INTERNATIONAL STANDARD

**ISO 4586-8**

Second edition
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# 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<br>1,0 mm < *d* ≤ 2,0 mm: ±0,18 mm maximum deviation<br>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.<br>[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<br>3,0 mm ≤ *d* < 5,0 mm: ±0,40 mm maximum deviation<br>5,0 mm ≤ *d* < 8,0 mm: ±0,50 mm maximum deviation<br>8,0 m ≤ *d* < 12,0 mm: ±0,70 mm maximum deviation<br>12,0 mm ≤ *d* < 16,0 mm: ±0,80 mm maximum deviation<br>16,0 mm ≤ *d* < 20,0 mm: ±0,90 mm maximum deviation<br>20,0 mm ≤ *d* < 25,0 mm: ±1,00 mm maximum deviation<br>25,0 mm ≤ *d*: to be agreed upon between the supplier and customer<br>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<br>6,0 ≤ *d* < 10,0 mm: 8,0 mm/m maximum deviation<br>10,0 ≤ *d*: 5, 0mm/m maximum deviation<br>where *d* = nominal thickness |
| [a] Tolerances for cut-to-size panels shall be agreed between supplier and purchaser.<br>[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<br>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 m: ±0,25 mm maximum deviation<br>3,0 mm ≤ *d* < 5,0 mm: ±0,40 mm maximum deviation<br>5,0 mm ≤ *d* < 8,0 mm: ±0,50 mm maximum deviation<br>8,0 mm ≤ *d* < 12,0 mm: ±0,70 mm maximum deviation<br>12,0 mm ≤ *d* < 16,0 mm: ±0,80 mm maximum deviation<br>16,0 mm ≤ *d* < 20,0 mm: ±0,90 mm maximum deviation<br>20,0 mm ≤ *d* < 25,0 mm: ±1,00 mm maximum deviation<br>25,0 mm ≤ *d*: to be agreed upon between the supplier and customer<br>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<br>6,0 mm ≤ *d* < 10,0 mm: 5,0 mm/m maximum deviation<br>10,0 mm ≤ *d*: 3,0 mm/m maximum deviation<br>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] | 0,75 | — |
| | | | T[c] | 1,35 | — |
| | | | % (max.)[a] | | |
| | | | 2 mm ≤ $d$ < 5 mm | | |
| | | | L[b] | — | 0,50 |
| | | | T[c] | — | 0,90 |
| | | | % (max.)[a] | | |
| | | | $d$ ≥ 5 mm | | |
| | | | L[b] | — | 0,45 |
| | | | T[c] | — | 0,85 |
| Dimensional stability at ambient temperature (Method B) | 22 | Cumulative dimensional change | % (max.)[a] | | |
| | | | $d$ < 2 mm | | |
| | | | L[b] | 0,70 | — |
| | | | T[c] | 1,30 | — |
| | | | % (max.)[a] | | |
| | | | 2 mm ≤ $d$ < 5 mm | | |
| | | | L[b] | — | 0,50 |
| | | | T[c] | — | 0,90 |
| | | | % (max.)[a] | | |
| | | | $d$ ≥ 5 mm | | |
| | | | L[b] | — | 0,40 |
| | | | T[c] | — | 0,70 |
| Resistance to crazing | 28 | Appearance | Rating (min.) | — | Surface: 4<br>Core: 3[g] |
| Resistance to scratching | 29 | Appearance | Rating (min.) | | |
| | | | Gloss finish | 2 | 2 |
| | | | Other finishes | 3 | 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.)<br>Groups 1 and 2<br>Group 3 | <br>5<br>4 | <br>5<br>4 |
| Resistance to staining (Method B) | 31 | Appearance | Cleanability (max.)<br>Stain 1 to 10<br>Stain 11 to 15 | 20<br>5<br>3 | 20<br>5<br>3 |
| Light fastness (xenon arc) (Method A) or | 32 | Contrast | Grey scale rating (min.) | Surface: 4[d]<br>Core: 3[d] | Surface: 4[d]<br>Core: 3[d] |
| Light fastness (xenon arc) (Method B) | 33 | Contrast | Colour change(min.) | Surface: 4[d]<br>Core: 3[d] | Surface: 4[d]<br>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] | | | | |
| | | | $2 \text{ mm} \leq d < 5$ 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] | | | | |
| | | | $2 \text{ mm} \leq d < 5$ 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] | | | | |
| | | | $d$ ≥ 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] | | | | |
| | | | $d$ ≥ 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] |
| | | | $d$ ≥ 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.

### 5.4.3 Reaction to fire

The requirements for reaction to fire are determined by the fire regulations of the country in which the material is to be used. The reaction-to-fire of construction products is classified in accordance with 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 A gives examples of how high-pressure laminates relate to ASTM E84[5] and EN 13501-1[3] 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[4] (SBI test) and ISO 11925-2[2] (Small-burner test), and the resulting reaction-to-fire performance is expressed in accordance with EN 13501-1.

Table A.1 shows typical EN 13501-1 reaction-to-fire classifications of HPL composite panels with wood-based substrates.

**Table A.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 type non 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 A.2 shows some examples of how high-pressure laminates typically relate to some of the more common European test methods.

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

| Test method | Test standard | Typical performance levels | |
|---|---|---|---|
| | | ISO 4586-3 HPL Type F | ISO 4586-3 HPL Types S and P |
| 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.<br>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 A.3 shows typical ASTM E84 reaction-to-fire classifications of HPDL composite panels with wood-based substrates.

**Table A.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 inorganic based 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 11664-2, *Colorimetry — Part 2: CIE standard illuminants*

[2] ISO 11925-2, *Reaction to fire tests — Ignitability of products subjected to direct impingement of flame — Part 2: Single-flame source test*</std>

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

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

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

[6] 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*

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

[8] 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*

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

[10] 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>

[11] 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)

[12] EN 438-9, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called laminates) — Part 9: Classification and specifications for alternative core laminates*

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