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BSI Standards Publication

Plastics — Unplasticized poly(vinyl chloride) (PVC-U) profiles for building applications

Part 3: Designation of PVC-UE profiles

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National foreword

This British Standard is the UK implementation of EN 13245-3:2010. Together with BS 7619:2010 and BS EN 13245-2:2008, it supersedes BS 7619:1993 which is withdrawn.

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Foreword

This document (EN 13245-3:2010) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2010, and conflicting national standards shall be withdrawn at the latest by December 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

EN 13245, *Plastics — Unplasticized poly(vinyl chloride) (PVC-U) profiles for building applications*, consists of the following parts, under the general title*:*

— *Part 1: Designation of PVC-U profiles*

— *Part 2: PVC-U profiles and PVC-UE profiles for internal and external wall and ceiling finishes*

— *Part 3: Designation of PVC-UE profiles*

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1 Scope

This European Standard establishes a system of designation for profiles made of cellular unplasticized poly(vinyl chloride) (PVC-UE) intended to be used for building applications.

This part is applicable to light coloured and coloured mono-extruded PVC-UE profiles, co-extruded profiles consisting of a core made of PVC-UE and a skin layer of non-cellular unplasticized poly(vinyl chloride) (PVC-U), and PVC-UE profiles with laminated foil or lacquered-coating.

It specifies test methods and test parameters.

This method of designation is intended to be used in product specification when the application is specified.

NOTE It is recommended to use this method for the designation of PVC-UE profiles for information related to technical literature of the manufacturer, not for the marking of the products.

Profiles for the management of electrical power cables, communication cables and power track systems used for the distribution of electrical power, profiles for windows or doors and profiles for guttering are not covered by this European Standard.[1)]

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 438-2:2005, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called Laminates) — Part 2: Determination of properties*

EN 477:1995, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of the resistance to impact of main profiles by falling mass*

EN 478, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Appearance after exposure at 150 °C — Test method*

EN 479, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of heat reversion*

EN 513:1999, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of the resistance to artificial weathering*

EN 20105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour (ISO 105-A02:1993)*

EN ISO 105-A01:2010, *Textiles — Tests for colour fastness — Part A01: General principles of testing (ISO 105-A01:2010)*

EN ISO 178, *Plastics — Determination of flexural properties (ISO 178:2001)*

EN ISO 179-1:2000, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test (ISO 179-1:2000)*

EN ISO 472:2001, *Plastics — Vocabulary (ISO 472:1999)*

1) Profiles that are excluded are in the scopes of standards prepared by CEN/TC 33, CENELEC/TC 213 or CEN/TC 128.

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EN ISO 1043-1:2001, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics (ISO 1043-1:2001)*

EN ISO 2409, *Paints and varnishes — Cross-cut test (ISO 2409:2007)*

EN ISO 2813, *Paints and varnishes — Determination of specular gloss of non-metallic paint films at 20°, 60° and 85° (ISO 2813:1994, including Technical Corrigendum 1:1997)*

EN ISO 4624, *Paints and varnishes — Pull-off test for adhesion (ISO 4624:2002)*

EN ISO 4892-2:2006, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps (ISO 4892-2:2006)*

EN ISO 4892-3:2006, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps (ISO 4892-3:2006)*

ISO 7724-1:1984, *Paints and varnishes — Colorimetry — Part 1: Principles*

ISO 7724-2:1984, *Paints and varnishes — Colorimetry — Part 2: Colour measurement*

ISO 7724-3:1984, *Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 472:2001 and EN ISO 1043-1:2001 and the following apply.

3.1
cellular unplasticized poly(vinyl chloride)
PVC-UE
unplasticized poly(vinyl chloride) the density of which is reduced by the presence of numerous small cavities (cells), interconnecting or not, dispersed throughout the mass

3.2
PVC-UE profile
profile made of unplasticized poly(vinyl chloride) (PVC-UE) material

3.3 Type of profile

3.3.1
Type 1 profile
PVC-UE profile obtained by a mono-extrusion process (coloured in the mass)

3.3.2
Type 2 profile
PVC-UE profile obtained by a co-extrusion process

3.3.3
Type 3 profile
PVC-UE profile as Type 1 or Type 2 profile with laminated foil

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3.3.4
Type 4 profile
PVC-UE profile as Type 1 or Type 2 profile with lacquer-coating

3.4
sight surface
surface of a profile that is exposed to view, when the PVC-UE profile is installed

3.5
coating
covering layer on the sight surface of a PVC-UE profile, e.g. a co-extruded layer, a lacquer-coating or a laminated foil

3.6
laminated foil
plastic layer bonded with an adhesive or under pressure and temperature to cover a surface of a PVC-UE profile

3.7
co-extrusion
durable bonding of two thermoplastics [e.g. PVC-UE and PVC-U or poly(methyl methacrylate) (PMMA)] that are melted in separated extruders and fused together in the profile tool

3.8
lacquer-coating
one or several layer(s) of lacquer (e.g. acrylic or polyurethane resin) or varnish (clear coating material) that cover(s) a PVC-UE profile

3.9
radiant exposure
time integral of irradiance, measured in joules per square metre (J/m^2)

[ISO 9370:2009]

4 Designation of PVC-UE profiles

The PVC-UE profiles are designated in accordance with a classification system of their characteristics.

The designation consists of a description block and five data blocks as given in Table 1.

Table 1 — Designation of PVC-UE profiles

Description block	Profile EN 13245-3	
Data block 1: Material and profile type identification	PVC-UE – Type 1, Type 2, Type 3 [a] or Type 4 [a] For types of profiles:	 see 3.3
Data block 2: Intended application	One or more following codes depending on the intended application: For outside building applications: For inside building applications:	 E I
Data block 3: Material properties	Modulus of elasticity in flexure	See 5.1
Data block 4: Profile properties	Nominal linear mass Heat reversion at 75 °C Impact resistance	See 5.2 See 5.3 See 5.4
Data block 5: Durability		See 5.5

[a] For Type 3 or Type 4 profiles, the requirements given in 6.1 to 6.4 shall be fulfilled, as applicable.

5 Codification system for Data block 3 to Data block 5

5.1 Modulus of elasticity in flexure (Data block 3)

The modulus of elasticity in flexure, E, shall be measured in accordance with EN ISO 178.

The test specimens shall be prepared from the finished profile and the sight surface of the profile shall be put on the supports during testing.

The value of the modulus of elasticity in flexure shall be coded according to Table 2.

Table 2 — Codification for Data block 3

Modulus of elasticity in flexure, E	
Range of values MPa	**Code**
E < 1 000	00
1 000 $\leq E$ < 1 500	10
1 500 $\leq E$ < 2 000	15
2 000 $\leq E$	20

5.2 Nominal linear mass (Data block 4)

The nominal linear mass of the PVC-UE profile shall be measured in accordance with Annex A.

The value of the nominal linear mass shall be coded according to Table 3.

5.3 Heat reversion at 75 °C (Data block 4)

The heat reversion at 75 °C of the PVC-UE profile, R, shall be measured in accordance with EN 479.

The value of the heat reversion at 75 °C shall be coded according to Table 3.

5.4 Impact resistance (Data block 4)

The impact resistance of the PVC-UE profile at 23 °C or, if required, at a low temperature (0 °C, - 10 °C, - 20 °C or - T °C), shall be measured in accordance with Annex B.

The value of the impact resistance shall be coded according to Table 3.

Table 3 — Codification for Data block 4

Nominal linear mass, P_M	Heat reversion at 75 °C		Impact resistance at T °C	
	R	Code	Energy level	Code
	%		J	
The nominal linear mass is represented by four figures giving the nominal linear mass. E.g. code 0500 for a nominal linear mass of 500 g/m.	$R \leq 1$	1	1	(T,01)
	$R \leq 2$	2	2	(T,02)
	$R \leq 3$	3	3	(T,03)
	$R \leq n$ [a]	n	4	(T,04)
			5	(T,05)
			6	(T,06)
			10	(T,10)
			15	(T,15)
			20	(T,20)
			"(5 x m)" [b]	"[T,(5 x m)]"
[a] n is an integer. [b] m is an integer.				

EXAMPLES

- Code (23,10) for a PVC-UE profile with an impact resistance of 10 J at 23 °C;
- Code (-20,05) for a PVC-UE profile with an impact resistance of 5 J at - 20 °C.

5.5 Durability (Data block 5)

5.5.1 General

Assessment of the durability is based on the following criteria:

a) The colour differences between unexposed and exposed PVC-UE profiles;

b) The Charpy impact strength of the PVC-UE profiles after artificial ageing (exposure to xenon-arc lamps) or a natural ageing,

OR

The falling weight impact resistance of the PVC-UE profiles after artificial ageing (exposure to fluorescent UV lamps) or a natural ageing;

c) The visual inspection of the PVC-UE profiles after ageing;

d) The adhesion of the coating of the PVC-UE profiles after ageing (for Type 3 and Type 4 profiles, only).

5.5.2 Test methods for ageing

5.5.2.1 Outside building applications

Ageing shall be carried out according to either an artificial ageing test method or a natural ageing test method.

The artificial ageing shall be carried out according to:

a) Either EN 513:1999, Method 1 (referring to EN ISO 4892-2:2006, Method A).

The conditions shall be defined in accordance with the code "A.n.T", where:

1) A means "artificial ageing";

2) n is the radiant exposure received by the exposed specimen, expressed in gigajoules per square metre, in the wavelength range 290 nm to 800 nm;

3) T is the black standard temperature (BST), if other than (60 ± 3) °C, as specified in EN 513:1999;

EXAMPLES

i) Codes A.8, A.12: a radiant exposure of 8 GJ/m² and 12 GJ/m² respectively, and a black standard temperature of 60 °C;

ii) Code A.8.55: a radiant exposure of 8 GJ/m² and a black standard temperature of 55 °C.

or

b) Artificial ageing shall be carried out according to EN ISO 4892-3;2006, Method A, using the exposure cycle N° 1.

The conditions shall be defined in accordance with the code "A.h.T", where:

1) A means "artificial ageing";

2) h is the exposure time, expressed in hours, in the wavelength range 290 nm to 400 nm;

3) T is the black-standard temperature (BST), if other than (60 ± 3) °C specified for the exposure cycle N° 1 in accordance with EN ISO 4892-3:2006, Method A.

The conditions of exposure to natural ageing shall be defined in accordance with the code "N.n.T ", where:

4) N means "natural ageing";

5) n is the total solar radiant exposure received in gigajoules per square metre, measured on a plane at 45° to the horizontal facing the equator;

6) T is the average temperature of the warmest month of the year on the exposure site.

NOTE For the assessment of solar irradiation conditions, it is recommended to refer to the WMO N° 8,1996, *Guide to meteorological instruments and methods of observation,* Sixth edition [2].

EXAMPLE

Example for a two-year exposure:

i) South of France: code "N.12.23", for a total solar radiant exposure of 12 GJ/m² and an average temperature of 23 °C;

ii) Florida: code "N.12.27", for a total solar radiant exposure of 12 GJ/m² and an average temperature of 27 °C;

iii) Arizona: code "N.18.34", for a total solar radiant exposure of 18 GJ/m² and an average temperature of 34 °C.

5.5.2.2 Inside building applications

Ageing shall be carried out according to:

a) EN ISO 4892-2:2006, Method B, with the following conditions:

1) without spraying;

2) black-standard temperature (BST): (60 ± 3) °C;

3) relative humidity: (65 ± 5) %.

The conditions shall be defined in accordance with the code "A.n", where:

4) A means "artificial ageing";

5) n is the radiant exposure received by the exposed specimen, expressed in gigajoules per square metre, in the wavelength range 300 nm to 800 nm.

or

b) EN ISO 4892-3:2006, Method B, using the exposure cycle N° 5.

The conditions shall be defined in accordance with the code "A.n", where:

1) A means "artificial ageing";

2) h is the exposure time, expressed in hours, in the wave length range 290 nm to 400 nm.

5.5.3 Methods for assessing of ageing

5.5.3.1 Change in colour (or colour fastness)

The change in colour (or colour fastness) between the unexposed and exposed specimens shall be evaluated either by a visual assessment using the grey scale as specified in EN 20105-A02 or by a colorimetric measurement according to ISO 7724-1, ISO 7724-2 and ISO 7724-3.

5.5.3.2 Charpy impact strength

The Charpy impact strength test shall be carried out according to EN ISO 179-1:2000, with the conditions and parameters as follows.

The impact strength shall be measured on the exposed external wall of ten un-notched specimens, cut from the profile in the extrusion direction, by using Method EN ISO 179-1/1fU (standard dimensions: length of 80 mm, width of 10 mm and thickness equal to sample thickness *d*).

The pendulum shall be directed to the inner surface so that the outer surface (skin) is subjected to tensile stress. The same test shall be repeated on ten non-exposed specimens prepared according to the same method, at the same time and from the same location of the profile. The difference between the mean value of the impact strength of the exposed specimens and the mean value for the unexposed specimens shall be calculated and expressed as a percentage.

5.5.3.3 Falling weight impact resistance

The impact resistance of the PVC-UE profile at 23 °C shall be measured in accordance with Annex B.

5.5.3.4 Visual inspection

The appearance is determined by viewing by normal or corrected vision at a range of 1 m, in 45° north sky light perpendicular to the surface as specified in Clause 14 of EN ISO 105-A01:2010 or with an equivalent artificial source of light.

5.5.3.5 Adhesion of the coating

For Type 3 profiles, the peel strength of the exposed specimens shall be measured in accordance with Annex C. In the case where the peel test cannot be performed, then the adhesion of the foil shall be determined according to EN ISO 4624.

For Type 4 profiles, the adhesion of the lacquer-coating of the exposed specimens shall be measured in accordance with EN ISO 2409.

5.5.4 Codification for properties after ageing

5.5.4.1 Assessment of the Charpy impact strength of the PVC-UE profiles after ageing

For outside building applications, the PVC-UE profiles shall be classified in accordance with Table 4, either from codes "A.2" to "A.n" after an artificial ageing, or from codes "N.0" to "N.n" after a natural ageing. Codes use increments of 2 GJ/m², according to the radiant exposure received during the exposure.

For inside building applications, the PVC-UE profiles shall be classified in accordance with Table 4 either code "A.2" or code "A.0".

5.5.4.2 Assessment of the falling weight impact resistance of the PVC-UE profiles after ageing

For outside building applications, the PVC-UE profiles shall be classified in accordance with Table 5, either from codes "A.2" to "A.h" after an artificial ageing, or from codes "N.0" to "N.n" after a natural ageing. Codes use increments of 2 GJ/m², according to the radiant exposure received during the exposure.

For inside building applications, the PVC-UE profiles shall be classified in accordance with Table 5 either code "A.2" or code "A.0".

Table 4 — Codification for Data block 5 (Charpy impact strength)

Ageing conditions			Requirements							Codes
			Type 1, Type 2, Type 3 and Type 4				Type 3		Type 4	
Ageing	Radiant exposure	Temperature	Charpy impact strength	Change in colour [a]		Visual inspection	Adhesion of coating		Resistance to cross cut	
				either grey scale	or ΔE^*		Peel strength	Reduction of breaking strength		
			EN ISO 179-1	EN 20105-A02	ISO 7724 (all parts)	5.5.3.4	Annex C	EN ISO 4624	EN ISO 2409	
	GJ/m²	°C	Retention %	-	-	-	N/mm	%	Class	
Profiles for outside building applications										
Artificial **EN 513**	n [b]	60	≥ 50	≥ 2	< 6,0	c	≥ 2,0	≤ 20	0	A.n
	n [b]	T	≥ 50	≥ 2	< 6,0	c	≥ 2,0	≤ 20	0	A.n.T
or										
Natural	n [b]	T	≥ 50	≥ 2/3	< 4,0	c	≥ 2,0	≤ 20	0	N.n.T
Profiles for inside building applications										
Artificial **EN ISO 4892-2:2006, Method B**	n [b]	60	≥ 50	≥ 2	< 6,0	c	≥ 2,0	≤ 20	0	A.2
	0	-	No requirement							A.0

[a] See 5.5.3.1.

[b] n = 2, 4, 6, 8, ,..., 20 GJ/m² or more.

[c] No bubbles/blistering, cracking or any signs of peeling, if relevant.

Table 5 — Codification for Data block 5 (impact resistance)

Ageing conditions			Requirements							Codes
			Type 1, Type 2, Type 3 and Type 4				Type 3		Type 4	
Ageing	Total exposure	Temperature	Falling weight impact resistance	Change in colour [a]		Visual inspection	Adhesion of coating		Resistance to cross cut	
				either grey scale	or ΔE^*		Peel strength	Reduction of breaking strength		
			Annex B	EN 20105-A02	ISO 7724 (all parts)	5.5.3.4	Annex C	EN ISO 4624	EN ISO 2409	
	h	°C	Retention %	-	-	-	N/mm	%	Class	
Profiles for outside building applications										
Artificial **EN ISO 4892-3:2006, Method A cycle 1**	h [b]	60	≥ 50	≥ 2	< 6,0	[d]	≥ 2,0	≤ 20	0	A.h
	h [b]	T	≥ 50	≥ 2	< 6,0	[d]	≥ 2,0	≤ 20	0	A.h.T
or										
Natural	n [c]	T	≥ 50	≥ 2/3	< 4,0	[d]	≥ 2,0	≤ 20	0	N.n.T
Profiles for inside building applications										
Artificial **EN ISO 4892-3:2006, Method B cycle 5**	h	60	≥ 50	≥ 2	< 6,0	[d]	≥ 2,0	≤ 20	0	A.h
	0	-	No requirement							A.0

[a] See 5.5.3.1.

[b] h = 1 (i.e. 500 h), 2 (i.e. 1 000 h), 3 (i.e. 1 500 h), …, 20 (i.e. 10 000 h) or more.

[c] h = 2, 4, 6, 8, ,..., 20 GJ/m² or more.

[d] No bubbles/blistering, cracking or any signs of peeling, if relevant.

6 Required characteristics for Type 3 and Type 4 profiles

6.1 **Resistance to cross cut** (only for Type 4 profiles)

The resistance to cross cut of the lacquer-coating shall be determined according to EN ISO 2409 and the test result shall not be higher than class 0.

6.2 **Thermal resistance** (only for Type 3 and Type 4 profiles)

The thermal resistance of the coating (laminated foil or lacquer-coating) shall be evaluated according to the test method specified in EN 478 with the following conditions:

— Temperature of exposure: 70 °C;

— Duration of exposure: 24 h.

After the exposure, the specimens shall be conditioned at room temperature for not less than 24 h before performing the visual inspection.

The visual inspection of the specimens shall not show any bubbles, blistering, cracking or any signs of peeling.

6.3 **Water vapour resistance** (only for Type 3 and Type 4 profiles, intended to be used for inside building applications)

The water vapour resistance of the coating (laminated foil or lacquer-coating) shall be evaluated according to the test method described in Clause 14 of EN 438-2:2005 with a duration of exposure of 1 h.

After testing, the specimens shall be conditioned at room temperature for not less than 24 h before performing the visual inspection.

The visual inspection of the specimens shall not show blistering, cracking or any signs of peeling.

6.4 **Peel strength** (only for Type 3 profiles)

The adhesion of the laminated foil to the substrate (PVC-U profile) shall be determined according to the peel test method specified in Annex C.

The peel strength values shall be greater or equal to 2,0 N/mm.

In the case where the peel test method according to Annex C cannot be carried out because of the type of foil, e.g. foil made from melamine material, the adhesion of the foil shall be determined according to EN ISO 4624 and the minimum value of the breaking strength shall be declared by the supplier.

7 Optional characteristics

7.1 Resistance to staining

Where required, the resistance to staining may be determined by applying the test method given in Clause 26 of EN 438-2:2005 or by applying the test method given in EN 12720 [3]. The staining agents and test conditions should be agreed between the supplier and the purchaser.

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7.2 Appearance and finishing of the coating (only for Type 3 and 4 profiles)

7.2.1 General

Where required, the appearance and the finishing of the coating may be examined.

The coating shall be uniform and free from defects such as foreign bodies, cracks, sink marks, die lines, ripples, bulges, scratches or other surface defects when viewed by normal or corrected vision at a range of 1 m in 45° north sky light or with an equivalent artificial light source (approximately standard illuminate D65), viewing perpendicular to the surface as described in EN ISO 105-A01.

When the colour of a profile is specified, the colorimetric coordinates, L^*, a^* and b^*, shall be determined in accordance with ISO 7724-1:1984, ISO 7724-2:1984 and ISO 7724-3:1984, using the test method D 65, SCI (specular reflectance included), 8/d or d/8.

7.2.2 Single colour profiles

The colour differences (ΔL^*, Δa^*, Δb^*, ΔE^*) between any profile and the manufacturer's stated reference colour shall be calculated according to ISO 7724-3 and shall not exceed the manufacturer's declared value.

7.2.3 Non-uniform colour and texture profiles

Reference samples of non-uniform colour and texture surface covered profiles shall be maintained demonstrating the extremes of permissible variation for comparison of the consistency of colour and appearance.

Applied textured surfaces shall have the pattern applied uniformly. Each textured surface shall match the reference sample when viewed by normal or corrected vision at a range of 1 m, in 45° north sky light or with an equivalent artificial light source (approximately standard illuminate D65), viewing perpendicular to the surface as described in EN ISO 105-A01.

7.2.4 Gloss

When required, the gloss value of a profile's surface shall be measured according to EN ISO 2813 and declared by the manufacturer.

8 Example of the designation of a PVC-UE profile

EXAMPLE A profile intended to be used for outside building applications made of PVC-UE compound, with the following characteristics:

- Type 3 profile (laminated foil);
- Value for the modulus of elasticity in flexure of the compound: 900 MPa;
- Value of the nominal linear mass of the profile: 650 g/m;
- Value of the heat reversion at 75 °C: 1 %;
- Result of the impact resistance test method at 23 °C, with a striker mass of 500 g: (23,05);
- Result of the test methods after an exposure to artificial ageing, with a radiant exposure of 12 GJ/m^2 and a black standard temperature of 60 °C: pass;
- Result of the thermal resistance test: pass;

— Result of water vapour resistance test: pass;

— Result of peel strength test: pass.

Description block	Data block 1	Data block 2	Data block 3	Data block 4	Data block 5
Profile EN 13245-3	PVC-UE, Type 3	E	00	650,1,(23,05)	A.12

9 Use of reprocessable and recyclable material

Own and external reprocessable and recyclable material may be used for the manufacture of PVC-UE profiles provided that the characteristics of the profiles conform to the requirements of the corresponding product specification, and any environmental legislation.

Annex A
(normative)

Determination of the linear mass

A.1 Apparatus

A.1.1 **Balance**, with an accuracy of 0,1 g.

A.1.2 **Rule or measuring tape**, with an accuracy of 0,5 mm.

A.2 Test specimens

The length of the test specimen, measured between two cross sections cut perpendicularly to the main axis of the profile, shall be such that its mass is at least 50 g.

A.3 Procedure

Condition the profile before measuring for at least 1 h, at (23 ± 2) °C.

Measure the length, L, of the specimen, in metres, to 1 mm.

Measure the mass, M, of the specimen, in grams, to 0,2 g.

A.4 Calculation and expression of results

Calculate the linear mass of the profile, P, using Equation (A.1):

$$P = \frac{M}{L} \qquad \text{(A.1)}$$

where

P is the value of the linear mass of the profile, expressed in grams per metre;

M is the mass of the specimen;

L is the length of the specimen.

Calculate the tolerance, T, for the linear mass of the profile, using Equation (A.2):

$$T = \pm 0{,}125\ P_M \qquad \text{(A.2)}$$

where

T is the tolerance for the linear mass of the profile;

P_M is the value of the nominal linear mass of the profile, as declared by the manufacturer, expressed in grams per metre.

Annex B
(normative)

Falling weight impact resistance of PVC-UE profiles

B.1 Principle

The falling weight impact resistance of a PVC-UE profile shall be measured at a specified temperature by striking the profile, completely supported by a plate, with a mass falling vertically from a known height onto the exposed surface, if any.

The energy levels shall be classified according to the results of a series of impact tests with a striker of specified mass.

B.2 Apparatus

The impact resistance test shall be carried out with an impact testing machine, as described in EN 477, incorporating the following equipment:

a) Main frame, rigidly fixed in the vertical position;

b) Guide rails or a guiding tube, rigidly fixed to the main frame to guide the striker and release it to fall vertically and freely;

c) Rigid specimen support, comprising two rounded off steel supports (200 ± 1) mm apart according to EN 477:1995, rigidly fixed to a solid foundation or to a table having a mass of more than 50 kg;

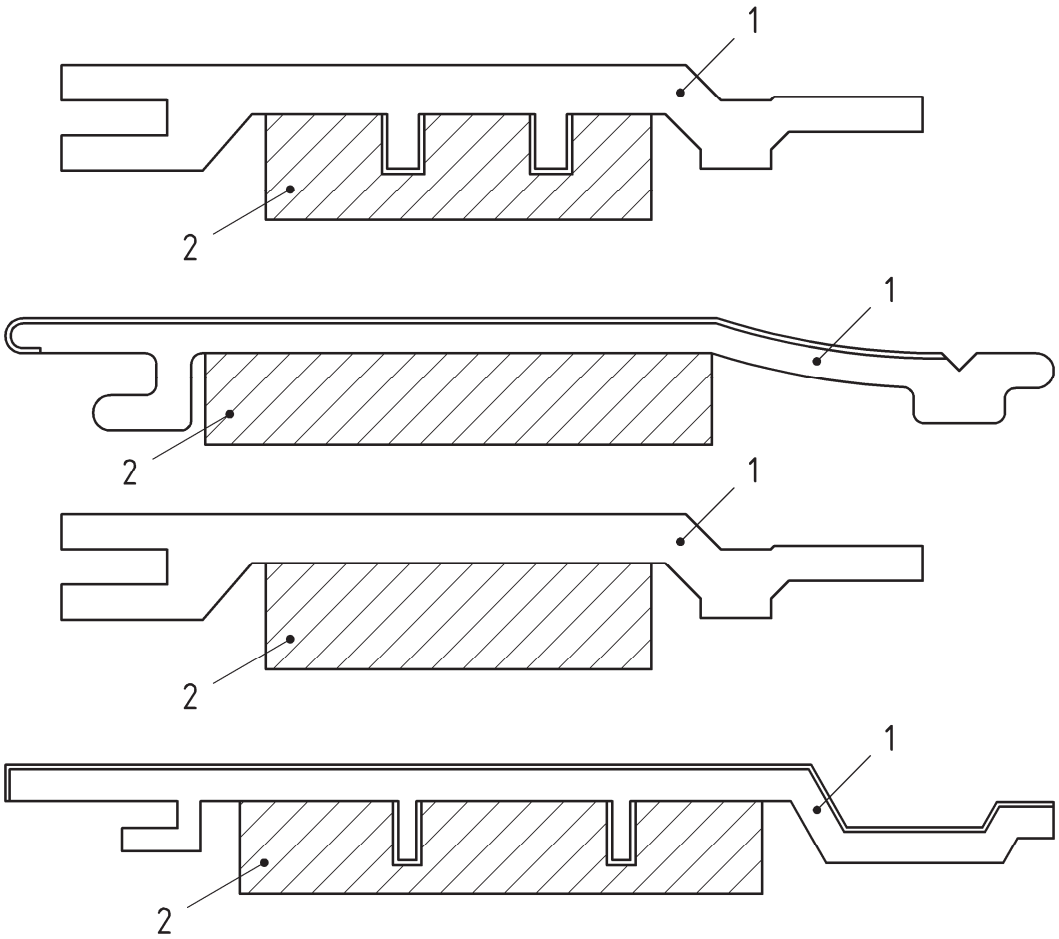
d) Release mechanism such that the striker can fall from a height which can be adjusted up to 1 500 mm, as measured from the top surface of the specimen;

e) Striker, with a smooth hemispherical striking surface of (25 ± 0,5) mm radius; the total mass of the striker shall be:

   1) either adjustable with relevant additional masses to the following masses: (100 ± 1) g, (200 ± 1) g, (300 ± 2) g, (400 ± 2) g, (500 ± 2) g, (600 ± 2) g, (1 000 ± 5) g, (1 500 ± 5) g, (2 000 ± 5) g or (m × 100 ± 5) g where m is an integer;

   2) or fixed at (1 000 ± 5) g;

f) Flat wooden plate (e.g. plywood of a minimum 32 mm thickness) adjusted to the geometry of the profile to support it completely when tested. Possible voids between back side of the profile and the support plate can be filled up with a soft material such as cellular rubber filler. Figure B.1 gives examples of profiles and corresponding plates.



Key

1 PVC-UE profile

2 wooden plate

Figure B.1 — Examples of profiles and corresponding plates

B.3 Test specimens

Cut ten specimens (300 ± 10) mm long from profiles selected at random from a batch.

In the case of PVC-UE profiles with webs, choose the impact point approximately at the mid point between the supporting webs on the surface of the PVC-UE profile normally exposed, if applicable.

If the geometry of the PVC-UE profile does not allow determining clearly the impact point, the impact point and the method of installation of the specimen shall be recorded.

If the exposed and unexposed faces of the PVC-UE profile are identical, mark each face and submit ten specimens to the impact resistance test on the external face.

B.4 Conditioning

B.4.1 Impact resistance at 23 °C

When required, the specimens shall be artificially or naturally aged before conditioning.

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The specimens shall be conditioned at (23 ± 2) °C for at least 1 h before testing.

B.4.2 Impact resistance at low temperature

When required, the specimens shall be artificially or naturally aged before conditioning.

For the determination of the impact resistance at a low temperature, the specimens shall be conditioned at the relevant temperature before testing in a liquid bath or in a temperature controlled cabinet, as applicable, for a time period not less than the applicable period given in Table B.1.

The tolerance on the test temperature shall be ± 2 °C.

Table B.1 — Conditioning period according the nominal linear mass

Nominal linear mass P_M	**Conditioning period**	
	Liquid bath	**Air**
g/m	min	min
$P_M \leq 150$	15	60
$150 < P_M \leq 750$	30	120
$750 < P_M$	60	240

In case of dispute, a liquid bath for conditioning at 0 °C, and a controlled air cabinet for conditioning at - 10 °C, - 20 °C, or - T' °C, as applicable, shall be used.

B.5 Procedure

Submit each specimen to the following test:

a) set down the specimen on the supports with the extrusion direction of the test specimen perpendicular to the two rounded steel supports and the determined impact point positioned vertically to the striker;

b) set up either:

1) the falling height at (1 000 ± 5) mm from the top surface of the specimen and using adjustable masses; or

2) the falling mass at (1 000 ± 5) g and adjusting the falling height from the top surface of the specimen based on the following formula:

$$H = (20 \times t + 100)$$

where

H is the falling height, expressed in millimetres;

t is the thickness of the specimen, expressed in millimetres;

c) release the striker.

In the case of testing at a low temperature, each specimen shall be struck within the time interval of 10 s after removal from the conditioning environment. If that time interval is exceeded, the specimen shall be returned to

the conditioning environment within 10 s, for a minimum period of 5 min. If the specimen is not returned to the conditioning environment within the 10 s after the time interval, it shall be discarded or fully reconditioned.

Examine the specimen and record the result as "Passed" or "Failed". Failure occurs when the impacted surface of the specimen splits or cracks. An unbroken dent of the impacted surface does not constitute failure.

In the case of a PVC-UE profile with a top layer/coating (laminated foil, lacquer-coating, co-extruded layer), delaminating of the top layer shall also be considered as a failure.

B.6 Expression of results

The energy levels to be used for the impact resistance are given in Table B.2 and shall be coded according to Table B.1.

For each energy level, the number of failures shall not be more than 1 out of 10 when the profile is tested.

Table B.2 — Energy levels and codes according to set up

Striker total mass OR height (g) or (mm)	**Energy level** (J)	**Code**
100	01	(23,01)
200	02	(23,02)
300	03	(23,03)
400	04	(23,04)
500	05	(23,05)
600	06	(23,06)
1 000	10	(23,10)
1 500	15	(23,15)
2 000	20	(23,20)
"(500 × m)" [a]	"(5 × m)"	"[23,(5 × m)]"
[a] m is an integer.		

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Annex C
(normative)

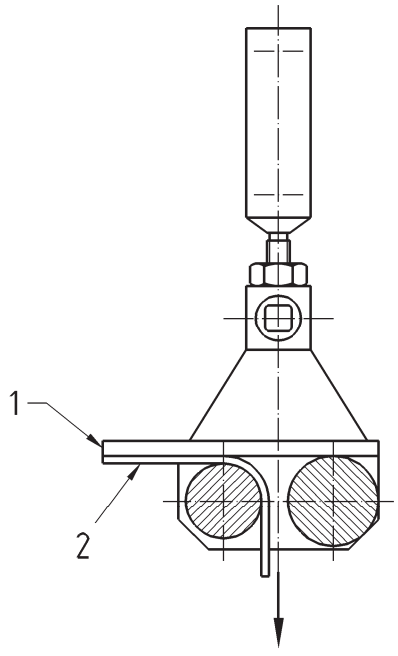
Determination of peel strength

C.1 Principle

The test consists of subjecting the tear strip of the laminated foil of a profile, to a longitudinal force, perpendicular to the profile surface, either at a constant-speed or under a constant-load.

C.2 Apparatus

C.2.1 Peel strength apparatus, capable of applying a load to a tear strip of a laminated test piece, either by static masses or by tension at a constant-speed using a tensile testing machine, as shown in Figure C.1, or comparable.



Key
1 profile test piece
2 laminated foil

Figure C.1 — Peel strength apparatus

C.3 Preparation of test pieces

Four test pieces either (20 ± 1) mm wide (for the constant-speed tensile test) or (25 ± 1) mm wide (for the constant-load tensile test) and at least 100 mm long shall be cut from the sight surface of a profile with laminated foil. Notching along the cut edge shall be avoided.

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The laminated foil (for clamping purposes) of approximately 50 mm long shall be separated from the substrate (PVC-UE profile) by a suitable procedure. The same result may be achieved during lamination by inserting a contact blocking material (e.g. polyethylene foil) between the profile and the laminated foil.

If only finished PVC-U profiles with laminated foil are available, the test pieces shall be prepared as follows:

a) Cut the sight surface of the profile from the core over the entire width of the profile. Cut the separated sight surface into 200 mm long test pieces;

b) Place either a (200 ± 2) mm × (20 ± 1) mm metal template (for the constant-speed tensile test) or a (200 ± 2) mm × (25 ± 1) mm metal template (for the constant-load tensile test) lengthways on the sight surface of the test piece, midway between the sides;

c) Using a blade, cut through the laminated foil along the long sides of the template;

d) Mill away the back wall of the profile surface to a thickness of 0,5 mm along a line midway between the test piece short sides and transverse to its longitudinal axis. Be careful not to cut into the PVC-UE substrate too deep so as to avoid damaging the laminated foil. Then mill away (also to a thickness of 0,5 mm) the entire back wall of the test piece along the two lines cut in the laminated foil from one end of the test piece as far as the transverse line. Break off the material on either of the 100 mm × 20 mm (for the constant-speed tensile test) or 100 mm × 25 mm (for the constant-load tensile test) milled by gently bending the test piece.

C.4 Conditioning

Condition the test pieces for a minimum of 72 h after lamination, at (23 ± 5) °C.

The test pieces shall not be tested within 72 h after lamination.

C.5 Procedure

C.5.1 Constant-speed tensile test

Carry out testing at (23 ± 5) °C the following procedure:

a) Set up the test piece (20 ± 1) mm wide in the peel strength apparatus and connect the laminated foil to the jaw such that the load is applied perpendicular to the main axis of the profile.

b) Extend the test piece by applying a rate of displacement of the driven grip of the test machine of (10 ± 1) mm/min.

If the foil breaks before peeling occurs, the tensile strength at break of the foil shall be reported.

The test results shall be expressed in newtons per millimetre.

For the determination of the peel strength after ageing, the constant-speed tensile test shall be used if it is used for testing non-aged profiles.

C.5.2 Constant-load tensile test

Carry out testing at (23 ± 5) °C the following procedure:

a) Set up the test piece (25 ± 1) mm wide in the peel strength apparatus, supported by free running rollers and connect the laminated foil to the jaw such that the load is applied perpendicular to the main axis of the profile.

b) Apply smoothly during one minute to the test piece a constant load of (5 ± 0,01) kg (i.e. 2,0 N/mm), either by slowly releasing the load or by gradually applying the equivalent force by means of the tensile testing machine.

Measure the peeled length occurring between the foil and the profile either before the foil stretches and shears or when the constant load is applied.

There shall be no more than 25 mm of peeling.

For the determination of the peel strength after ageing, the constant-load tensile test shall be used if it is used for testing non-aged profiles.

C.6 Test report

The test report shall include the following information:

a) reference to EN 13245-3:2010, Annex C;

b) all details necessary for complete identification of the test pieces;

c) number of test pieces;

d) width of the test pieces, in millimetres;

e) test method used [constant-speed tensile test (C.5.1) or constant-load tensile test (C.5.2)];

f) type of separation of the laminated foil;

g) result of the constant-speed tensile test (C.5.1):

   1) individual peel strength values in newtons per millimetres;

   2) if the foil breaks, the tensile strength at break of the foil in newtons;

h) the result of the constant-load tensile test (C.5.2):

   1) peeled length in millimetres;

i) any factors which may have affected the results, such as any incidents or any operating details not specified in this annex;

j) date of the test.

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