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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

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

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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

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

This first edition of ISO 4586-3:2015 cancels and replaces (ISO 4586-1:2004), which has been technically revised.

ISO 4586 consists of the following parts, under the general title *Plastics — High-Pressure Decorative Laminates (HPL, HPDL) — Sheets based on Thermosetting Resins (Usually called Laminates):*

— *Part 1: Introduction and general Information*

— *Part 2: Determination of properties*

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

— *Part 4: Classification and specifications for compact laminates of thickness 2 mm and greater*

— *Part 5: Classification and specifications for flooring grade laminates less than 2 mm thick intended for bonding to supporting substrates*

— *Part 6: Classification and specifications for exterior-grade compact laminates of thickness 2 mm and greater*

— *Part 7: Classification and specifications for design laminates*

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

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

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

1 Scope

This part of ISO 4586 applies to laminates 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 part of ISO 4586 also specifies requirements for the properties of the various types of laminates covered by this classification system.

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.

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

In an effort to harmonize ISO 4586 with other High-Pressure Decorative Laminate standards, multiple methods may be published that demonstrate similar properties. In these instances, the same test method title is given and is annotated as either “Method A” or “Method B”. This is the case in the following tests: Edge Squareness - 8/9, Dry Heat – 17/18 Dimensional Stability at Elevated Temperatures - 19/20, Dimensional Stability at Ambient Temperature - 21/22, Staining - 30/31, Lightfastness - 32/33, Cigarette Burns - 36/37, Formability - 38/39, and Blistering - 40/41. In these instances, either method may be utilized in testing. Compliance to both methods is not required. While these tests are similar they are by no means identical and results of one method do not necessarily correspond to the results of the accompanying test. In these situations, consult the documentation in specific clauses of ISO 4586 for performance requirements. Each specific method has performance requirements particular to that method for individual grades of high-pressure decorative laminate.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4586-2, *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.

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

3.2
High-Pressure Process
simultaneous application of heat (temperature ≥ 120°C) and high specific pressure (≥5 MPa), to provide flowing and subsequent curing of the thermosetting resins to obtain a homogeneous non-porous material with increased density (≥1,35 g/cm^3), and with the required surface finish

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

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)	**First index number – Wear resistance**		
Wear value (revs)	2	3	4
	≥ 50	≥ 150	≥ 350
	≥ 150	≥ 350	≥ 1000
	Second index number – Impact resistance		
Small diameter ball (N)	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 ISO 4586. Index number 1 represents a lower quality level that does not apply to HPL as defined by the scope of this part of ISO 4586.

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)	G (General purpose)	S (Standard grade)
or V (Vertical grade)	or D (Heavy duty)	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 Index numbers			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 Postforming)	Countertops, institutional applications (prisons, military, barracks, etc.)

NOTE 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.

Table 3 *(continued)*

Performance category	Material type	Numerical Classification Index numbers			Equivalent alphabetical classification	Examples of typical applications
		Wear resistance	Impact resistance	Scratch resistance		
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
NOTE 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, Test Method 4 at a distance of 1,5 m.

6.2.2 Colour and pattern

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

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

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.

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

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

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 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.

6.2.5.1 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 mm^2/m^2 of laminate and is proportional to the sheet size under inspection.

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

— Fibres, hairs and scratches.

The admissible size of defects is based on a maximum contamination length equivalent to 10 mm/m^2 of laminate and is proportional to the sheet size under inspection.

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

6.2.5.2 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, Clause No.)	Requirement
Thickness	5	0,5 ≤ *d* ≤ 1,0 mm: ± 0,10 mm maximum variation 1,0 < *d* < 2,0 mm: ± 0,15 mm maximum variation (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[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 they shall comply with the flatness requirements specified in Table 4 when measured in accordance with ISO 4586-2:2015, Clause 10.

6.4 Test requirements

6.4.1 General requirements

General requirements specified in Table 5.

Table 5 — General requirements

Property	Test method (ISO 4586-2 Clause no. Unless otherwise stated)	Property or attribute	Unit (max or min)	Laminate grade		
				HDS HDF HDP	HGS HGF HGP	VGS VGF VGP
				444	333	222
Resistance to surface wear	11	Wear resistance	revolutions (min) initial point wear value	350 1000	150 350	50 150
Resistance to immersion in boiling water	13	Appearance	Rating (min) gloss finish other finishes	3 4	3 4	3 4
Resistance to water vapour	14	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 Clause no. Unless otherwise stated)	Property or attribute	Unit (max or min)	Laminate grade		
				HDS HDF HDP	HGS HGF HGP	VGS VGF VGP
Resistance to dry heat (180°C)	17 or 18	Appearance	Rating (min) gloss finish other finishes	 3 4	 3 4	 3 4
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max) L[a] T[b]	 0,45 0,90	 0,55 1,05	 0,75 1,25
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max) L[a] T[b]	 0,50 0,90	 1,10 1,40	 1,10 1,40
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max) L[a] T[b]	 0,45 0,90	 0,55 1,05	 0,75 1,25
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max) L[a] T[b]	 0,50 0,90	 1,10 1,40	 1,10 1,40
Resistance to impact by small diameter ball	24	Spring force	N (min)	25	20	15
Resistance to impact by large diameter ball (optional)	25	Drop height Indent diameter	mm (min) mm (max)	1000 10	800 10	600 10
Resistance to cracking under stress (optional)	27	Appearance	Rating (min)	4	4	4
Resistance to scratching	29	Force	Rating (see Annex A)	4	3	2
Resistance to staining (Method A) or	30	Appearance	Rating (min) groups 1 and 2 group 3	 5 4	 5 4	 5 4
Resistance to staining (Method B)	31	Appearance				

[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 Clause no. Unless otherwise stated)	Property or attribute	Unit (max or min)	Laminate grade		
				HDS HDF HDP	HGS HGF HGP	VGS VGF VGP
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 cigarette burns-radiant heat (Method A) or	36	Appearance	Rating (min)	3	3	3
Resistance to cigarette burns-radiant heat (Method B)	37	Appearance	Seconds	≥ 200	≥ 200	≥ 200
Resistance to wet heat (100°C)	42	Appearance	Rating (min) gloss finish other finishes	 3 4	 3 4	 3 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, Clause no.)	Property or attribute	Unit	Requirement
Formability (Method A) or	38	Radius	mm L[a] T[b]	 ≤ 10 × laminate nominal thickness ≤ 20 × laminate nominal thickness
Formability (Method B)	39	Radius	mm L[a] T[b]	 ≤ 15 × laminate nominal thickness ≤ 20 × laminate nominal thickness
Resistance to blistering (Method A) or	40	Time to blister (t_2 - t_1)	Seconds Nominal thickness < 0,8 mm Nominal thickness ≥ 0,8 mm	 ≥ 10 ≥ 15
Resistance to blistering (Method B)	41	Time to blister	Seconds Nominal thickness < 1,0 mm Nominal thickness ≥ 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 individual nation where the material is installed. For applications other than construction, fire test methods and performance requirements may vary from one country to another, and at present it is not possible, with any test, to predict compliance with all national and other requirements. No fire performance test is therefore included in this specification, however Annex B gives examples of how high-pressure laminates relate to ASTM E-84[7] and EN 13501-1[3] and some of the more common fire test scenarios.

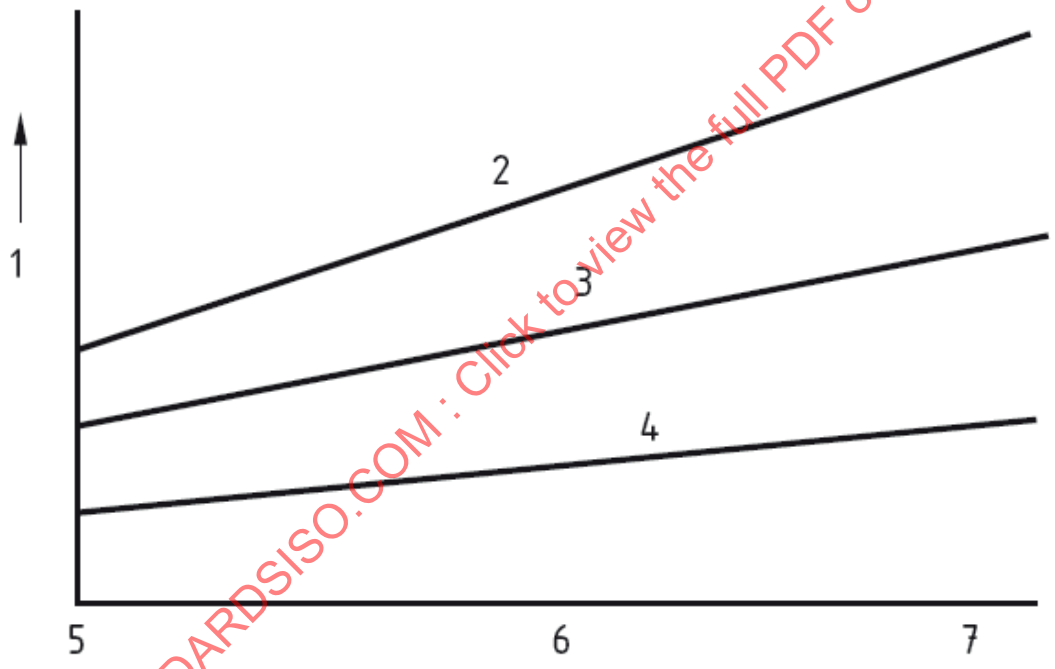
Annex A
(informative)

Addendum to Table 5 relating to Test Method 29: Scratch Resistance

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.



Key

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

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

Annex B
(informative)

Addendum to 6.4.3, 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 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 FR HPL bonded to FR wood-based substrates	B-s2,d0
Composite panels comprising non-FR HPL 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**
Spread of flame	BS 476–7	Class 1	Class 2
Brandschacht	DIN 4102–1	B1	B2
Epiradiateur	NF P 92–501	M1	M3 or better
Smoke density and toxicity	NF F 16–101	F2 or better	F2 or better
Heat release	IMO Res.A653(16)	Pass	Pass
NOTE 1 Fire test performance will depend on laminate thickness and construction, substrate type and thickness, and adhesive used. The laminate manufacturer should be contacted for details of test reports and certifications held, and for information on fire test methods and specifications. NOTE 2 Flame-retardant additives used in High-Pressure Decorative Laminates are not halogen based and remain effective throughout the service life of the product			

In North America, laminate panels intended for construction applications are tested in accordance with ASTM E-84 and rated accordingly.

Table B.3 shows typical ASTM E-84 reaction-to-fire classifications of HPDL composite panels with wood-based substrates.

Table B.3 — Typical ASTM E-84 classifications of HPDL composite panels with wood-based substrates

Product type	**Typical** ASTM E-84 **classification**
Composite panels comprising FR HDPL bonded to FR wood-based or non-combustible substrates	Class A
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. NOTE Flame-retardant additives used in High-Pressure Decorative Laminates are not halogen based and remain effective throughout the service life of the product.	