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

**Part 3:
Classification and specifications for
laminates less than 2 mm thick and
intended for bonding to supporting
substrates**

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

*Partie 3: Classification et spécifications des stratifiés d'épaisseur
moins de 2 mm d'épaisseur et destiné pour le collage de support*



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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 4586-3:2015), 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 laminate 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 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 438-3 whenever possible.

In addition, [Annex C](#) provides information on electrostatic properties and is included as a convenient reference to answer common questions.

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

Part 3:

Classification and specifications for laminates less than 2 mm thick and intended for bonding to supporting substrates

1 Scope

This document applies to high-pressure laminates (HPL) less than 2 mm thick normally intended for bonding to supporting substrates to produce HPL composite panels and establishes a classification system for high-pressure decorative laminates according to their performance and main recommended fields of application, including materials with special characteristics, for example formability or defined reaction to fire. This document also specifies requirements for the properties of the various types of laminates covered by this classification system.

ISO 4586-2 specifies the methods of test relevant to this document. ISO 4586-4 through ISO 4586-8 are reserved for other types of HPL materials.

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

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

3 Terms and definitions

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

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

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

3.1
high-pressure decorative laminate
HPL
HPDL

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

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

3.2
high-pressure process

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

3.3
surface layer

upper decorative layer consisting in one or more sheets of fibrous material (usually paper) impregnated with aminoplastic thermosetting resins (usually melamine based resins) or other curable resins or other decorative design surfaces such as metal foils, wood-veneers, and textiles, etc. which are not necessarily treated with thermosetting resin

3.4
core layer

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

4 Material types

4.1 Type S — Standard grade decorative laminates.

4.2 Type P — Postformable decorative laminates, similar to type S but can also be formed at elevated temperature.

4.3 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 6.4.3 and Annex B).

5 Requirements

5.1 General

Two different HPL classification systems are commonly used and both have been included in this document as alternatives.

5.2 Numerical classification system

In this system the classification of a letter denoting material type (see Clause 4) followed by three index numbers showing the levels of performance for wear resistance, impact resistance and scratch resistance respectively.

Table 1 shows the performance levels corresponding to the index numbers.

Table 1 — Numerical classification

Initial point(revs) Wear value (revs)	First index number — Wear resistance		
	2	3	4
	≥ 50	≥ 150	≥ 350
	≥ 150	≥ 350	≥ 1 000
Small diameter ball (N)	Second index number — Impact resistance		
	2	3	4
	≥ 15	≥ 20	≥ 25
Scratch resistance (Rating)	Third index number — Scratch resistance		
	2	3	4
	2	3	4

NOTE Index numbers 2, 3, and 4 are specified to maintain consistency with earlier editions of ISO 4586 parts. Index number 1 represents a lower quality level that does not apply to HPL as defined by the scope of this document.

5.3 Alphabetical classification system

This system uses three letters to classify laminates as shown in [Table 2](#).

Table 2 — Alphabetical classification

First letter	Second letter	Third letter
H (Horizontal grade) or V (Vertical grade)	G (General purpose) or D (Heavy duty)	S (Standard grade) or P (Postformable grade) or F (Flame-retardant grade)

[Table 3](#) compares the alternative classification systems and shows how different HPL products relate to some typical applications. The list of typical applications shown for each category is for guidance only and is not intended to be comprehensive.

Table 3 — Classification system and typical applications

Performance category	Material type	Numerical classification			Equivalent alphabetical classification	Examples of typical applications
		Wear resistance	Impact resistance	Scratch resistance		
Very high resistance to surface wear Very high resistance to impact Very high resistance to scratching	S, F or P	4	4	4	HDS (Horizontal Heavy Duty Standard), HDF (Horizontal Heavy Duty Flame-retardant), or HDP (Horizontal Heavy Duty Post-forming)	Countertops, institutional applications (prisons, military, barracks, etc.)
High resistance to surface wear High resistance to impact High resistance to scratching	S, F or P	3	3	3	HGS (Horizontal General purpose Standard), HGF (Horizontal General purpose Flame-retardant), or HGP (Horizontal General purpose Postforming)	Kitchen and office work surfaces, restaurant and hotel tables, doors and wall coverings in public areas, interior walls of public transport vehicles
Medium resistance to surface wear Medium resistance to impact Medium resistance to scratching	S, F or P	2	2	2	VGS (Vertical General purpose Standard), VGF (Vertical General purpose Flame retardant), or VGP (Vertical General purpose Postforming)	Front panels for kitchen, office and bathroom furniture, wall coverings, ceiling panels, shelves, and furniture elements
Combinations of wear, impact and scratch resistance index numbers other than those shown in Table 3 are possible and can be specified using the numerical classification system. In such cases properties other than wear resistance, impact resistance and scratch resistance shall meet the requirements specified for type VG in Table 5.						

5.4 Nomenclature

In addition to the abbreviation “HPL” or “HPDL” and the number of this document, materials can be specified either by the numerical classification system, or by the alphabetical classification system. For example, horizontal general purpose post-formable laminate can be specified as HPL/ISO 4586-3/P33, 3 or HPDL/ISO 4586-3/HGP.

6 Requirements

6.1 Compliance

Laminates classified in Table 3 shall meet all appropriate requirements specified in 6.2, 6.3 and 6.4. This applies to both full-size sheets and cut-to-size panels.

6.2 Inspection requirements

6.2.1 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.

6.2.2 Colour and pattern

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

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

6.2.3 Surface finish

When inspected at different viewing angles, there shall be no significant difference between the corresponding surface-finish reference sample held by the supplier and the specimen under test.

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

6.2.4 Reverse side

The reverse side of sheets shall be suitable for adhesive bonding (e.g. sanded). In the case of sanded backs, slight chatter marks are permitted.

6.2.5 Visual inspection

6.2.5.1 General

The inspection requirements specified in [6.2.5.2](#) and [6.2.5.3](#) 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 supplier and purchaser. In such cases the following requirements may be used as a basis for agreement. It shall be noted that only a small percentage of sheets in a batch (the level to be agreed with the customer) shall contain defects of the minimum acceptable level.

6.2.5.2 Surface quality

The following surface defects are permissible:

- Dirt, spots, and similar surface defects.

The admissible size of such defects is based on a maximum contamination area equivalent to 1,0 mm²/m² of laminate and is proportional to the sheet size under inspection.

The total admissible area of contamination may be concentrated in one spot or dispersed over an unlimited amount of smaller defects.

- Fibres, hairs, and scratches.

The admissible size of defects is based on a maximum contamination length equivalent to 10 mm/m² of laminate and is proportional to the sheet size under inspection.

The total admissible length of contamination may be concentrated in one defect or dispersed over an unlimited amount of smaller defects.

6.2.5.3 Edge quality

Visual defects (e.g. moisture marks, lack of gloss, corner damage, etc.) 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.

6.3 Dimensional tolerance requirements

Dimensional tolerance requirements are specified in [Table 4](#).

Table 4 — Dimensional tolerance requirements

Property	Test method (ISO 4586-2:2018, Clause No.)	Requirement
Thickness	5	0,5 ≤ <i>d</i> ≤ 1,0 mm: ±0,10 mm maximum variation 1,0 < <i>d</i> < 2,0 mm: ±0,15 mm maximum variation (where <i>d</i> = nominal thickness)
Length and width ^a	6	+10 mm/−0 mm
Straightness of edges ^a	7	1,5 mm/m maximum deviation
Squareness ^a (Method A)	8	1,5 mm/m maximum deviation
Squareness ^a (Method B)	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.		

6.4 Test requirements

6.4.1 General requirements

General requirements are specified in [Table 5](#).

Table 5 — General requirements

Property	Test method (ISO 4586-2:2018 Clause No. un- less otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade		
				HDS	HGS	VGS
				HDF	HGF	VGF
				HDP	HGP	VGP
				444	333	222
Resistance to surface wear	11	Wear resistance	revolutions (min.)			
			initial point wear value	350 1 000	150 350	3 4
Resistance to immersion in boiling water	13	Appearance	Rating (min.)			
			gloss finish other finishes	3 4	3 4	3 4
Resistance to water vapour	15	Appearance	Rating (min.)			
			gloss finish other finishes	3 4	3 4	3 4
^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).						

Table 5 (continued)

Property	Test method (ISO 4586-2:2018 Clause No. un- less otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade		
				HDS	HGS	VGS
				HDF	HGF	VGF
				HDP	HGP	VGP
				444	333	222
Resistance to dry heat (160 °C)	17	Appearance	Rating (min.)			
			gloss finish	3	3	3
			other finishes	4	4	4
Resistance to dry heat (180 °C)	18	Appearance	Rating (min.)			
			gloss finish	3	3	3
			other finishes	4	4	4
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max.)			
			L ^a	0,45	0,55	0,75
			T ^b	0,90	1,05	1,25
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max.)			
			L ^a	0,50	1,10	1,10
			T ^b	0,90	1,40	1,40
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max.)			
			L ^a	0,45	0,55	0,75
			T ^b	0,90	1,05	1,25
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max.)			
			L ^a	0,50	1,10	1,10
			T ^b	0,90	1,40	1,40
Resistance to impact by small diameter ball	24	Spring force	N (min.)	25	20	15
Resistance to impact by large diameter ball	25	Drop height	mm (min.)	1 000	800	600
		Indent diameter	mm (max.)	10	10	10
Resistance to cracking under stress (optional)	27	Appearance	Rating (min.)	4	4	4
Resistance to scratching	29	Force	Rating			
			(see Annex A)			
			Smooth finishes	3	2	1
			Textured finishes	4	3	2
Resistance to staining (Method A) or	30	Appearance	Rating (min.)			
			groups 1 and 2	5	5	5
			group 3	4	4	4

^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).

Table 5 (continued)

Property	Test method (ISO 4586-2:2018 Clause No. un- less otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade		
				HDS	HGS	VGS
				HDF	HGF	VGf
				HDP	HGP	VGP
				444	333	222
Resistance to staining (Method B)	31	Appearance	Cleanability	< 20	< 20	< 20
			Stains 1 to 10 (min.)	5	5	5
			Stains 11 to 15 (min.)	3	3	3
Light fastness (xenon arc) (Method A) or	32	Contrast	Grey scale rating (min.)	4	4	4
Light fastness (xenon arc) (Method B)	33	Contrast	Colour change (min.)	4	4	4
Resistance to radiant heat	36	Appearance	s	≥ 200	≥ 200	≥ 200
Resistance to wet heat (100 °C)	41	Appearance	Rating (min.)			
			gloss finish	3	3	3
			other finishes	4	4	4
Density	ISO 1183-1	Density	g/cm ³ (min.)	1,35	1,35	1,35
^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).						

6.4.2 Additional requirements for Type P laminates

In addition to meeting the appropriate requirements specified in Table 5, Type P post-formable laminates of thickness ≤ 1,5mm shall meet the values specified in Table 6 for formability and blister resistance.

Table 6 — Additional requirements for Type P laminates

Property	Test method (ISO 4586-2:2018 Clause No.)	Property or attribute	Unit	Requirement
Formability (Method A) or	37	Radius	mm L ^a T ^b	$\leq 10 \times$ laminate nominal thickness $\leq 20 \times$ laminate nominal thickness
Formability (Method B)	38	Radius	mm L ^a T ^b	$\leq 15 \times$ laminate nominal thickness $\leq 20 \times$ laminate nominal thickness
Resistance to blistering (Method A) or	39	Time to blister ($t_2 - t_1$)	s Nominal thickness < 0,8 mm Nominal thickness $\geq 0,8$ mm	≥ 10 ≥ 15
Resistance to blistering (Method B)	40	Time to blister	s Nominal thickness < 1,0 mm Nominal thickness $\geq 1,0$ 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).				

6.4.3 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 the 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^[6] and EN 13501-1^[2] and some of the most common fire test scenarios.

Annex A (informative)

Addendum to [Table 5](#) 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 [Table 5](#) 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.

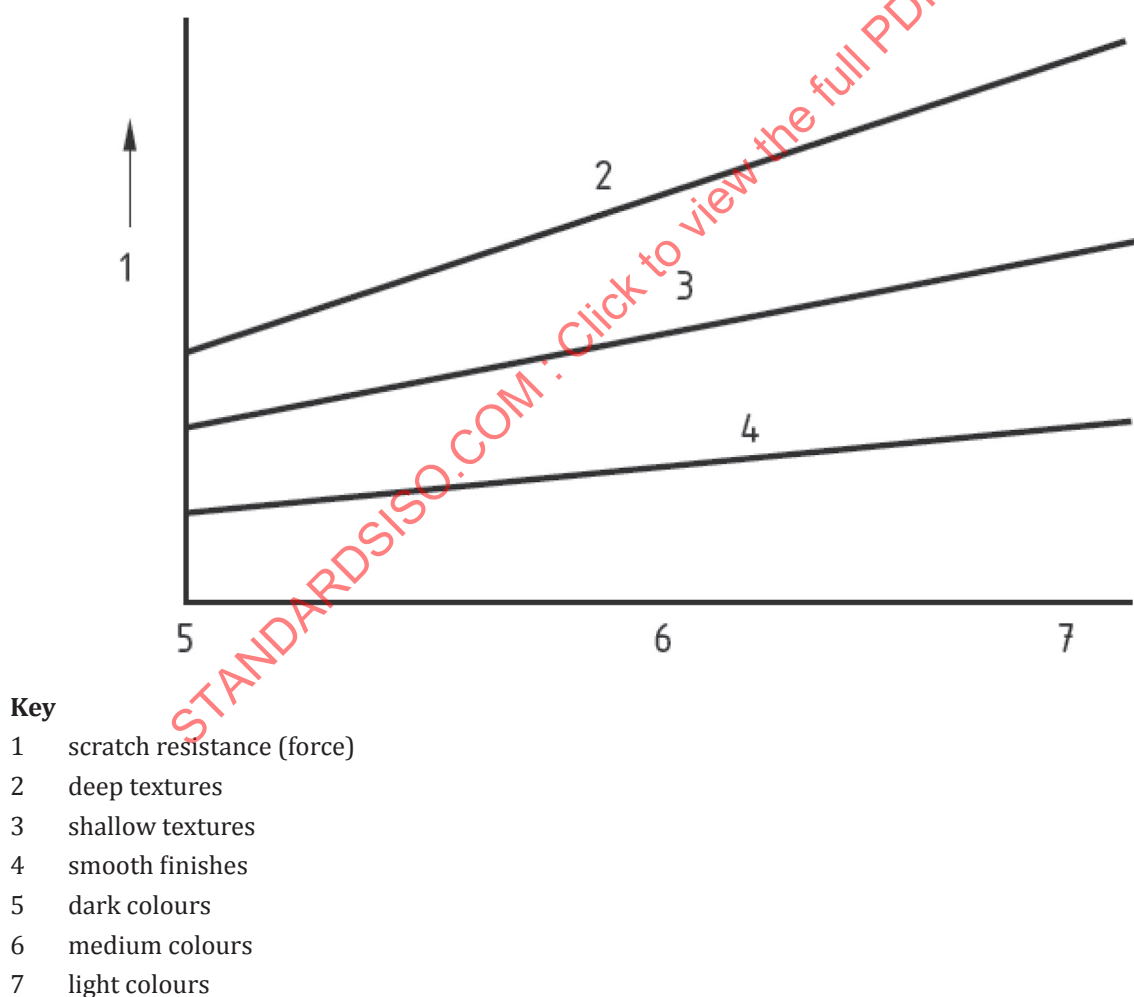


Figure A.1 — Effects of surface finish and colour on scratch resistance

Annex B (informative)

Addendum to 6.4.3, relating to fire performance

In Europe, laminate panels intended for construction applications are tested in accordance with EN 13823[3] (SBI test) and ISO 11925-2[1] (Small-burner test), and the resulting reaction-to-fire performance is expressed in accordance with EN 13501-1.

Table 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 non-combustible substrates	B-s2,d0
Composite panels comprising HPL type F bonded to FR wood-based substrates	C-s2,d0
Composite panels comprising HPL type S or P bonded to non-FR 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	
		ISO 4586-3 HPL Type F	ISO 4586-3 HPL Types S and P
Smoke density and toxicity	NF F16-101	F2 or better	F2 or better
Heat release	IMO Res.A653(16)[9] according to 96/98/EC	Pass	Pass
Railway applications	EN 45545-2[8]	—	—
Transport Applications	Council Directive 96/98/EC[10]	—	—
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.