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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

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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Contents

Page

Foreword

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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. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This first edition of ISO 4586-6:2015 cancels and replaces (ISO 4586-1:2004), which has been technically revised.

ISO 4586 consists of the following parts, under the general title *Plastics — High-Pressure Decorative Laminates (HPL, HPDL) — 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: Classification and specifications for design laminates*

— *Part 8: Classification and specifications for alternative core laminates*

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 part of ISO 4586 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. Laminates complying with this part of ISO 4586 are referred to as Exterior-grade Compact laminates, and 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.

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

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, Cigarette Burns - 36/37, 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, consult the documentation in specific sections of ISO 4586 for performance requirements. Each specific method has performance requirements particular to that method for individual grades of high-pressure decorative laminate.

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.

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 pyknometer method and titration method*

ISO 4586-2, *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

3.1
High-Pressure Decorative Laminate(s)
HPL
HPDL
sheet(s) consisting of layers of cellulosic fibrous material (normally paper) impregnated with thermosetting resins and bonded together by the high pressure process described below

Note 1 to entry: The back of the sheet(s) is 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 (≥ 1,35 g/cm^3), and with the required surface finish

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 4586-7.

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, Test Method 4 at a distance of 1,5 m.

5.2.2 Colour and pattern

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

NOTE 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.

NOTE 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 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:

— Fibres, hairs and scratches.

The admissible size of defects is based on a maximum contamination length equivalent to 20 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.

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, Clause no.)	Requirement
Thickness	5	2,0 mm≤ *d* < 3,0 mm: ± 0.20 mm maximum variation 3,0 mm≤ *d* < 5,0 mm: ± 0.30 mm maximum variation 5,0 mm≤ *d* < 8,0 mm: ± 0.40 mm maximum variation 8,0 mm≤ *d* < 12,0 mm: ± 0.50 mm maximum variation 12,0 mm≤ *d* < 16,0 mm: ± 0.60 mm maximum variation 16,0 mm≤ *d* < 20,0 mm: ± 0.70 mm maximum variation 20,0 mm≤ *d* < 25,0 mm: ± 0.80 mm maximum variation 25,0 mm≤ *d*: to be agreed between supplier and customer (where *d* = 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≤ *d* < 6,0 mm: 8,0 mm/m maximum deviation 6,0 mm≤ *d* < 10,0 mm: 5,0 mm/m maximum deviation 10,0 mm≤ *d*: 3,0 mm/m maximum deviation (where *d* = 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 they shall comply with the flatness requirements specified in Table 2 when measured in accordance with ISO 4586-2:2015, 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.

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, Clause no. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				EGS and EDS	EGF and EDF
Resistance to wet conditions[a]	16	Mass increase	% (max)		
			$2 \le d < 5$	7	10
			$d \ge 5$	5	8
			(where d = nominal thickness)		
		Appearance	Rating (min)	4	4
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max)		
			2 mm ≤ d < 5 mm		
			L[b]	0,40	0,40
			T[c]	0,80	0,80
			$d \ge 5$ mm		
			L[b]	0,30	0,30
			T[c]	0,60	0,60
			(where d = nominal thickness)		
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max)		
			2 mm ≤ d < 5 mm		
			L[b]	0,40	0,40
			T[c]	0,80	0,80
			$d \ge 5$ mm		
			L[b]	0,30	0,30
			T[c]	0,60	0,60
			(where d = nominal thickness)		
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max)		
			2 mm ≤ d < 5 mm		
			L[b]	0,40	0,40
			T[c]	0,80	0,80
			$d \ge 5$ mm		
			L[b]	0,30	0,30
			T[c]	0,60	0,60
			(where d = nominal thickness)		

[a] See Annex B.

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

[e] Machine crosshead speed 2 mm/min.

[f] Specimen type 1A. Machine crosshead speed 5 mm/min. Tested in accordance with procedure A using specimen III.

Table 3 *(continued)*

Property	Test method (ISO 4586-2, Clause no. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				EGS and EDS	EGF and EDF
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max) L[b] T[c] (where d = nominal thickness)	 0,30 0,60	 0,30 0,60
Resistance to impact by large diameter ball (shatter resistance)[d]	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
Flexural modulus[e]	ISO 178	Stress	MPa (min)	9 000	9 000
Flexural strength[e]	ISO 178	Stress	MPa (min)	80	80
Tensile strength[f]	ISO 527-2	Stress	MPa (min)	60	60
Density	ISO 1183-1	Density	g/cm^3 (min)	1,30	1,30

[a] See Annex B.

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

[e] Machine crosshead speed 2 mm/min.

[f] Specimen type 1A. Machine crosshead speed 5 mm/min. Tested in accordance with procedure A using specimen III.

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 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)	0,95	0,95
		Flexural modulus index, D_m	(min)	0,95	0,95

Table 4 *(continued)*

Property	Test method (ISO 4586-2 Clause no.)	Property or attribute	Unit (max. or min.)	Laminate grade	
				EGS and EGF	EDS and EDF
Resistance to UV light	34	Contrast	Grey scale rating (not worse than)	No requirement	3 (after 1 500 h exposure)
		Appearance	Rating (min)	No requirement	4 (after 1 500 h exposure)
Resistance to artificial weathering (including light fastness)	35	Contrast	Grey scale rating (not worse than)	3 (after 325 MJ/m^2 radiant exposure)	3 (after 650 MJ/m^2 radiant exposure)
		Appearance	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 E-84 and EN 13501-1[2] and some of the more 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[1] (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 P 92–501	M1	M3 or better
Smoke density and toxicity	NF F 16–101	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 E-84 and rated accordingly.

Table A.3 shows typical ASTM E-84 reaction-to-fire classifications of Compact Laminates.