmonized with EN 438-6 whenever possible.

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

Part 6:

Classification and specifications for exterior-grade compact laminates of thickness 2 mm and greater

1 Scope

This document applies to exterior-grade compact laminates of thickness 2 mm and greater. It specifies requirements for standard and flame-retardant laminates intended for use under outdoor weather conditions such as direct sunlight, rain, and frost. Two levels of performance are specified; one for moderate exterior conditions, and the other for severe exterior conditions.

ISO 4586-2 specifies the methods of test relevant to this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 178, *Plastics — Determination of flexural properties*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

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

ISO 4586-2:2018, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called laminates) — Part 2: Determination of properties*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1
high-pressure decorative laminate
HPL
HPDL

sheet consisting of layers of cellulosic fibrous material (normally paper) impregnated with thermosetting resins and bonded together by the *high pressure process* (3.2)

Note 1 to entry: This is a general definition of high-pressure decorative laminate(s). More specific product definitions can be found in ISO 4586-3 to ISO 4586-8.

Note 2 to entry: The surface layer(s) on one or both sides, having decorative colours or designs, are typically impregnated with melamine based resins. The core layers are typically impregnated with phenolic based resins.

Note 3 to entry: The back of the sheet(s) may be made suitable for adhesive bonding to a substrate.

3.2
high-pressure process

simultaneous application of heat (temperature ≥ 120 °C) and high specific pressure (≥ 5 MPa), to provide flowing and subsequent curing of the thermosetting resins to obtain a homogeneous non-porous material with increased density ($\geq 1,35$ g/cm³), and with the required surface finish

3.3
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) or other curable resins or other decorative design surfaces such as metal foils, wood-veneers, and textiles, etc. which are not necessarily treated with thermosetting resin

3.4
core layer

fibrous material (usually paper) impregnated with thermosetting resins (usually phenolic based resins) or other curable resins, possibly reinforced by metal layer(s) or metal mesh(es) and others which are not necessarily treated with thermosetting resin

4 Material types and classification system

Exterior-grade compact laminates are defined using the three letter classification system shown in [Table 1](#).

Table 1 — Classification system

First letter	Second letter	Third letter
E (Exterior grade)	G (Moderate use) or D (Severe use)	S (Standard grade) or F (Flame-retardant grade)

For example an exterior-grade flame-retardant HPL for severe outdoor conditions is specified as HPL/ISO 4586-6/EDF.

Laminate grades EGS and EGF are intended for moderate outdoor conditions, for example applications involving medium term exposure to average levels of sunlight and weathering.

Laminate grades EDS and EDF are intended for severe outdoor conditions, for example applications involving long term exposure to strong sunlight and weather.

5 Requirements

5.1 Compliance

Exterior-grade compact laminate types EGS, EGF, EDS and EDF shall meet 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 ISO 4586-2:2018, Clause 4 at a distance of 0,75 m to 1,5 m.

5.2.2 Colour and pattern

When inspected in daylight or D65 standard illuminant and again under tungsten illuminant A, there shall be no significant difference between the corresponding colour reference sample held by the supplier and the specimen under test.

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

5.2.3 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.

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

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 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.

5.2.4.2 Surface quality

The following surface defects are permissible.

- Dirt, spots and similar surface defects.

The admissible size of such defects is based on a maximum contamination area equivalent to 2,0 mm²/m² 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 20 mm/m² 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

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

5.3 Dimensional tolerance requirements

Dimensional tolerance requirements are specified in [Table 2](#).

Table 2 — Dimensional tolerances

Property	Test method (ISO 4586-2:2018 Clause No.)	Requirement
Thickness	5	2,0 mm ≤ <i>d</i> < 3,0 mm: ±0,20 mm maximum variation 3,0 mm ≤ <i>d</i> < 5,0 mm: ±0,30 mm maximum variation 5,0 mm ≤ <i>d</i> < 8,0 mm: ±0,40 mm maximum variation 8,0 mm ≤ <i>d</i> < 12,0 mm: ±0,50 mm maximum variation 12,0 mm ≤ <i>d</i> < 16,0 mm: ±0,60 mm maximum variation 16,0 mm ≤ <i>d</i> < 20,0 mm: ±0,70 mm maximum variation 20,0 mm ≤ <i>d</i> < 25,0 mm: ±0,80 mm maximum variation 25,0 mm ≤ <i>d</i> : to be agreed between supplier and customer (where <i>d</i> = nominal thickness)
Length and width ^a	6	+10 mm/−0 mm
Straightness of edges ^a	7	1,5 mm/m maximum deviation
Squareness (Method A) ^a	8	1,5 mm/m maximum deviation
Squareness (Method B) ^a	9	≤ 6 mm
Flatness ^b	10	2,0 mm ≤ <i>d</i> < 6,0 mm: 8,0 mm/m maximum deviation 6,0 mm ≤ <i>d</i> < 10,0 mm: 5,0 mm/m maximum deviation 10,0 mm ≤ <i>d</i> : 3,0 mm/m maximum deviation (where <i>d</i> = nominal thickness)
^a Tolerances for cut-to-size panels shall be agreed between supplier and purchaser. ^b Provided that the laminates are stored in the manner and conditions recommended by the manufacturer. The flatness values specified apply to laminates with two decorative faces. Limits for laminates with one face sanded shall be agreed between supplier and customer.		

5.4 Test requirements

5.4.1 Physical property requirements

Physical property requirements are specified in [Table 3](#).

Table 3 — Physical property requirements

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				EGS and EDS	EGF and EDF
Resistance to wet condi- tions ^a	16	Mass increase Appearance	% (max.) $2 \leq d < 5$	7	10
			$d \geq 5$	5	8
			(where d = nominal thickness)	4	4
			Surface rating (min.) Edge rating	3	3
Dimension- al stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max.) $2 \text{ mm} \leq d < 5 \text{ mm}$		
			L ^b	0,40	0,40
			T ^c	0,80	0,80
			$d \geq 5 \text{ mm}$		
L ^b	0,30	0,30			
T ^c	0,60	0,60			
Dimension- al stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max.) $2 \text{ mm} \leq d < 5 \text{ mm}$		
			L ^b	0,40	0,40
			T ^c	0,80	0,80
			$d \geq 5 \text{ mm}$		
L ^b	0,30	0,30			
T ^c	0,60	0,60			
Dimension- al stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max.) $2 \text{ mm} \leq d < 5 \text{ mm}$		
			L ^b	0,40	0,40
			T ^c	0,80	0,80
			$d \geq 5 \text{ mm}$		
L ^b	0,30	0,30			
T ^c	0,70	0,70			
Dimension- al stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max.)		
			L ^b	0,30	0,30
			T ^c	0,70	0,70
			(where d = nominal thickness)		

Table 3 (continued)

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				EGS and EDS	EGF and EDF
Resistance to impact by large diameter ball (shatter resistance)	25	Drop height	mm (min.) $2 \leq d < 6$ mm $6 \geq d$ mm (where d = nominal thickness)	1 400 1 800	1 400 1 800
		Indentation diameter	mm (max.)	10	10
Flexural modulus ^d	ISO 178	Stress	MPa (min.)	9 000	9 000
Flexural strength ^d	ISO 178	Stress	MPa (min.)	80	80
Tensile strength ^e	ISO 527-2	Stress	MPa (min.)	60	60
Density	ISO 1183-1	Density	g/cm ³ (min.)	1,35	1,35
<p>a See Annex B.</p> <p>b L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminate).</p> <p>c T = in the cross-longitudinal (cross-machine) direction of the fibrous sheet material (at right angles to direction L).</p> <p>d Machine crosshead speed 10 mm/min.</p> <p>e Specimen type 1A. Machine crosshead speed 5 mm/min.</p>					

5.4.2 Weather resistance requirements

Weather resistance requirements are specified in [Table 4](#).

Weather resistance is the behaviour of exterior-grade laminates in relation to degradation of the surface, colour fading and reduction of mechanical properties, due to exposure to sunlight, rain, frost, etc.

Table 4 — Weather resistance requirements

Property	Test method (ISO 4586-2:2018 Clause No.)	Property or attribute	Unit (max. or min.)	Laminate grade	
				EGS and EGF	EDS and EDF
Resistance to climatic shock	23	Appearance	Rating (min.)	4	4
		Flexural strength index, D_s	(min.)	0,80	0,80
		Flexural modulus index, D_m	(min.)	0,80	0,80
Resistance to UV light	34	Contrast Appearance	Grey scale rating (not worse than)	No requirement	3 (after 1 500 h exposure)
			Rating (min.)	No requirement	4 (after 1 500 h exposure)
Resistance to artificial weathering (including light fast- ness)	35	Contrast Appearance	Grey scale rating (not worse than)	3 (after 325 MJ/m ² radiant exposure)	3 (after 650 MJ/ m ² radiant exposure)
			Rating (min.)	4 (after 325 MJ/m ² radiant exposure)	4 (after 650 MJ/m ² radiant exposure)

5.4.3 Notes on requirements for reaction to fire (see [Annex A](#))

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 various test methods specific to individual nation where the material is installed. 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 B](#) gives examples of how high-pressure laminates relate to ASTM E84^[4] and EN 13501-1^[2] and some of the most common fire test scenarios.

Annex A (informative)

Addendum to 5.4.3, relating to fire performance

In Europe, laminate panels intended for construction applications are tested in accordance with EN 13823^[3] (SBI test) and ISO 11925-2^[4] (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 exterior-grade compact laminates.

Table A.1 — Typical EN 13501-1 classifications of exterior-grade compact laminates

Product type	EN 13501-1 classification
EGF and EDF ≥ 6mm thick	B-s2,d0
EGF and EDF < 6mm thick	C-s2,d0 or better
EGS and EDS	D-s2,d0 or better

NOTE The laminate manufacturer should be contacted 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 exterior-grade compact laminates typically relate to some of the more common European test methods.

Table A.2 — Examples of typical fire performance of exterior-grade compact laminates

Test method	Test standard	Typical performance levels	
		EDF and EGF	EGS and EDS
Spread of flame	BS 476-7	Class 1	Class 2
Brandschacht	DIN 4102-1	B1	B2
Epiradiateur	NF P92-501	M1	M3 or better
Smoke density and toxicity	NF F16-101	F2 or better	F2 or better

NOTE The laminate manufacturer should be contacted for details of fire test reports and certifications held, and for information on fire test methods and specifications.

In North America, laminate panels intended for construction applications are tested in accordance with ASTM E84 and rated accordingly.

Table A.3 shows typical ASTM E84 reaction-to-fire classifications of compact laminates.