



SLOVENSKI STANDARD

SIST EN 13706-2:2003

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Ojačeni polimerni kompoziti - Specifikacije za pultrudirane profile - 2. del: Preskusne metode in splošne zahteve

Reinforced plastics composites - Specifications for pultruded profiles - Part 2: Methods of test and general requirements

Verstärkte Kunststoffverbundwerkstoffe - Spezifikationen für pultrudierte Profile - Teil 2:
Prüfverfahren und allgemeine Anforderungen

Composites en plastiques renforcés - Spécification pour les profilés pultrudés - Partie 2:
Méthodes d'essai et exigences générales

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83.120 Ojačani polimeri Reinforced plastics

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EUROPEAN STANDARD
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Reinforced plastics composites - Specifications for pultruded profiles - Part 2: Methods of test and general requirements

Composites en plastique renforcé - Spécification pour les profilés pultrudés - Partie 2: Méthodes d'essai et exigences générales

Verstärkte Kunststoffverbundwerkstoffe - Spezifikationen für pultrudierte Profile - Teil 2: Prüfverfahren und allgemeine Anforderungen

This European Standard was approved by CEN on 16 September 2002.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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Foreword

This document EN 13706-2:2002 has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by IBN.

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of an identical text or by endorsement, at the latest by April 2003, and conflicting national standards shall be withdrawn at the latest by April 2003.

Part 2 of this European Standard, EN 13706, defines the test methods and general requirements applicable to the specification of pultruded profiles.

EN 13706 consists of the following parts under the general title *Reinforced plastics composites - Specifications for pultruded profiles*.

- *Part 1: Designation*
- *Part 2: Methods of test and general requirements*
- *Part 3: Specific requirements*

Annexes A to E of are normative. Annexes F and G are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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EN 13706-2:2002 (E)**1 Scope**

1.1 This Part 2 of EN 13706 specifies the general requirements applicable to the specification of all types of pultruded profiles falling within the scope of this specification as defined in Part 1 of EN 13706.

1.2 This Part 2 of EN 13706 specifies the properties to be followed in the preparation of test specimens for the determination of mechanical properties required for the designation in Part 1 and the specific requirements in Part 3 of EN 13706.

1.3 This Part 2 of EN 13706 also specifies the test methods to be used to determine both the designated and the specified properties given in Parts 1 and 3 respectively of EN 13706.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 10204, *Metallic products - Types of inspection documents*.

EN ISO 472, *Plastics- Vocabulary (ISO 472:1999)*.

EN ISO 527-4, *Plastics - Determination of tensile properties Part 4: Test condition for isotropic and orthotropic fibre-reinforced plastics composites (ISO 527-4:1997)*.

EN ISO 14125, *Fibre-reinforced plastic composites - Determination of flexural properties (ISO 14125:1998)*.

EN ISO 14130, *Fibre-reinforced plastic composites - Determination of apparent interlaminar shear strength by short-beam method (ISO 14130:1997)*.

ISO 1268-6, *Fibre-reinforced plastics – Methods for producing test plates - Part 6: Pultrusion moulding*.

ISO 5893, *Rubber and plastics test equipment – Tensile, flexural and compression types (constant rate of traverse) – Specification*.

NOTE Other test methods in Tables F.1 to F.4 of annex F are informative and the full titles are given in those Tables.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 472 and the following apply.

3.1**pultrusion**

continuous production process for the manufacture of composite profiles, by pulling layers of fibrous materials, impregnated with a synthetic resin, through a temperature controlled die, and by curing and/or cooling the resin, forming the final shape of the profile

3.2**pultruded profile**

linear composite products, produced continuously by the pultrusion process and usually of constant cross section and characteristics

3.3

structural

area of application of pultruded profiles where the load bearing characteristic is the major criterion of design and where the product is part of a load bearing system. For the purposes of this standard the minimum mechanical properties for a profile to be classified as structural is one which meets the minimum properties of grade E17 as defined in Table 1 of 4.4 in EN 13706-3:2002

3.4

reinforcement layer

discrete layer of reinforcement comprising of one type of fibre format, such as unidirectional rovings, mat or fabric

3.5

transverse reinforcement

reinforcement included to provide the required level of properties in the direction transverse to the pultrusion axis (e.g. mat, fabric)

4 General requirements

4.1 Appearance

The pultrusion shall meet the requirements given in annex A, "Visual Defects: Descriptions and Acceptance Levels".

4.2 Dimensional tolerance

The pultrusion shall meet the requirements given in annex B, "Dimensional Tolerances for Pultruded Profiles".

4.3 Workmanship

The pultrusion shall meet the requirements given in annex C, "Workmanship".

5 Sampling

5.1 General

The properties of pultruded profiles shall be measured by the manufacturer in accordance with a recognised quality control scheme and documented in the form of a certificate of conformity.

5.2 Certificate of Conformity

Where required by the customer a certificate of conformity shall be issued identifying both the obligatory properties as defined in EN 13706-3, plus other optional tests as may be agreed between customer and supplier. The certificate shall comply with the requirements of EN 10204.

5.3 Resolution of quality issues

In the case when issues of quality arise between customer and supplier, re-testing of the material is necessary. The sampling and tests shall be undertaken as agreed between customer and supplier.

6 Preparation of plates and test specimens

Test specimens shall be cut from the profile where the dimensions of the profile permit (see 6.2.2). In other cases, a test plate can be used to simulate the pultrusion for the determination of the laminate properties for design or qualification purposes.

EN 13706-2:2002 (E)**6.1 Manufacture of test plates**

Test plates shall be manufactured in accordance with ISO 1268-6 using a flat strip die. For test specimens cut only in the direction of production, the flat strip shall be a minimum of 50 mm wide.

If properties perpendicular to the direction of production are required, the flat strip shall be a minimum of 250 mm wide.

The thickness of the flat strip shall be the same as the profile being simulated.

The raw materials used, the laminate construction and the production parameters (die temperature, pull speed, etc.) of the test plate shall match as closely as possible the intended production conditions of the profile being simulated.

6.2 Preparation of specimens**6.2.1 Dimensions**

Test specimens shall be cut to the dimensions and tolerances given in the individual test methods.

6.2.2 Cutting of test specimens

Test specimens shall not be taken closer than 10 mm to the edges or change in section of a profile. The cutting of test specimens shall be undertaken in such a way that any resultant edge defects do not adversely affect the test results. One of the following three procedures may be used.

6.2.2.1 Milling

Test specimens may be cut from the test plaque using a duplicating or CNC milling machine.

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6.2.2.2 Sawing

Test specimens may be cut from the test plaque using a circular saw fitted with a hardened metal or diamond edged saw blade. Alternative techniques such as laser or water jet cutting are also acceptable if meeting the above quality requirements.

6.2.2.3 Pre-cutting

Test specimens may be cut by any convenient means to a minimum of 5 mm over the specified width of the test specimen. 5 or 10 test specimens may then be packed together and milled to size as a block.

6.3 Profile full section test specimens

A profile full section test shall be used to determine the effective full section flexural modulus as required in clause 4 of EN 13706-3:2002 using the test method described in annex D.

Samples for the profile full section test shall be selected in accordance with the criteria given in clause 5 of this Part 2.

The samples selected shall be cut square at the ends and of sufficient length for the intended test (see annex D of Part 2), and free from obvious production or other defects as listed in annexes B and C.

7 List of Properties

Table 1 defines the list of material properties which shall be specified and the test methods which shall be used in each case to determine the property value.

Table 1 — List of properties which shall be specified and associated test methods

	Property	Unit	Test Method
1.1	Full Section test	GPa	annex D, EN 13706-3
1.2	Tension modulus-axial	GPa	EN ISO 527-4
1.3	Tension modulus-transverse	GPa	
1.4	Tension strength-axial	MPa	
1.5	Tension strength-transverse	MPa	
1.6	Pin bearing strength- axial	MPa	annex E, Part 2
1.7	Pin bearing strength-transverse	MPa	
1.8	Flexural strength-axial	MPa	EN ISO 14125
1.9	Flexural strength- transverse	MPa	
1.10	Interlaminar shear strength-axial	MPa	EN ISO 14130

NOTE It should be noted that the stacking sequence of the different reinforcements formats (e.g. mat, rovings) produces a "sandwich type" layered structure, which results in different properties being obtained in flexural and tensile coupon tests. The position of the lay-up in the profile in webs and flanges results in similar differences between these coupon tests and the full section test. It is not possible to predict any of the values from data obtained from a different test mode or test direction.

Table 2 defines the list of material properties which may be specified by agreement between customer and supplier and the test methods which shall be used in each case to determine the property value.

Table 2 — List of properties which may be specified and associated test methods

	Property	Units	Test Method
2.1	Compression strength -axial	MPa	EN ISO 14126
2.2	Compression strength - transverse	MPa	
2.3	Fibre content by weight	%	EN ISO 1172
2.4	Density	kg/m ³	ISO 1183
2.5	Poisson's Ratio-axial		EN ISO 527-4
2.6	Poisson's Ratio-transverse		
2.7	Thermal expansion-axial	m/m °C	ISO 11359-2
2.8	Thermal expansion-transverse	m/m °C	
2.9	In-plane shear modulus	GPa	ISO 15310

Recommended methods for the determination of a number of mechanical, thermal, chemical, environmental and electrical properties are given in the Informative annexes F and G. Unless otherwise agreed between interested parties, it is recommended that preference should be given to using these methods where applicable.

EN 13706-2:2002 (E)**8 Labelling**

Each package shall be clearly identified with:

- 8.1 Reference to the designation code.
- 8.2 Product type.
- 8.3 Section dimensions.
- 8.4 Number of sections or the total length in metres.
- 8.5 Gross and net weight of the pallet.

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Annex A (normative)

Visual Defects: Descriptions and Acceptance Levels (see also annex C -Workmanship)

NOTE 1 These descriptions and levels are assessed by the unaided eye at a distance of 400 mm to 500 mm.

NOTE 2 Defect acceptable levels are on the basis that they cause no-adverse effect on mechanical performance of the pultruded profile.

NOTE 3 Some defects require examination of the cut end of a length of pultruded profile.

Table A.1

Name	Definition	Acceptance Level
Blister	A rounded elevation of the pultruded surface with boundaries that may be more or less sharply defined. NOTE The rounded elevation somewhat resembles in shape a blister on the surface of human skin. Blisters may exist within the pultrusion as a hollow delaminated area (gas-filled) under a raised portion of the surface.	Permitted if formed between surfacing veil and next layer of reinforcement. Size not greater than 15 % of width and not greater than 10 mm in any direction. No more than 1 per 5 m of length. Product shall meet test requirements and not exceed dimensional tolerances.
Crack	A visual separation that occurs internally or penetrates perpendicularly down from the pultruded surface to the equivalent of one full layer or more transverse to the reinforcement.	None
Crater	A small, shallow pultrusion surface imperfection, greater than 1 mm in diameter.	None greater than 5 mm diameter and 1 mm depth. No more than two per metre for craters between 1 mm and 5 mm diameter.
Delamination	The visible separation of two or more layers or plies of reinforcing material within a pultrusion.	None
Die Parting Line	A lengthwise flash or depression on the surface of a pultruded plastic part. NOTE The die-parting line is associated with the area where separate pieces of the die join together to form the cavity.	The line projection caused by the die-parting line shall not extend past the product's surface by more than 0,20 mm. It shall not create a sharp edge or have loose fibres. Repair if limits exceeded.
Dullness	A lack of normal pultruded surface gloss or shine. NOTE This condition can be caused by insufficient cure locally or in large areas, resulting in the dull band created on a pultruded part within the die when the pultrusion process is interrupted briefly (see Stop mark).	Permitted unless caused by insufficient cure.

Table A.1 (continued)

Name	Definition	Acceptance Level
Exposed Underlayer	The underlying layer of mat or roving not covered by surface veil in a pultruded profile.	Permitted if surfacing material covers all but 5 mm from each free edge but not to exceed 20 % of the width of the surface being inspected
Fibre prominence	A visible and measurable pattern of the reinforcing material on the surface of a pultruded profile.	Permitted if reinforcing material is encapsulated by resin.
Folded Reinforcement	An unintentional or unspecified misalignment of mat or fabric reinforcing material in relation to the contour of a pultruded section. NOTE Such folds can or can not affect the surface appearance of the pultrusion and are chiefly visible in a cut cross section of the product. Such reinforcement irregularities are usually due to shifting and crowding of the reinforcing material during pultrusion.	Not permitted if fold causes a deviation in layer position greater than 20 % of thickness or 1,5 mm out of its plane.
Fracture	Cracks, crazing, or delamination, or a combination thereof, resulting from physical damage to the pultrusion.	None
Grooving	Long narrow grooves or depressions in a surface of a pultruded profile parallel to its length.	Permitted if material thickness reduction is not over 10 % and groove width is 3 mm or less. May be continuous in a length. Grooves on opposing surfaces are not permitted. Shall satisfy dimensional and mechanical requirements.
Inclusion	Any foreign matter or particles greater than 1 mm in any dimension that are either encapsulated or imbedded in the pultruded profile.	None in excess of 5 mm in any dimension. No inclusion shall create a surface blemish above the resin. Not more than 1 per metre of length.
Internal Dry Fibre	A condition in which fibres are not fully impregnated by resin during pultrusion.	Permissible if area less than 0,5 mm diameter and not more than 2 % of the cross-section, including Internal Porosity (Void).
Internal Shrinkage Cracks	Longitudinal cracks in the pultrusion that are found within sections of roving reinforcement. NOTE This condition is caused by shrinkage strains during cure that show up in the roving portion of the pultruded profile where transverse strength is low.	Permitted if the crack does not penetrate an adjoining layer, reach the surface of the product or cause the product not to meet the test requirements.
Porosity, Internal (Void)	The presence of numerous voids beneath the pultruded profile surface, usually observable only in a cut cross section.	Sum of pinhole porosity area and void area shall be no more than 2 % of cross-sectional area, including Internal Dry Fibre
Porosity, Surface (Void)	The presence of numerous visible pits or pinholes at or near the pultruded profile surface, less than 1 mm diameter.	Permitted if pits are less than 0,4 mm in diameter and 0.4 mm deep. Maximum of 5 pits per 100 cm ² of area and no more than one such area per 0,3 m of product.
Resin rich area	An area of pultruded profile that lacks sufficient reinforcement	Permitted if product meets test requirements (see also Folded Reinforcement).

Table A.1 (continued)

Name	Definition	Acceptance Level
Saw Burn	Blackening or carbonisation of a cut surface of a pultruded profile.	Permitted if product meets test requirements.
Scale	A condition wherein resin plates or particles are on the surface of a pultruded profile. NOTE Scales can often be readily removed, sometimes leaving surface voids or depressions.	Permitted if removal does not expose dry fibres and dimensional tolerances are met.
Stop Mark	A band, either dull or glossy, on the surface, approximately 12 to 100 mm long and extending around the periphery of a pultruded profile. NOTE This condition is the result of an interruption in the normal continuous pulling operation.	Permitted unless other associated defects (such as scale, craters, porosity, chips, and gouges) exceed their permitted levels.
Under Cure	Insufficient crosslinking of the resin. NOTE Leads to lower mechanical performance and lower Barcol hardness (e.g. less than 30).	None
Wrinkle Depression	An undulation or series of undulations or waves on the surface of the pultruded profile. NOTE This condition can occur in either the lengthwise or crosswise direction of the pultruded profile and is caused by reinforcement shifting and crowding (see Folded reinforcement). Wrinkles affect the flatness of the surface.	Permitted if the product is still within the dimensional tolerance limits.

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