INTERNATIONAL STANDARD

ISO 4586-7

Second edition
2018-07

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

Part 7: Classification and specifications for design laminates

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

Partie 7: Classification et spécifications pour conception stratifiés

Reference number
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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 4586-7:2015), 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

High-pressure decorative laminates are characterized by their qualities, durability, and functional performance. High-pressure laminates sheet 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.

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 438-8 whenever possible.

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

Part 7: Classification and specifications for design laminates

1 Scope

This document applies to laminates intended for interior use with a design effect surface having a phenolic based core and a decorative surface, not covered by ISO 4586-3 through ISO 4586-6 and ISO 4586-8. Three surface material types (metal, wood veneer, and pearlescent décor) are defined in this document.

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

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

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

EN 12722[1)], *Furniture — Assessment of surface resistance to dry heat*

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

1) ISO 4211-2:1993 modified.

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 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

3.3
pearlescent laminate
high-pressure decorative laminate (3.1), the surface material of which consists of a pearlescent effect decorative paper, which is impregnated with melamine resin

Note 1 to entry: To achieve the optimum aesthetic effect from the pearlescent pigment a protective melamine layer is not used.

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

3.4
metal laminate
high-pressure decorative laminate (3.1), the surface material of which consists of a thin layer of metal

EXAMPLE Aluminium, steel, or copper.

Note 1 to entry: The surface is often protected by a thin layer of lacquer or in the case of aluminium, the surface may be anodized. The surface performance and appearance of these metal laminates is equivalent to that of a thin metal sheet.

Note 2 to entry: As some surface properties are lower than that of melamine (e.g. scratch, wear), it is recommended that these products are used for vertical applications.

3.5
wood veneer laminate
high-pressure decorative laminate (3.1), the surface material of which consists of a wood veneer, which is covered by a protective melamine layer

Note 1 to entry: 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

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

Table 1 — Numerical classification

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 laminate)		or F (Flame-retardant grade)
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 5.4.5). In addition to the abbreviation "HPL" or "HPDL" and the number of this document, materials shall be specified by the alphabetical classification system. NOTE As an example, pearlescent standard grade thin high-pressure decorative design laminate is designated as HPL/ISO 4586-8 ATS or HPDL/ISO 4586-8 ATS.		

5 Requirements

5.1 Compliance

High-pressure decorative design laminates classified in Table 1 shall comply with all the 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, pattern and surface finish

When inspected in daylight or D65 standard illuminant, as specified in ISO 11664-2, and under tungsten-filament lighting illuminant F 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 the 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.

5.2.3 Metal

When inspected in daylight or D65 standard illuminant and under tungsten-filament lighting illuminant F 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 the 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.

5.2.4 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 normal. Singularities such as knots and resin inclusions are not considered as defects, but as a part of the décor. There are differences in light fastness performance depending on the wood species and the source of the wood.

5.2.5 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.

5.2.6 Visual inspection

5.2.6.1 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 the 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 upon between the supplier and the customer) shall contain defects of the minimum acceptable level.

5.2.6.2 Surface quality

The following 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 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 such defects is based on a maximum contamination area equivalent to 10 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.

5.2.6.3 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 (ISO 4586-2:2018, Clause No.)	Requirement
Thickness	5	0,5 mm ≤ *d* ≤ 1,0 mm: ±0,10 mm maximum deviation 1,0 mm ≤ *d* ≤ 2,0 mm: ±0,15 mm maximum deviation 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	60 mm/m maximum deviation
[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.		

Table 3 — Dimensional tolerance requirements for compact pearlescent laminates

Property	Test method (ISO 4586-2:2018, Clause No.)	Requirement
Thickness	5	2,0 mm ≤ *d* < 3,0 mm: ±0,20 mm maximum deviation 3,0 mm ≤ *d* < 5,0 mm: ±0,30 mm maximum deviation 5,0 mm ≤ *d* < 8,0 mm: ±0,40 mm maximum deviation 8,0 mm ≤ *d* < 12,0 mm: ±0,50 mm maximum deviation 12,0 mm ≤ *d* < 16,0 mm: ±0,60 mm maximum deviation 16,0 mm ≤ *d* < 20,0 mm: ±0,70 mm maximum deviation 20,0 mm ≤ *d* < 25,0 mm: ±0,80 mm maximum deviation 25,0 mm ≤ *d*: to be agreed upon between the 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.		

5.3.2 Dimensional tolerance 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 (ISO 4586-2:2018, Clause No.)	Requirement
Thickness	5	0,5 mm ≤ *d* < 1,0 mm: ±0,15 mm maximum deviation 1,0 mm ≤ *d* < 2,0 mm: ±0,18 mm maximum deviation 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	100 mm/m maximum deviation

[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.

Table 5 — Dimensional tolerance requirements for compact metal laminates

Property	Test method (ISO 4586-2:2018, Clause No.)	Requirement
Thickness	5	2,0 mm ≤ *d* < 3,0 mm: ±0,25 mm maximum deviation 3,0 mm ≤ *d* < 5,0 mm: ±0,40 mm maximum deviation 5,0 mm ≤ *d* < 8,0 mm: ±0,50 mm maximum deviation 8,0 mm ≤ *d* < 12,0 mm: ±0,70 mm maximum deviation 12,0 mm ≤ *d* < 16,0 mm: ±0,80 mm maximum deviation 16,0 mm ≤ *d* < 20,0 mm: ±0,90 mm maximum deviation 20,0 mm ≤ *d* < 25,0 m: ±1,00 mm maximum deviation 25,0 mm ≤ *d*: to be agreed upon between the 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.

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 (ISO 4586-2:2018, Clause No.)	Requirement
Thickness	5	0,5 mm ≤ *d* < 1,0 mm: ±0,15 mm maximum deviation 1,0 mm ≤ *d* < 2,0 mm: ±0,18 mm maximum deviation 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	120 mm/m maximum deviation

[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.

Table 7 — Dimensional tolerance requirements for compact wood veneer laminates

Property	Test method (ISO 4586-2:2018, Clause No.)	Requirement
Thickness	5	2,0 mm ≤ *d* < 3,0 mm: ±0,25 mm maximum deviation 3,0 mm ≤ *d* < 5,0 mm: ±0,40 mm maximum deviation 5,0 mm ≤ *d* < 8,0 mm: ±0,50 mm maximum deviation 8,0 mm ≤ *d* < 12,0 mm: ±0,70 mm maximum deviation 12,0 m ≤ *d* < 16,0 mm: ±0,80 mm maximum deviation 16,0 mm ≤ *d* < 20,0 mm: ±0,90 mm maximum deviation 20,0 mm ≤ *d* < 25,0 mm: ±1,00 mm maximum deviation 25,0 mm ≤ *d*: to be agreed upon between the 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: 12,0 mm/m maximum deviation 6 mm ≤ *d* < 10,0 mm: 8,0 mm/m maximum deviation 10 mm ≤ *d*: 5,0 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.

5.4 Test requirements

5.4.1 General requirements for pearlescent laminates

General requirements for pearlescent laminates are specified in Table 8.

Table 8 — General requirements for pearlescent laminates

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade				
				ATS	ATP	ATF	ACS	ACF
Resistance to immersion in boiling water	13	Appearance	Rating (min.)					
			Gloss finish	3	3	3	3	3
			Other finishes	4	4	4	4	4
		Mass increase	% (max.)[a]					
			2 mm ≤ d < 5 mm	—	—	—	5,0	7,0
			d ≥ 5 mm	—	—	—	2,0	3,0
		Thickness increase	% (max.)[a]					
			2 mm ≤ d < 5 mm	—	—	—	6,0	9,0
			d ≥ 5 mm	—	—	—	2,0	6,0
Resistance to water vapour	15	Appearance	Rating (min.)	3	3	3	3	3
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max.)[a]					
			d < 2 mm					
			L[b]	0,75	0,75	0,75	—	—
			T[c]	1,25	1,25	1,25	—	—
			% (max.)[a]					
			2 mm ≤ d < 5 mm					
			L[b]	—	—	—	0,40	0,40
			T[c]	—	—	—	0,80	0,80
			% (max.)[a]					
			d ≥ 5 mm					
			L[b]	—	—	—	0,30	0,30
			T[c]	—	—	—	0,60	0,60

[a] Where d = nominal thickness.

[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] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[e] Machine crosshead speed of 10 mm/min.

Table 8 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade				
				ATS	ATP	ATF	ACS	ACF
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max.)[a]					
			d < 2 mm					
			L[b]	0,75	1,00	1,10	—	—
			T[c]	1,25	1,15	1,25	—	—
			% (max.)[a]					
			2 mm ≤ d < 5 mm					
			L[b]	—	—	—	0,30	0,30
			T[c]	—	—	—	0,70	0,30
			% (max.)[a]					
			d ≥ 5 mm					
			L[b]	—	—	—	0,30	0,30
			T[c]	—	—	—	0,70	0,30
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max.)[a]					
			d < 2 mm					
			L[b]	0,75	0,75	0,75	—	—
			T[c]	1,25	1,25	1,25	—	—
			% (max.)[a]					
			2 mm ≤ d < 5 mm					
			L[b]	—	—	—	0,40	0,40
			T[c]	—	—	—	0,80	0,80
			% (max)[a]					
			d ≥ 5 mm					
			L[b]	—	—	—	0,30	0,30
			T[c]	—	—	—	0,60	0,60

[a] Where d = nominal thickness.

[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] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[e] Machine crosshead speed of 10 mm/min.

Table 8 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade				
				ATS	ATP	ATF	ACS	ACF
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max.)[a]					
			d < 2 mm					
			L[b]	0,75	1,00	1,10	—	—
			T[c]	1,25	1,15	1,25	—	—
			% (max.)[a]					
			2 mm ≤ d < 5 mm					
			L[b]	—	—	—	0,30	0,30
			T[c]	—	—	—	0,70	0,30
			% (max.)[a]					
			d ≥ 5 mm					
			L[b]	—	—	—	0,30	0,30
			T[c]	—	—	—	0,70	0,30
Resistance to impact by small diameter ball	24	Spring force	N (min.)	15	15	15		
Resistance to impact by large diameter ball	25	Drop height	mm (min.)	—	—	—	800	800
		Indent diameter	mm (max.)	—	—	—	12	12
Resistance to cracking under stress (optional)	27	Appearance	Rating (min.)	4	4	4	—	—
Resistance to crazing	28	Appearance	Rating (min.)	—	—	—	4	4
Resistance to scratching	29 and see Annex A	Force	Rating (min.)	2	2	2	2	2
Resistance to staining (Method A) or	30	Appearance	Rating (min.)					
			Groups 1 and 2	5	5	5	5	5
			Group 3	4	4	4	4	4
Resistance to staining (Method B)	31	Appearance	Cleanability (max.)	20	20	20	20	20
			Stain 1 to 10	5	5	5	5	5
			Stain 11 to 15	3	3	3	3	3
Light fastness (xenon arc) (Method A)	32	Contrast	Grey scale rating (min.)	4[d]	4[d]	4[d]	4[d]	4[d]

[a] Where d = nominal thickness.

[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] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[e] Machine crosshead speed of 10 mm/min.

Table 8 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade				
				ATS	ATP	ATF	ACS	ACF
Light fastness (xenon arc) (Method B)	33	Contrast	Colour change (min.)	4[d]	4[d]	4[d]	4[d]	4[d]
Flexural strength	ISO 178[e]	Stress	MPa (min.)	—	—	—	80	
Flexural modulus	ISO 178[e]	Stress	MPa (min.)	—	—	—	9 000	
Density	ISO 1183-1	Density	g/cm^3 (min.)	1,35	1,35	1,35	1,35	1,35

[a] Where d = nominal thickness.

[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] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[e] Machine crosshead speed of 10 mm/min.

5.4.2 General requirements for metal laminates

General requirements for metal laminates are specified in Table 9.

Table 9 — General requirements for metal laminates

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade				
				MTS	MTP	MTF	MCS	MCF
Resistance to immersion in boiling water	13	Appearance	Core delamination (pass or fail)	pass[a]	pass[a]	pass[a]	pass[a]	pass[a]
Resistance to water vapour	15	Appearance	Rating (min.)	3	3	3	3	3
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max.)[b]					
			$d < 2$ mm					
			L[c]	0,75	0,75	0,75	—	—
			T[d]	1,25	1,25	1,25	—	—
			% (max.)[b]					
			2 mm ≤ d < 5 mm					
			L[c]	—	—	—	0,40	0,40
			T[d]	—	—	—	0,80	0,80
			% (max.)[b]					
			$d \geq 5$ mm					
			L[c]	—	—	—	0,30	0,30
			T[d]	—	—	—	0,60	0,60
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max.)[b]					
			$d < 2$ mm					
			L[c]	0,75	1,00	1,10	—	—
			T[d]	1,25	1,15	1,25	—	—
			% (max.)[b]					
			2 mm ≤ d < 5 mm					
			L[c]	—	—	—	0,30	0,30
			T[d]	—	—	—	0,70	0,70
			% (max.)[b]					
			$d \geq 5$ mm					
			L[c]	—	—	—	0,30	0,30
			T[d]	—	—	—	0,70	0,70

[a] No delamination of the core.

[b] Where d = nominal thickness.

[c] L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminate).

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

[e] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[f] Machine crosshead speed of 2 mm/min.

Table 9 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade				
				MTS	MTP	MTF	MCS	MCF
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max.)[b]					
			d < 2 mm					
			L[c]	0,75	0,75	0,75	—	—
			T[d]	1,25	1,25	1,25	—	—
			% (max.)[b]					
			2 mm ≤ d < 5 mm					
			L[c]	—	—	—	0,40	0,40
			T[d]	—	—	—	0,80	0,80
			% (max.)[b]					
			d ≥ 5 mm					
			L[c]	—	—	—	0,30	0,30
			T[d]	—	—	—	0,60	0,60
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max.)[b]					
			d < 2 mm					
			L[c]	0,75	1,00	1,10	—	—
			T[d]	1,25	1,15	1,25	—	—
			% (max.)[b]					
			d < 2 mm					
			L[c]	0,75	0,75	0,75	—	—
			T[d]	1,25	1,25	1,25	—	—
			% (max.)[b]					
			2 mm ≤ d < 5 mm					
			L[c]	—	—	—	0,40	0,40
			T[d]	—	—	—	0,80	0,80
Resistance to cracking under stress (optional)	27	Appearance	Rating (min.)	4	4	4	—	—
Resistance to crazing	28	Appearance	Rating (min.)	—	—	—	4	4
Resistance to scratching	29 and see Annex A	Force	Rating (min.)	1	1	1	1	1

[a] No delamination of the core.

[b] Where d = nominal thickness.

[c] L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminate).

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

[e] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[f] Machine crosshead speed of 2 mm/min.

Table 9 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade				
				MTS	MTP	MTF	MCS	MCF
Resistance to staining (Method A) or	30	Appearance	Rating (min.)					
			Groups 1 and 2	4	4	4	4	4
			Group 3	4	4	4	4	4
Resistance to staining (Method B)	31	Appearance	Cleanability (max.)	20	20	20	20	20
			Stain 1 to 10	5	5	5	5	5
			Stain 11 to 15	3	3	3	3	3
Light fastness (xenon arc) (Method A)	32	Contrast	Grey scale rating (min.)	4[e]	4[e]	4[e]	4[e]	4[e]
Light fastness (xenon arc) (Method B)	33	Contrast	Colour change (min.)	4[e]	4[e]	4[e]	4[e]	4[e]
Flexural strength	ISO 178[f]	Stress	MPa (min.)	—	—	—	80	
Flexural modulus	ISO 178[f]	Stress	MPa (min.)	—	—	—	9 000	
Density	ISO 1183-1	Density	g/cm^3 (min.)	1,35	1,35	1,35	1,35	1,35

[a] No delamination of the core.

[b] Where d = nominal thickness.

[c] L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminate).

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

[e] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[f] Machine crosshead speed of 2 mm/min.

5.4.3 General requirements for wood veneer laminates

General requirements for wood veneer laminates are specified in Table 10.

Table 10 — General requirements for wood veneer laminates

Property	Test method ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	WTS	WTF	WCS	WCF
Resistance to surface wear	11	Wear resistance	Revolutions (min.) Initial point Wear value	150 350	150 350	150 350	150 350
Resistance to immersion in boiling water	13	Appearance	Core delamination (pass or fail)	pass[a]	pass[a]	pass[a]	pass[a]
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max.)[b] d < 2 mm L[c] T[d]	 0,75 1,25	 0,90 1,40	 — —	 — —
			% (max.)[b] 2 mm ≤ d < 5 mm L[c] T[d]	 — —	 — —	 0,55 0,90	 0,55 0,90
			% (max.)[b] d ≥ 5 mm L[c] T[d]	 — —	 — —	 0,45 0,75	 0,45 0,75
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max.)[b] d < 2 mm L[c] T[d]	 0,75 1,25	 1,00 1,45	 — —	 — —
			% (max.)[b] 2 mm ≤ d < 5 mm L[c] T[d]	 — —	 — —	 0,30 0,70	 0,30 0,70
			% (max.)[b] d ≥ 5 mm L[c] T[d]	 — —	 — —	 0,30 0,70	 0,30 0,70

[a] No delamination of the core.

[b] Where d = nominal thickness.

[c] L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminate).

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

[e] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[f] Machine crosshead speed of 2 mm/min.

Table 10 *(continued)*

Property	Test method ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	WTS	WTF	WCS	WCF
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max.)[b]				
			$d < 2$ mm				
			L[c]	0,70	0,95	—	—
			T[d]	1,20	1,30	—	—
			% (max.)[b]				
			2 mm ≤ $d < 5$ mm				
			L[c]	—	—	0,55	0,55
			T[d]	—	—	0,90	0,90
			% (max.)[b]				
			$d \geq 5$ mm				
			L[c]	—	—	0,45	0,45
			T[d]	—	—	0,75	0,75
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max.)[b]				
			$d < 2$ mm				
			L[c]	1,00	1,10	—	—
			T[d]	1,15	1,25	—	—
			% (max.)[b]				
			$d < 2$ mm				
			L[c]	—	—	0,55	0,55
			T[d]	—	—	0,90	0,90
			% (max.)[b]				
			2 mm ≤ $d < 5$ mm				
			L[c]	—	—	0,45	0,45
			T[d]	—	—	0,75	0,75
Resistance to impact by large diameter ball (optional)	25	Drop height	mm (min.)	600	600	800	800
		Indent diameter	mm (max.)	12	12	10	10
Resistance to cracking under stress (optional)	27	Appearance	Rating (min.)	4	4	—	—
Resistance to crazing	28	Appearance	Rating (min.)	—	—	4	4

[a] No delamination of the core.

[b] Where d = nominal thickness.

[c] L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminate).

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

[e] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[f] Machine crosshead speed of 2 mm/min.

Table 10 *(continued)*

Property	Test method ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	WTS	WTF	WCS	WCF
Resistance to scratching	29 and see Annex A	Force	Rating (min.)	2	2	2	2
Resistance to staining (Method A) or	30	Appearance	Rating (min.) Groups 1 and 2 (min.) Group 3 (min.)	 5 4	 5 4	 5 4	 5 4
Resistance to staining (Method B)	31	Appearance	Cleanability (max.) Stain 1 to 10 (min.) Stain 11 to 15 (min.)	20 5 3	20 5 3	20 5 3	20 5 3
Light fastness (xenon arc) (Method A) or	32	Contrast	Grey scale rating (min.)	2[e]	2[e]	2[e]	2[e]
Light fastness (xenon arc) (Method B)	33	Contrast	Colour change (min.)	4[e]	4[e]	4[e]	4[e]
Resistance to wet heat	42	Appearance	Rating (min.)	3	3	3	3
Resistance to dry heat (100 °C)	EN 12722	Appearance	Rating (min.)	3	3	3	3
Flexural strength	ISO 178[f]	Stress	MPa (min.)			65	
Flexural modulus	ISO 178[f]	Stress	MPa (min.)			6 500	
Density	ISO 1183—1	Density	g/cm^3 (min.)	1,0	1,0	1,1	1,1

[a] No delamination of the core.

[b] Where d = nominal thickness.

[c] L = in the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminate).

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

[e] Extraneous darkening and/or photochroism are due to the shock effect of accelerated exposure and are not characteristic of natural exposure.

[f] Machine crosshead speed of 2 mm/min.

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

Additional requirements for type P laminates are specified in Table 11.

Table 11 — Additional requirements for type P laminates

Property	Test method ISO 4586-2:2018, Clause No.)	Property or attribute	Unit	Requirement
Formability (Method A) or	38	Radius	mm L[a] T[b]	 ≤ 10 × d^c ≤ 20 × d^c
Formability (Method B)	39	Radius	mm L[a] T[b]	 ≤ 15 × d^c ≤ 20 × d^c
Resistance to blistering (Method A) or	40	Time to blister ($t_2 - t_1$)	s (seconds) d^c < 0,8 mm d^c ≥ 0,8 mm	 ≥ 10 ≥ 15
Resistance to blistering (Method B)	41	Time to blister	s (seconds) d^c < 1,0 mm d^c ≥ 1,0 mm	 ≥ 40 ≥ 55

[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).

[c] Where d = nominal thickness.

5.4.5 Notes on requirements for reaction to fire (see Annex B)

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 and EN 13501-1[2] and some of the more common fire test scenarios.

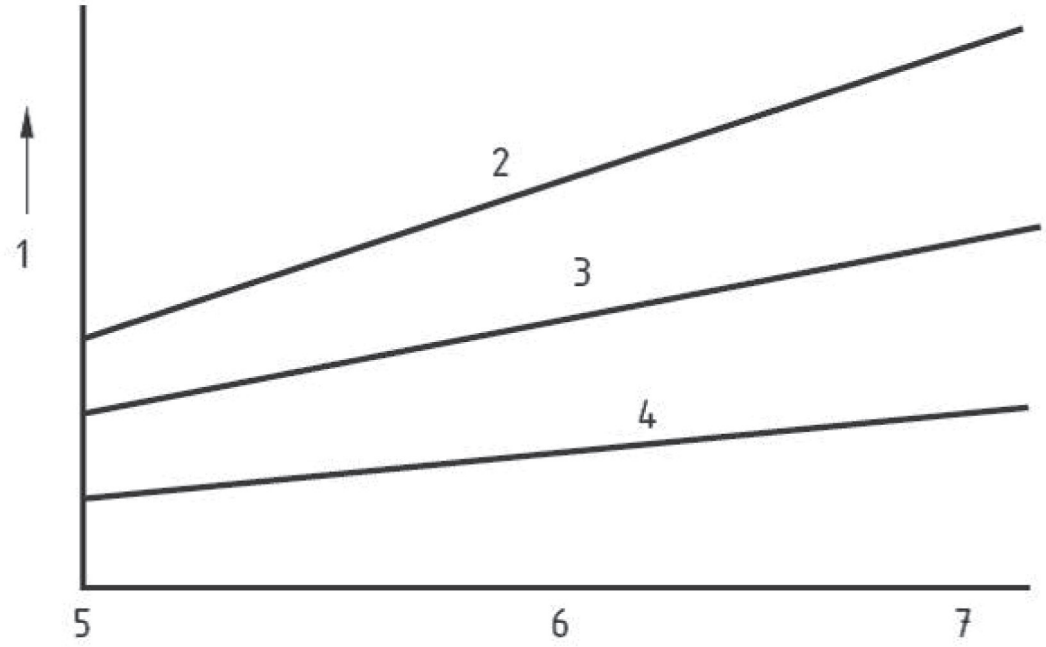
Annex A
(informative)

Addendum to Tables 8, 9, and 10 relating to test method for resistance to scratching

The degree to which decorative laminates show scuff and scratch marks is influenced by surface finish and colour, and the limits given in Tables 8, 9, and 10 indicate the minimum acceptable performance for each grade of laminate. However, superior scratch resistance performance can be achieved by selecting particular combinations of surface finish, colour and pattern.

In general terms, scuff and scratch marks are less easily seen on textured surfaces than on plane surface finishes; light colours are better than dark colours; and prints are usually better than plain colours.

Figure A.1 gives an indication of the effect of surface finish and colour on the scratch resistance performance of laminates. The choice of surface finish, colour and print can be made to suit the particular application.



Key

1 scratch resistance (force)
2 deep textures
3 shallow textures
4 smooth finishes
5 dark colours
6 medium colours
7 light colours

Figure A.1 — Effects of surface finish and colour on scratch resistance

Annex B
(informative)

Addendum to 5.4.5, 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 B.1 shows typical EN 13501-1 reaction-to-fire classifications of HPL composite panels with wood-based substrates.

Table B.1 — Typical EN 13501-1 classifications of HPL composite panels with wood-based substrates

Product type	Typical EN 13501-1 classification
Composite panels comprising HPL type F bonded to fire rated wood-based substrates	B-s2,d0
Composite panels comprising HPL non type F bonded to non-fire rated wood-based substrates	D-s2,d0
NOTE Fire test performance will depend on laminate thickness and construction, substrate type and thickness, and adhesive used. The laminate manufacturer should be contacted 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 B.2 shows some examples of how high-pressure laminates typically relate to some of the more common European test methods.

Table B.2 — Examples of typical fire performance of high-pressure laminates

Test method	Test standard	Typical performance levels	
		ACF, ATF, MCF, MCT, WCF, and WCT	ACS, ACP, ATS, ATP, MCS, MCP, MTS, MTP, WCS, WCP, WTS, and WTP
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
Heat release	IMO Res. A653 (16)	Pass	Pass
NOTE 1 Fire test performance will depend on laminate thickness and construction, substrate type and thickness, and adhesive used. The laminate manufacturer should be contacted for details of test reports and certifications held, and for information on fire test methods and specifications. NOTE 2 Flame-retardant additives used in high-pressure decorative laminates are not halogen based and remain effective throughout the service life of the product.			

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

Table B.3 shows typical ASTM E84 reaction-to-fire classifications of HPDL composite panels with wood-based substrates.

Table B.3 — Typical ASTM E84 classifications of HPDL composite panels with wood-based substrates

Product type	Typical ASTM E84 classification
Composite panels comprising HDPL type F bonded to fire rated wood-based or non-combustible substrates	Class A
NOTE 1 Fire test performance will depend on laminate thickness and construction, substrate type and thickness, and adhesive used. The laminate manufacturer should be contacted for details of test reports and certifications held, and for information on fire test methods and specifications.	
NOTE 2 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] ISO 11925-2, *Reaction to fire tests — Ignitability of products subjected to direct impingement of flame — Part 2: Single-flame source test*

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

[3] EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*

[4] ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

[5] BS 476-7, *Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products*

[6] DIN 4102-1, *Fire behaviour of building materials and building components — Part 1: Building materials; concepts, requirements and tests*

[7] NF P92-501, *Sécurité contre l'incendie — Bâtiment — Essais de réaction au feu des matériaux — Essai par rayonnement applicable aux matériaux rigides ou rendus tels (matériaux de revêtement collés) de toute épaisseur et aux matériaux souples d'épaisseur supérieure à 5 mm*

[8] NF F16-101, *Matériel roulant ferroviaire — Comportement au feu — Choix des matériaux*

[9] 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</ unknown>

[10] Council Directive 96/98/EC of 20 December 1996 on marine equipment (OJ L 46, 17.2.1997, P. 25-26 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)

[11] EN 438-8, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (Usually called Laminates) — Part 8: Classification and specifications for design laminates*

[12] ISO 4211-2:1993,[2)]*Furniture — Tests for surfaces — Part 2: Assessment of resistance to wet heat*

2) Withdrawn standard.

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Price based on 22 pages