INTERNATIONAL STANDARD

ISO 4586-4

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

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

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

Partie 4: Classification et spécifications des stratifiés compacts d'épaisseur égale ou supérieure à 2 mm

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 4586-4:2015), 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 compact laminates are characterized by their aesthetic qualities, strength, durability, and functional performance. Compact high-pressure decorative laminate sheets are available in a wide variety of colours, patterns, and surface finishes. They are extremely strong, and resistant to wear, impact, scratching, 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 438-4 whenever possible.

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

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

1 Scope

This document specifies performance requirements for compact laminate (defined in Clause 4) of thickness 2 mm or greater intended for interior use.

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) — 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 compact 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 surface layer(s) on one or both sides, having decorative colours or designs, are typically impregnated with melamine based resins. The core layers are typically impregnated with phenolic based resins.

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
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 and classification system

4.1 General

Compact laminates are defined using a three-letter classification system as shown in Table 1.

Table 1 — Compact laminate classification system

First letter	Second letter	Third letter
C (Compact grade)	G (General purpose)	S (Standard grade) or F (Flame retardant grade)

4.2 Type CGS

Standard grade decorative compact laminates. Specified as HPL/ISO 4586-4/CGS.

4.3 Type CGF

Decorative compact laminates with improved fire retardance similar to type CGS but also meeting special requirements of specified tests which may vary according to the application (e.g. construction, marine, transport) and the country of use (see 6.3.2 and Annex B). Specified as HPL/ISO 4586-4/CGF.

Other laminates having special characteristics are also available but these products are outside the scope of this document.

5 Characteristics and applications

HPL compact laminates have the following characteristics:

— attractive aesthetic qualities;

— high mechanical strength;

— durability (high resistance to impact, wear and scratching);

— good dimensional stability;

— high resistance to the effects of water, steam, heat and frost;

— non-corrosive;

— good colour fastness;

— easy to clean and maintain (good anti-graffiti properties);

— hygienic;

— good chemical resistance;

— no dust attraction;

— ease of installation;

— good fire performance.

Typical applications include wall cladding, partitions, doors, cubicles, lockers, laboratory bench tops, and various self-supporting components in construction, marine, and transport industries.

When compact laminates are self-supporting they are ready for installation and only require cutting to size, drilling, etc. to suit the application.

6 Requirements

6.1 Compliance

Compact laminate types CGS and CGF 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 illuminate and again under tungsten illuminate 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 Visual inspection

6.2.4.1 General

The inspection requirements specified in 6.2.4.2 and 6.2.4.3 are intended as a general guide, indicating the minimum acceptable quality for each decorative face of a laminate supplied as a full-size sheet.

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 should be noted that only a small percentage of sheets in a batch (the level to be agreed with the customer) should contain defects of the minimum acceptable level.

It may be agreed between purchaser and supplier that the visual quality standard applies to one decorative face only.

6.2.4.2 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 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.

6.2.4.3 Edge quality

Edge chipping up to 3 mm on each side is permissible.

6.3 Dimensional tolerance requirements

Dimensional tolerance requirements are specified in Table 2.

Table 2 — Dimensional tolerances

Property	Test method (ISO 4586-2:2018 Clause No.)	Requirement
Thickness	5	2,0 ≤ *d* < 3,0 mm: ±0,20 mm maximum variation 3,0 ≤ *d* < 5,0 mm: ±0,30 mm maximum variation 5,0 ≤ *d* < 8,0 mm: ±0,40 mm maximum variation 8,0 ≤ *d* < 12,0 mm: ±0,50 mm maximum variation 12,0 ≤ *d* < 16,0 mm: ±0,60 mm maximum variation 16,0 ≤ *d* < 20,0 mm: ±0,70 mm maximum variation 20,0 ≤ *d* < 25,0 mm: ±0,80 mm maximum variation 25,0 ≤ *d* To be agreed between 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] or	8	1,5 mm/m maximum deviation
Squareness (Method B)[a]	9	≤ 6 mm
Flatness[b]	10	2,0 ≤ *d* < 6,0 mm: 8,0 mm/m maximum deviation 6,0 ≤ *d* < 10,0 mm: 5,0 mm/m maximum deviation 10,0 ≤ *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. The flatness values specified apply to laminates with two decorative faces. Limits for laminates with one face sanded shall be agreed between supplier and customer.

6.4 Test requirements

6.4.1 General requirements

General requirements are specified in Table 3.

Table 3 — General requirements

Property	Test method (ISO 4586-2:2018 Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				CGS	CGF
Resistance to surface wear	11	Wear resistance	Revolutions (min.)		
			Initial point	150	150
			Wear value	350	350
Resistance to immersion in boiling water	13	Mass increase Thickness increase Appearance	% (max.)		
			2 mm ≤ d < 5 mm	5,0	7,0
			d ≥ 5 mm	2,0	3,0
			% (max.)		
			2 mm ≤ d < 5 mm	6,0	9,0
			d ≥ 5 mm	2,0	6,0
			(where d = nominal thickness)		
			Rating (min.)		
			Gloss finish	3	3
			Other finishes	4	4
			Edge Rating(min.)	3	3
Resistance to water vapour	15	Appearance	Rating (min.)		
			Gloss finish	3	3
			Other finishes	4	4
Resistance to dry heat (160 °C) (Method A) or	17	Appearance	Rating (min.)		
			Gloss finish	3	3
			Other finishes	4	4
Resistance to dry heat (180 °C) (Method B)	18	Appearance	Rating (min.)		
			Gloss finish	3	3
			Other finishes	4	4
Dimensional stability at elevated temperature (Method A) or	19	Cumulative dimensional change	% (max.)		
			2 mm ≤ d < 5 mm		
			L[a]	0,40	0,40
			T[b]	0,80	0,80
			d ≥ 5 mm		
			L[a]	0,30	0,30
			T[b]	0,60	0,60
			(where d = nominal thickness)		

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

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

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

[d] Machine crosshead speed 10 mm/min.

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

Table 3 *(continued)*

Property	Test method (ISO 4586-2:2018 Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				CGS	CGF
Dimensional stability at elevated temperature (Method B)	20	Cumulative dimensional change	% (max.)		
			L[a]	0,40	0,40
			T[b]	0,80	0,80
Dimensional stability at ambient temperature (Method A) or	21	Cumulative dimensional change	% (max.)		
			2 mm ≤ d < 5 mm		
			L[a]	0,40	0,40
			T[b]	0,80	0,80
			d ≥ 5 mm		
			L[a]	0,30	0,30
			T[b]	0,60	0,60
			(where d = nominal thickness)		
Dimensional stability at ambient temperature (Method B)	22	Cumulative dimensional change	% (max.)		
			L[a]	0,40	0,40
			T[b]	0,80	0,80
Resistance to impact by large diameter ball	25	Drop height[c]	mm (min.)		
			2 ≤ d < 6	1 400	1 400
			6 ≤ d	1 800	1 800
			(where d = nominal thickness)		
Resistance to crazing	28	Appearance	Grade (min.)	4	4
Resistance to scratching	29	Force	Rating (min.)		
			(see Annex A)		
			Smooth finishes	2	2
			Textured finishes	3	3
Resistance to staining (Method A) or	30	Appearance	Rating (min.)		
			Groups 1 and 2	5	5
			Group 3	4	4
Resistance to staining (Method B)	31	Appearance	Cleanability	< 20	< 20
			Stains 1 to 10 (min.)	5	5
			Stains 11 to 15 (min.)	3	3

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

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

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

[d] Machine crosshead speed 10 mm/min.

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

Table 3 *(continued)*

Property	Test method (ISO 4586-2:2018 Clause No. unless otherwise stated)	Property or attribute	Unit (max. or min.)	Laminate grade	
				CGS	CGF
Light fastness (xenon arc) (Method A) or	32	Contrast	Grey scale rating	4 to 5	4 to 5
Light fastness (xenon arc) (Method B)	33	Contrast	Rating (min.)	4	4
Resistance to radiant heat	36	Appearance	s	≥ 200	200
Resistance to wet heat (100 °C)	41	Appearance	Rating (min.) Gloss finish Other finishes	 3 4	 3 4
Flexural modulus	ISO 178[d]	Stress	MPa (min.)	9 000	9 000
Flexural strength	ISO 178[d]	Stress	MPa (min.)	80	80
Tensile strength	ISO 527-2[e]	Stress	MPa (min.)	60	60
Density	ISO 1183-1	Density	g/cm^3 (min.)	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).

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

[d] Machine crosshead speed 10 mm/min.

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

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

The requirements for reaction to fire are determined by the fire regulations of the country in which the material is to be used. The reaction-to-fire of construction products is classified in accordance with various test methods specific to individual nation where the material is installed. For applications other than construction, fire test methods and performance requirements may vary from one country to another, and at present it is not possible, with any test, to predict compliance with all national and other requirements. No fire performance test is therefore included in this specification, however Annex B gives examples of how high-pressure laminates relate to ASTM E84[4] and EN 13501-1[2] and some of the most common fire test scenarios.

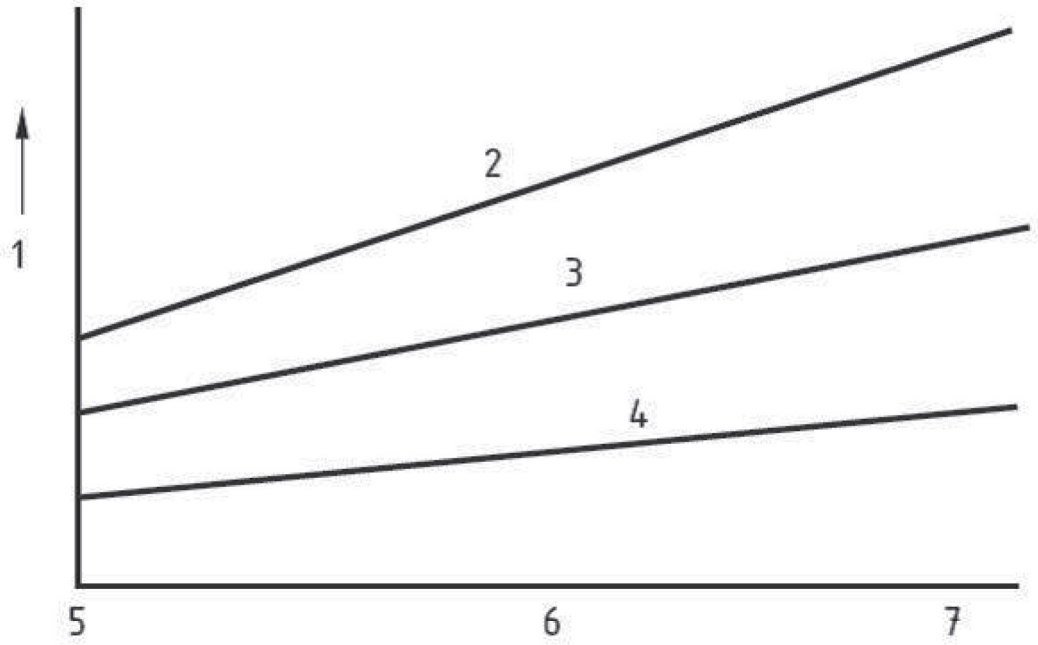
Annex A
(informative)

Addendum to Table 3 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 3 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 6.4.2, 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 compact laminates.

Table B.1 — Typical EN 13501-1 classifications of compact laminates

Product type	EN 13501-1 classification
CGF ≥ 6 mm thick	B-s2,d0
CGF < 6 mm thick	C-s2,d0 or better
CGS	D-s2,d0 or better
NOTE The laminate manufacturer should be contacted for details of fire 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 compact laminates typically relate to some of the more common European test methods.

Table B.2 — Examples of typical fire performance of compact laminates

Test method	Test standard	Typical performance levels	
		CGF	CGS
Spread of flame	BS 476-7	Class 1	Class 2
Brandschacht	DIN 4102-1	B1	B2
Epiradiateur	NF P92–501	M1	M3 or better
Smoke density and toxicity	NF F16–101	F2 or better	F2 or better
NOTE The laminate manufacturer should be contacted for details of fire test reports and certifications held, and for information on fire test methods and specifications.			

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 compact laminates.

Table B.3 — Typical ASTM E84 classifications of compact laminates

Product type	Typical ASTM E84 classification
CGF ≥ 6 mm thick	Class A
CGF < 6 mm thick	Class B
CGS	Class C

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 compact laminates are not halogen based and remain effective throughout the service life of the product.

Bibliography

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

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

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

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

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

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

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

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

[9] EN 438-4, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called laminates) — Part 4: Classification and specifications for compact laminates of thickness 2 mm and greater*

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