
Prosojne ploščate večslojne polikarbonatne (PC) plošče za notranje in zunanje strehe, stene in strope - Zahteve in preskusne metode

Light transmitting flat multiwall polycarbonate (PC) sheets for internal and external roofs, walls and ceilings - Requirements and test methods

Lichtdurchlässige flache mehrwandige Platten aus Polycarbonat (PC) für Innen- und Außenanwendungen an Dächern, Wänden und Decken - Anforderungen und Prüfverfahren

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Plaques d'éclairage planes multiparois en polycarbonate (PC) pour toitures, bardages et plafonds intérieurs et extérieurs - Exigences et méthodes d'essai

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Light transmitting flat multiwall polycarbonate (PC) sheets for internal and external use in roofs, walls and ceilings - Requirements and test methods

Plaques d'éclairage multiparois et planes en
polycarbonate (PC) pour usage intérieur ou extérieur dans
les toitures, bardages et plafonds - Exigences et méthodes
d'essai

Lichtdurchlässige, flache Stegmehrfachplatten aus
Polycarbonat (PC) für Innen- und Außenanwendungen an
Dächern, Wänden und Decken - Anforderungen und
Prüfverfahren

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Contents

Page

Foreword.....	4
Introduction	5
1 Scope.....	6
2 Normative references.....	6
3 Terms, definitions and symbols	7
3.1 Terms and definitions	7
3.2 Symbols.....	11
4 Requirements	13
4.1 Visual appearance.....	13
4.2 Dimensions and mass per unit area and their tolerances.....	13
4.3 Spectral characteristics	14
4.4 Total solar energy transmittance.....	15
4.5 Impact resistance.....	15
4.6 Durability	16
4.7 Deformation behaviour	17
4.8 Airborne sound insulation.....	17
4.9 Thermal transmittance.....	17
4.10 Water vapour permeability.....	18
4.11 Water/air tightness.....	18
4.12 Linear thermal expansion	18
4.13 Reaction to fire.....	18
4.14 External fire performance.....	18
4.15 Resistance to fire	18
4.16 Net heat of combustion.....	19
4.17 Presence of functional layers	19
4.18 Dangerous substances	19
4.19 Resistance to fixings	19
4.20 Temporary protective coverings	19
5 Test and calculation methods	19
5.1 Dimensional tolerances and mass per unit area	19
5.2 Total solar energy transmittance.....	24
5.3 Test method of exposure to artificial ageing	28
5.4 Yellowness index	28
5.5 Small hard body impact resistance.....	29
5.6 Deformation behaviour	30
5.7 Airborne sound insulation	41
5.8 Reaction to fire.....	42
6 Evaluation of conformity.....	47
6.1 General	47
6.2 Initial type testing.....	47
6.3 Factory production control (FPC).....	49
6.4 Initial inspection of factory and of FPC.....	51
6.5 Continuous surveillance of FPC.....	52
7 Marking and labelling.....	52
Annex A (normative) Magnification and reduction factors	54
A.1 General	54
A.2 Load duration	54
A.3 Ageing and environmental influences	54
A.4 Influence of temperature.....	54

A.5	Conversion factors.....	55
A.6	Marginal deformation	55
Annex ZA	(informative) Clauses of this European Standard addressing the provisions of the EU Construction Products Directive	56
ZA.1	Scope and relevant characteristics	56
ZA.2	Procedures for the attestation of conformity of light transmitting flat multiwall polycarbonate sheets.....	59
ZA.3	CE marking and labelling.....	62
Bibliography	65

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Foreword

This document (EN 16153:2013) has been prepared by Technical Committee CEN/TC 128 "Roof covering products for discontinuous laying and products for wall cladding", 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 September 2013, and conflicting national standards shall be withdrawn at the latest by September 2013.

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This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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Introduction

This document describes the requirements for light transmitting flat multiwall PC sheets for internal and external use in walls, roofs and ceilings.

It is applicable to the sheets for the delivery only. Reference should be made to national regulations and manufacturer's literature for requirements concerning the design, storage and fundamental guidance for installation of sheets, including all safety aspects.

The standards and guideline addressing light transmitting flat multiwall PC sheets for building applications are the following:

- EN 1873, *Prefabricated accessories for roofing — Individual roof lights of plastics — Product specification and test methods* (harmonised standard)
- EN 14963, *Roof coverings — Continuous rooflights of plastics with or without upstands — Classification, requirements and test methods* (harmonised standard)
- EOTA ETA-Guideline 010, *Self supporting translucent roof kits*

The multiwall PC sheets that satisfy the requirements of this document are suitable for use as components in accordance with EN 1873, EN 14963 or EOTA ETA-Guideline 010.

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EN 16153:2013 (E)**1 Scope**

This European Standard specifies the requirements for light transmitting flat multiwall polycarbonate (PC) sheets for internal and external use in walls, roofs and ceilings.

This European Standard applies to light transmitting flat extruded multiwall PC sheets with or without functional layers (e.g. coating, co-extruded layer) made from PC-based or other materials, without filling materials.

It also specifies the test methods needed for the evaluation of conformity and marking of the sheets.

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.

EN 410:2011, *Glass in building — Determination of luminous and solar characteristics of glazing*

EN 673, *Glass in building — Determination of thermal transmittance (U value) — Calculation method*

EN 674, *Glass in building — Determination of thermal transmittance (U value) — Guarded hot plate method*

EN 1990:2002, *Eurocode — Basis of structural design*

EN 1873:2005, *Prefabricated accessories for roofing — Individual roof lights of plastics — Product specification and test methods*

EN 1995-1-1, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*

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

EN 13501-2, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

EN 13501-5, *Fire classification of construction products and building elements — Part 5: Classification using data from external fire exposure to roofs tests*

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

EN 14500:2008, *Blinds and shutters — Thermal and visual comfort — Test and calculation methods*

EN 14963:2006, *Roof coverings — Continuous rooflights of plastics with or without upstands — Classification, requirements and test methods*

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

EN ISO 291, *Plastics — Standard atmospheres for conditioning and testing (ISO 291)*

EN ISO 472:2013, *Plastics — Vocabulary (ISO 472:2013)*

EN ISO 717-1, *Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation (ISO 717-1)*

EN ISO 899-2, *Plastics — Determination of creep behaviour — Part 2: Flexural creep by three-point loading (ISO 899-2)*

EN ISO 1043-1:2011, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics (ISO 1043-1:2011)*

EN ISO 1716, *Reaction to fire tests for products — Determination of the gross heat of combustion (calorific value) (ISO 1716)*

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

EN ISO 6603-1, *Plastics — Determination of puncture impact behaviour of rigid plastics — Part 1: Non-instrumented impact testing (ISO 6603-1)*

EN ISO 10077-2, *Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 2: Numerical method for frames (ISO 10077-2)*

EN ISO 10140-1:2010, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 1: Application rules for specific products (ISO 10140-1:2010)*

EN ISO 10140-2, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 2: Measurement of airborne sound insulation (ISO 10140-2)*

EN ISO 10140-4, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 4: Measurement procedures and requirements (ISO 10140-4)*

EN ISO 10140-5, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 5: Requirements for test facilities and equipment (ISO 10140-5)*

EN ISO 11664-1, *Colorimetry — Part 1: CIE standard colorimetric observers (ISO 11664-1)*

EN ISO 11664-2, *Colorimetry — Part 2: CIE standard illuminants (ISO 11664-2)*

EN ISO 11925-2, *Reaction to fire tests — Ignitability of products subjected to direct impingement of flame — Part 2: Single-flame source test (ISO 11925-2)*

EN ISO 12572, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties (ISO 12572)*

ISO 11359-2, *Plastics — Thermomechanical analysis (TMA) — Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

EOTA ETA-Guideline 010, *Self Supporting Translucent roof Kits*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 472:2013, EN ISO 1043-1:2011 and the following apply.

3.1.1

PC sheet

extruded sheet substantially made of polycarbonate polymer to which are added those additives to facilitate the manufacture of sheet conforming to the requirements of this standard and customer requirements

Note 1 to entry: Additives can be e.g. lubricants, processing aids, UV absorbers, colorants, functional layers or flame retardants.

EN 16153:2013 (E)

Note 2 to entry: There is a distinction between a coloured sheet containing colorants and an uncoloured sheet having a coloured functional layer or paint on the external surfaces.

3.1.2 multiwall PC sheet

flat PC sheet with two parallel outside walls, internal parallel or non-parallel walls generally connected by vertical or non-vertical ribs or other internal features

3.1.3 multiwall PC sheet with symmetrical in-plane cross-section

multiwall PC sheet having, perpendicularly to the extrusion direction, symmetrical geometrical shape and material distribution relatively to a median plane

Note 1 to entry: Examples of typical sheets with symmetrical in-plane cross-section are given in Figure 1.

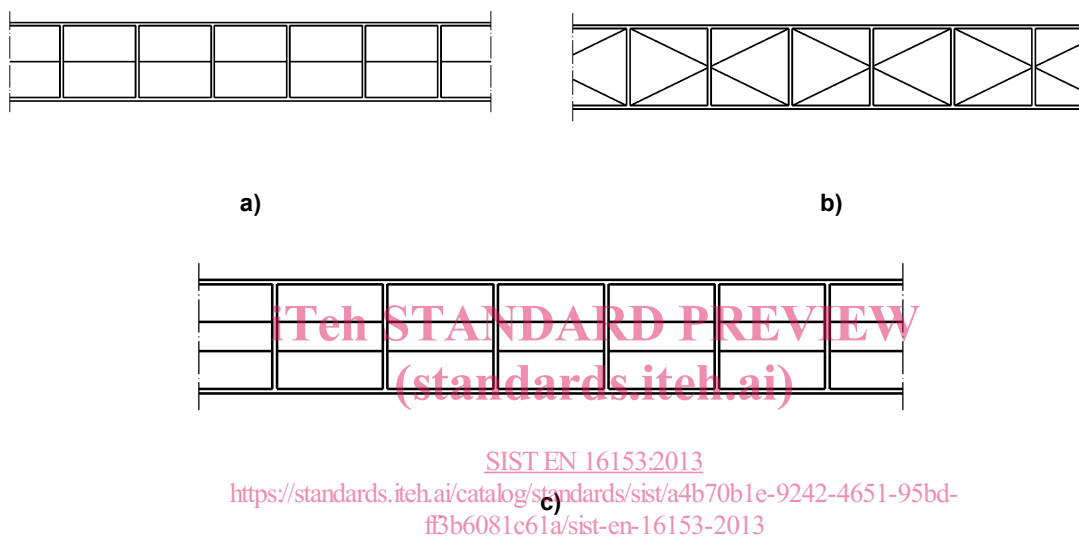


Figure 1 — Typical sheets with symmetrical in-plane cross-section

3.1.4 multiwall PC sheet with symmetrical in-plane mirror

multiwall PC sheet having perpendicularly to the extrusion direction, symmetrical geometrical shape and material distribution relatively to a plane-mirror located parallel to one of both outer surfaces and lateral movement

Note 1 to entry: An example of typical sheets with symmetrical in-plane mirror is given in Figure 2.

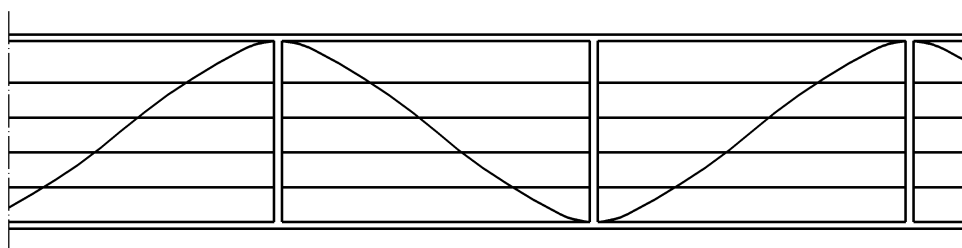


Figure 2 — Typical sheet with symmetrical in-plane mirror

3.1.5 multiwall PC sheet with unsymmetrical geometry

multiwall PC sheet which does not comply with the definitions given in 3.1.3 and 3.1.4

Note 1 to entry: Examples of typical sheets with unsymmetrical geometry are given in Figure 3.

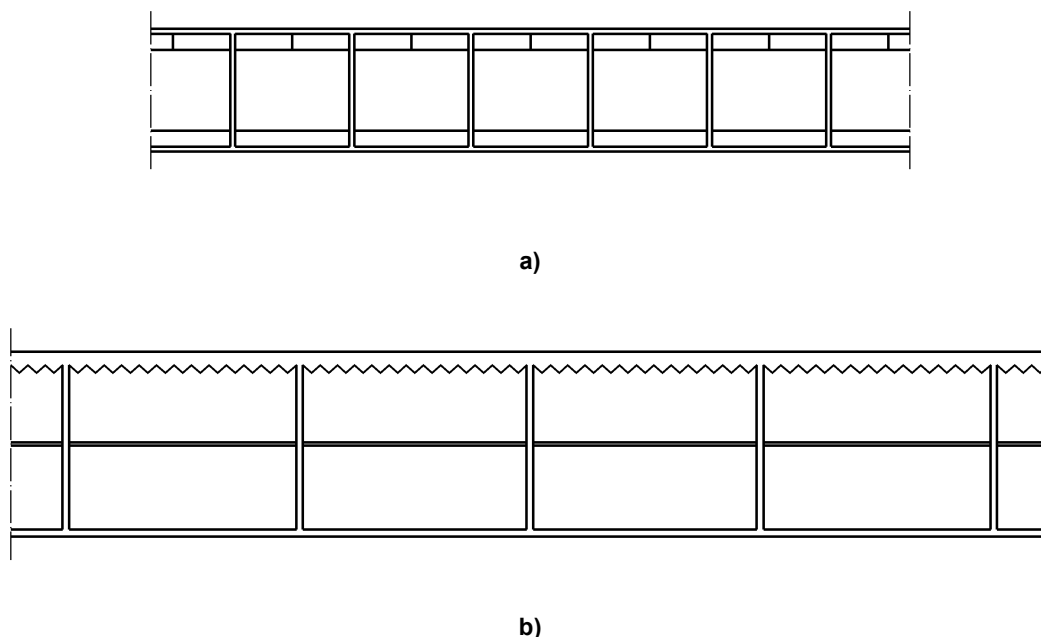


Figure 3 — Typical sheets with unsymmetrical geometry

3.1.6 indirect test

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test performed by the manufacturer, different from that specified for that particular characteristic, having verified its correlation with the specified test

3.1.7 sheet length

dimension of a sheet in the extrusion direction, parallel to the cells

Note 1 to entry: It is expressed in millimetres (mm).

3.1.8 sheet width

W_s

dimension of a sheet perpendicular to the extrusion direction

Note 1 to entry: It is expressed in millimetres (mm).

3.1.9 x-direction

extrusion direction corresponding to the length of a sheet

3.1.10 y-direction

direction perpendicular to the x-direction of a sheet in the sheet plane

3.1.11 overall sheet thickness

h

total thickness of a sheet

Note 1 to entry: It is expressed in millimetres (mm).

EN 16153:2013 (E)

3.1.12

width b

width of a test specimen in x-direction testing or length of a test specimen in y-direction testing

Note 1 to entry: It is expressed in millimetres (mm).

Note 2 to entry: For the purposes of bending tests in 5.6.

3.1.13

span L

initial distance between lines of contact between the test specimen and the test specimen supports

Note 1 to entry: It is expressed in millimetres (mm).

Note 2 to entry: For the purposes of bending tests in 5.6.3 and 5.6.4.

3.1.14

cross-head span L_c

distance between the cross-head loading points

Note 1 to entry: It is expressed in millimetres (mm).

Note 2 to entry: For the purposes of the four-point bending test in 5.6.4.2.

3.1.15

cell size w_c

dimension of the smallest geometric unit of a sheet perpendicular to the extrusion direction, which is repeated across the sheet structure

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Note 1 to entry: It is expressed in millimetres (mm).

Note 2 to entry: Examples of typical cells geometry are given in Figure 4.

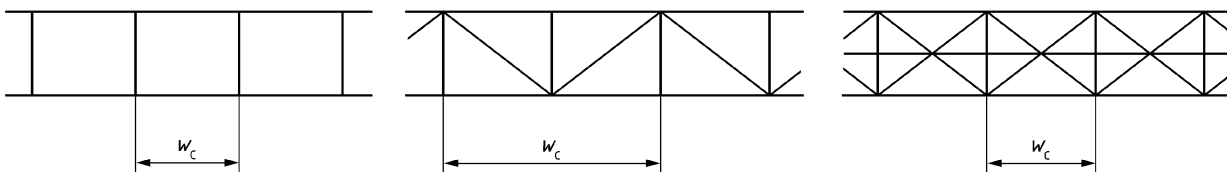


Figure 4 — Typical cell geometry

3.2 Symbols

For the purposes of this document, the symbols and the relevant subclauses are given in Table 1.

Table 1 — Symbols

Symbols	Term/definition	Relevant subclause
a_1	Out of squareness of a sheet	5.1.11
a_2	Out of squareness of a sheet	5.1.11
b	Either width of a test specimen in x-direction testing or length of a test specimen in y-direction testing	5.6.3 and 5.6.4
c	Lateral curvature of a sheet	5.1.12
B_x	Bending stiffness in x-direction	5.6.3
B_y	Bending stiffness in y-direction	5.6.3
d_1	Flatness across the sheet width	5.1.10
d_2	Flatness across the sheet width	5.1.10
F	Applied force	5.6.4
F_b	Maximum applied force corresponding to buckling	5.6.4
F_x	Applied force for test in x-direction	5.6.3
F_y	Applied force for test in y-direction	5.6.3
g	Total solar energy transmittance	4.4; 5.2
h	Overall sheet thickness	Whole document
h_e	External heat transfer coefficient	5.2.1
h_i	Internal heat transfer coefficient	5.2.1
L	Span	5.6
L_c	Cross-head span	5.6.4.2
L_{sp}	Length of a test specimen	5.1
L_x	Span for test in x-direction	5.6.3.3

Table 1 (concluded)

Symbols	Term/definition	Relevant subclause
L_y	Span for test in y-direction	5.6.3.3
M_b	Buckling moment	5.6.4
m	Mass of a test specimen	5.1.5; 5.1.6
o_s	Overhang	5.6.4.2; 5.6.4.3
R	Sound reduction index	4.8; 5.7
R_1	Radius of the supports	5.6.4.2; 5.6.4.3
r	Flexural strain rate	5.6.3; 5.6.4.2; 5.6.4.3
S_y	Shear stiffness in y-direction	5.6.3.3
S_x	Deflection at mid-span	5.6.3.3
s	Deflection	5.6.4.2
s_{y1}	Deflection at mid-span L_{y1}	5.6.3.3
s_{y2}	Deflection at mid-span L_{y2}	5.6.3.3
U	Thermal transmittance	4.9
W_s	Sheet width	5.1
W_{sp}	Width of a test specimen	5.1
w_c	cell size	5.6.4.2; 5.6.4.3
YI	Yellowness index	4.6, 5.4
α	Linear thermal expansion	4.12
α_{e1}	Solar direct absorptance of the outer face	5.2.1.3
α_{e2}	Solar direct absorptance of the inner face	5.2.1.3
α_{pe}	Solar direct absorptance of one of both outside walls	5.2.1.3
δ	Water vapour permeability	4.10
ΔY	Variation of yellowness index	4.6, 5.4
Λ	Thermal conductance between two virtual walls	5.2.1
ρ_a	Mass per unit area	5.1.5
ρ_d	Mass per unit area of a test specimen	5.1.6
ρ_e	Solar direct reflectance	5.2.1
ρ_{pe}	Solar direct reflectance of one of both outside walls	5.2.1
τ_e	Solar direct transmittance	4.3; 5.2.1
$\tau_{e,n-h}$	Normal-hemispherical solar transmittance (see 4.3, NOTE 1).	4.3
τ_{pe}	Solar direct transmittance of one of both outside walls	4.3; 5.2.1
τ_v	Light transmittance	4.3
$\tau_{v,n-h}$	Normal-hemispherical light transmittance (see 4.3, NOTE 1).	4.3

4 Requirements

4.1 Visual appearance

The sheets shall have regular and smooth surfaces. There shall be no scratches, marks or other defects larger than 4 mm² each anywhere on the sheet surface.

There shall be no obvious bubbles, inclusions, cracks, depressions or other defects anywhere in the sheet that could adversely affect the performance of the sheet in its intended application.

The edges of the sheet shall be straight and cut cleanly.

The colour distribution shall be visually uniform, unless otherwise specified.

For specific uses, further requirements concerning the visual aspects of the sheets might be considered.

4.2 Dimensions and mass per unit area and their tolerances

The dimensional tolerances and mass per unit area shall be assessed when subject to regulatory requirement.

When tested in accordance with the test methods specified in 5.1.1 to 5.1.12, the dimensional tolerances and mass per unit area of the sheets shall conform to the requirements given in Table 2.

The test methods given in Table 2 are used for initial type testing, and are the reference test methods. Any other indirect test method may be chosen provided that it is sufficiently accurate to ensure that the dimensions of the products meet the requirements of Table 2 and as far as a correlation is demonstrated with the concerned reference test method.

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