INTERNATIONAL STANDARD

ISO 4586-8

Second edition
2018-07

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

Part 8: Classification and specifications for alternative core laminates

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

Partie 8: Classification et spécifications des différents modes de base laminés

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 4586-8:2015), 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. HPL sheets are available in a wide variety of colours, patterns, and surface finishes. They are resistant to wear, scratching, impact, moisture, heat, and staining; and possess good hygienic and anti-static properties, being easy to clean and maintain.

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 438-9 whenever possible.

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

Part 8: Classification and specifications for alternative core laminates

1 Scope

This document specifies performance requirements for high-pressure decorative laminates (HPL, HPDL) intended for interior use that have core compositions not covered by ISO 4586-1 through ISO 4586-7. The core composition types (coloured core and metal reinforced core) 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 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 4586-2:2018, *High-pressure decorative laminates (HPL, HPDL) — Sheets based on thermosetting resins (usually called laminates) — Part 2: Determination of properties*

ISO 12572, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties — Cup method*

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 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
alternative core laminate
high-pressure decorative laminate (3.1), consisting of decorative surface layers and alternative core layers

Note 1 to entry: The decorative surface layer(s) impregnated with melamine resin may appear on one or both sides of the laminate.

3.4
colored core laminate
high-pressure decorative *alternative core laminate* (3.3), the core material of which consists of cellulosic fibrous layers (normally paper), impregnated with thermosetting resins (typically aminoplastic thermosetting resins)

Note 1 to entry: To achieve a coloured core laminate, either the cellulosic fibres or the resins can be coloured. A translucent laminate can be achieved by using clear resins and bleached fibres.

Note 2 to entry: The surface and the core layers can have a similar colour producing a uniformly coloured laminate or be different colour to achieve a succession of coloured layers.

3.5
metal reinforced core laminate
high-pressure decorative *alternative core laminate* (3.3), the core material of which consists of metal layer(s) or mesh(es) and cellulosic fibrous layers (normally paper) impregnated with phenolic or aminoplastic thermosetting resins

Note 1 to entry: The purpose of including metal layers is to improve the mechanical, fire, or permeability performance of the laminate. Additionally the metal layers can give aesthetic improvements to the edge.

4 Material types

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

Table 1 — Numerical classification

First letter	Second letter	Third letter
B (Coloured core laminate)	C (Compact)	S (Standard grade)
H (Metal reinforced core laminate)	T (Thin laminate, < 2 mm)	F (Flame-retardant grade)
Type S — Standard grade high pressure decorative alternative core laminates.		
Type F — High pressure decorative alternative core laminates with improved fire retardance; similar to type S but also complying special requirements of specified fire tests which may vary according to the application (e.g. construction, marine, transport) and the country of use (see 5.4.3).		
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, coloured core standard grade thin high-pressure decorative laminate is designated as HPL/ISO 4586-8 BTS or HPDL/ISO 4586-8 BTS.		

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 and under tungsten-filament lighting illuminant A, 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.

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 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.

5.2.4 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.

5.2.5 Visual inspection

5.2.5.1 General

The following inspection requirements are intended as a general guide, indicating the minimum acceptable quality for laminates. Cut-to-size panels and certain applications involving full-size sheets may call for special quality requirements which can be negotiated between 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.

In the case of a double faced laminate, it may be agreed between the purchaser and supplier that the visual quality standard applies to one decorative face only.

5.2.5.2 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.

5.2.5.3 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.

For compact laminate grades, edge chipping up to 3 mm on each side is permissible.

5.3 Dimensional tolerance requirements

5.3.1 Dimensional tolerance requirements for coloured core laminates

Dimensional tolerance requirements for coloured core laminates are specified in Tables 2 and 3.

Table 2 — Dimensional tolerance requirements for thin coloured core 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 3 — Dimensional tolerance requirements for compact coloured core 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 m ≤ 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 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 ≤ d < 6,0 mm: 12,0 mm/m maximum deviation 6,0 ≤ d < 10,0 mm: 8,0 mm/m maximum deviation 10,0 ≤ d: 5, 0mm/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 reinforced core laminates

Dimensional tolerance requirements for metal reinforced core laminates are specified in Table 4 and Table 5.

Table 4 — Dimensional tolerance requirements for thin metal reinforced core laminates

Property	Test method (ISO 4586-2:2018 Clause No.)	Requirement
Thickness	5	0,5 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 reinforced core 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 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: 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.

5.4 Test requirements

5.4.1 General requirements for coloured core laminates

General requirements for coloured core laminates are specified in Table 6.

Table 6 — General requirements for coloured core laminates

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				BTS	BCS
Resistance to surface wear	11	Wear resistance	Revolutions (min.)		
			Initial point	150	150
			Wear value	350	350
Resistance to immersion in boiling water	13	Appearance	Rating (min.)		
			Gloss finish	3	3
			Other finishes	4	4
		Mass increase	% (max.)[a]		
			2 mm ≤ d < 5 mm	—	5,0
			d ≥ 5 mm	—	3,0
		Thickness increase	% (max.)[a]		
			2 mm ≤ d < 5 mm	—	6,0
			d ≥ 5 mm	—	4,0
Resistance to water vapour	15	Appearance	Rating (min.)		
			Gloss finish	3	3
			Other finishes	4	4
Resistance to dry heat (Method A)	17	Appearance	Rating (min.)		
			Gloss finish	3	3
			Other finishes	4	4
Resistance to dry heat (Method B)	18	Appearance	Rating (min.)		
			Gloss finish	3	3
			Other finishes	4	4

[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.

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

[g] The moderate crack lines run along all the edge of the specimen.

Table 6 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				BTS	BCS
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max.)[a]		
			d < 2 mm		
			L[b]	0,80	—
			T[c]	1,40	—
			% (max.)[a]		
			2 mm ≤ d < 5 mm		
			L	—	0,60
			T[c]	—	1,00
			% (max)[a]		
			d ≥ 5 mm		
			L[b]	—	0,50
			T[c]	—	0,80
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max.)[a]		
			d < 2 mm		
			L[b]	0,75	—
			T[c]	1,35	—
			% (max.)[a]		
			2 mm ≤ d < 5 mm		
			L[b]	—	0,55
			T[c]	—	0,95
			% (max.)[a]		
			d ≥ 5 mm		
			L[b]	—	0,45
			T[c]	—	0,75

[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.

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

[g] The moderate crack lines run along all the edge of the specimen.

Table 6 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				BTS	BCS
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max.)[a] d < 2 mm L[b] T[c]	 0,75 1,35	 — —
			% (max.)[a] 2 mm ≤ d < 5 mm L[b] T[c]	 — —	 0,50 0,90
			% (max.)[a] d ≥ 5 mm L[b] T[c]	 — —	 0,45 0,85
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max.)[a] d < 2 mm L[b] T[c]	 0,70 1,30	 — —
			% (max.)[a] 2 mm ≤ d < 5 mm L[b] T[c]	 — —	 0,50 0,90
			% (max.)[a] d ≥ 5 mm L[b] T[c]	 — —	 0,40 0,70
Resistance to crazing	28	Appearance	Rating (min.)	—	Surface: 4 Core: 3[g]
Resistance to scratching	29	Appearance	Rating (min.) Gloss finish Other finishes	 2 3	 2 3

[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.

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

[g] The moderate crack lines run along all the edge of the specimen.

Table 6 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				BTS	BCS
Resistance to staining (Method A) or	30	Appearance	Rating (min.) Groups 1 and 2 Group 3	 5 4	 5 4
Resistance to staining (Method B)	31	Appearance	Cleanability (max.) Stain 1 to 10 Stain 11 to 15	20 5 3	20 5 3
Light fastness (xenon arc) (Method A) or	32	Contrast	Grey scale rating (min.)	Surface: 4[d] Core: 3[d]	Surface: 4[d] Core: 3[d]
Light fastness (xenon arc) (Method B)	33	Contrast	Colour change(min.)	Surface: 4[d] Core: 3[d]	Surface: 4[d] Core: 3[d]
Resistance to radiant heat	36	Appearance	s (min.)	150	200
Density	ISO 1183-1	Density	g/cm^3 (min.)	1,35	1,35
Flexural strength	ISO 178[e]	Stress	MPa (min.)	—	80
Flexural modulus	ISO 178[e]	Stress	MPa (min.)	—	9 000
Tensile strength	ISO 527-2[f]	Stress	MPa (min.)	—	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.

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

[g] The moderate crack lines run along all the edge of the specimen.

5.4.2 General requirements for metal reinforced core laminates

General requirements for metal reinforced core laminates are specified in Table 7.

Table 7 — General requirements for metal reinforced core laminates

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade			
				HTS	HTF	HCS	HCF
Resistance to surface wear	11	Wear resistance	Revolutions (min.)				
			Initial point	150	150	150	150
			Wear value	350	350	350	350
Resistance to immersion in boiling water	13	Appearance	Rating (min.)				
			Gloss finish	3	3	3	3
			Other finishes	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.)				
			Gloss finish	3	3	3	3
			Other finishes	4	4	4	4
Resistance to dry heat (Method A)	17	Appearance	Rating (min.)				
			Gloss finish	3	3	3	3
			Other finishes	4	4	4	4
Resistance to dry heat (Method B)	18	Appearance	Rating (min.)				
			Gloss finish	3	3	3	3
			Other finishes	4	4	4	4

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

[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 10 mm/min.

[g] Specimen type 1A. Machine crosshead speed of 5 mm/min.

Table 7 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade			
				HTS	HTF	HCS	HCF
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max.)[a]				
			$d < 2$ mm				
			L[b]	0,75	0,75	—	—
			T[c]	1,25	1,25	—	—
			% (max.)[a]				
			2 mm ≤ $d < 5$ mm				
			L[b]	—	—	0,60	0,60
			T[c]	—	—	1,00	1,00
			% (max.)[a]				
			$d \geq 5$ mm				
			L[b]	—	—	0,50	0,50
			T[c]	—	—	0,80	0,80
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max.)[a]				
			$d < 2$ mm				
			L[b]	0,75	0,75	—	—
			T[c]	1,35	1,35	—	—
			% (max.)[a]				
			2 mm ≤ $d < 5$ mm				
			L[b]	—	—	0,55	0,55
			T[c]	—	—	0,95	0,95
			% (max.)[a]				
			$d \geq 5$ mm				
			L[b]	—	—	0,45	0,45
			T[c]	—	—	0,75	0,75

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

[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 10 mm/min.

[g] Specimen type 1A. Machine crosshead speed of 5 mm/min.

Table 7 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade			
				HTS	HTF	HCS	HCF
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max.)[a]				
			$d < 2$ mm				
			L[b]	0,75	0,75	—	—
			T[c]	1,35	1,35	—	—
			% (max.)[a]				
			2 mm ≤ d < 5 mm				
			L[b]	—	—	0,55	0,55
			T[c]	—	—	0,85	0,85
			% (max.)[a]				
			$d \geq 5$ mm				
			L[b]	—	—	0,45	0,45
			T[c]	—	—	0,75	0,75
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max.)[a]				
			$d < 2$ mm				
			L[b]	0,70	0,70	—	—
			T[c]	1,30	1,30	—	—
			% (max.)[a]				
			2 mm ≤ d < 5 mm				
			L[b]	—	—	0,50	0,50
			T[c]	—	—	0,90	0,90
			% (max.)[a]				
			$d \geq 5$ mm				
			L[b]	—	—	0,40	0,40
			T[c]	—	—	0,70	0,70
Resistance to impact by large diameter ball (optional)	25	Drop height	mm (min.)[a]				
			$d < 2$ mm	1 000[d]	1 000[d]	—	—
			2 mm ≤ d < 6 mm	—	—	1 400[d]	1 400[d]
			$d \geq 6$ mm	—	—	1 800[d]	1 800[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] When tested at the specified drop height, the diameter of the indentation shall not exceed 10 mm.

[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 10 mm/min.

[g] Specimen type 1A. Machine crosshead speed of 5 mm/min.

Table 7 *(continued)*

Property	Test method (ISO 4586-2:2018, Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade			
				HTS	HTF	HCS	HCF
Resistance to cracking under stress (optional)	27	Appearance	Rating (min.)	4	4	—	—
Resistance to crazing	28	Appearance	Rating (min.)	—	—	4[e]	4[e]
Resistance to scratching	28	Appearance	Rating (min.)				
			Gloss finish	2	2	2	2
			Other finishes	3	3	3	3
Resistance to staining (Method A) or	30	Appearance	Rating (min.)				
			Groups 1 and 2	5	5	5	5
			Group 3	4	4	4	4
Resistance to staining (Method B)	31	Appearance	Cleanability (max.)	20	20	20	20
			Stain 1 to 10	5	5	5	5
			Stain 11 to 15	3	3	3	3
Light fastness (xenon arc) (Method A) or	32	Contrast	Grey scale rating (min.)	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]
Resistance radiant heat	36	Appearance	Seconds (min.)	150	150	150	150
Resistance to wet heat	41	Appearance	Rating (min.)				
			Gloss finish	3	3	3	3
			Other finishes	4	4	4	4
Density	ISO 1183-1	Density	g/cm^3 (min.)	1,35	1,35	1,35	1,35
Flexural strength	ISO 178[f]	Stress	MPa (min.)	—	—	80	80
Flexural modulus	ISO 178[f]	Stress	MPa (min.)	—	—	9 000	9 000
Tensile strength	ISO 527-2[g]	Stress	MPa (min.)	—	—	60	60
Permeability	ISO 12572	Permeability	μ	Wet cup = 110; Dry cup = 250			

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

[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 10 mm/min.

[g] Specimen type 1A. Machine crosshead speed of 5 mm/min.