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

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

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

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

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

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

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

This European Standard was approved by CEN on 5 October 2013.

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EN 16240:2013 (E)**Foreword**

This document (EN 16240:2013) 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of an identical text or by endorsement, at the latest by June 2014, and conflicting national standards shall be withdrawn at the latest by June 2014.

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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 solid 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 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 solid PC sheets for building applications are the following:

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

The flat solid PC sheets that satisfy the requirements of this document are suitable for use as components in accordance with EN 1873, EN 14963 or ETAG 010.

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EN 16240:2013 (E)**1 Scope**

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

This European Standard applies to light transmitting flat extruded solid PC sheets of minimum thickness 2 mm, without or with uniform functional layers (e.g. coating, co-extruded layer) made from PC-based or other 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 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 13501-1, *Fire classification of construction products and building elements - Part 1: Classification using test 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 178:2010, *Plastics - Determination of flexural properties (ISO 178:2010)*

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

EN ISO 527-1:2012, *Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:2012)*

EN ISO 527-2, *Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2)*

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 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 4892-2:2013, *Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps (ISO 4892-2:2013)*

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

EN ISO 6946, *Building components and building elements - Thermal resistance and thermal transmittance - Calculation method (ISO 6946)*

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)*

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*

ETAG 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

flat 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 and/or flame retardants.

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.

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3.1.2

indirect test

IT

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

3.1.3

sheet length

dimension of a sheet in the extrusion direction

Note 1 to entry: It is expressed in millimetres.

3.1.4

sheet width

dimension of a sheet perpendicular to the extrusion direction

Note 1 to entry: It is expressed in millimetres.

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
d_1	Flatness across the sheet width	5.1.8
d_2	Flatness across the sheet width	5.1.8
E_f	Flexural modulus	4.7 and 5.5.2
g	Total solar energy transmittance	4.4
h	Overall sheet thickness	4.9 and 5.5.3
h_e	External heat transfer coefficient	4.4 and 4.9
h_i	Internal heat transfer coefficient	4.4 and 4.9
L_{sp}	Length of a test specimen	5.1
m	Mass of a test specimen	5.1.5; 5.1.6
q_i	Secondary internal heat transfer factor	4.4
R_{se}	External surface resistance	4.9
R_{si}	Internal surface resistance	4.9
R_T	Total thermal resistance	4.9
$R_w (C; C_{tr})$	Sound reduction index	4.8; 5.6
U	Thermal transmittance	4.9
W_s	Sheet width	5.1
YI	Yellowness index	4.6.1.2 and 5.3
α	Linear thermal expansion	4.12
α_e	Solar direct absorbance	4.4
δ	Water vapour permeability	4.10
ΔY	Variation of yellowness index	4.6.1.2 and 5.3
λ	Design thermal conductivity	4.9
μ	Poisson's ratio	4.7

ρ_a	Mass per unit area	5.1.5
ρ_e	Solar direct reflectance	4.4
σ_M	Tensile stress at yield	4.7 and 5.5.3
τ_e	Solar direct transmittance	4.4
$\tau_{e,n-h}$	Normal-hemispherical solar transmittance (see 4.3, NOTE 1).	4.3
τ_v	Light transmittance	4.3
$\tau_{v,n-h}$	Normal-hemispherical light transmittance (see 4.3, NOTES 1 and 2).	4.3

4 Requirements

4.1 Visual appearance

The sheets shall have regular, smooth or patterned 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 sheets that could adversely affect the performance of the sheets 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 5.1.8, 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.

Table 2 — Requirements for dimensions and mass per unit area and their tolerances

Characteristic	Test method	Requirement
Sheet thickness	5.1.4	The nominal sheet thickness of the sheet shall be declared in millimetres. The sheet thickness at any point shall not vary by more than: – ± 5 % of the declared nominal sheet thickness for nominal sheet thickness greater or equal to 2 mm and up or equal to 5 mm. – ± 10 % of the declared nominal sheet thickness for nominal sheet thickness greater than 5 mm. For sheets with patterned surfaces, the sheet thickness is the overall thickness of the sheet.
Mass per unit area	5.1.5	The nominal mass per unit area of the sheet shall be declared in grams per square metre. The mass per unit area of a sheet shall be not less than 95 % of the declared nominal mass per unit area.

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Sheet length and width	5.1.6	The sheet length/width shall be within the interval from 0 % to +0,30 % of the declared sheet length/width.
Deviation from rectangular shape (only for rectangular sheets)	5.1.7	The difference between the lengths of the two diagonals of the sheet shall be less than 0,35 % of the width of the sheet or 2 mm, whichever is the higher.
Sheet flatness	5.1.8	The deviation from flat across the width of the sheet shall be ≤ 3 mm per metre of width. The deviation from flat along the length of the sheet shall be ≤ 3 mm per metre of length.

4.3 Spectral characteristics

The spectral characteristics of solid PC sheets shall be assessed when subject to regulatory requirement.

The spectral characteristics of a solid PC sheet include the luminous and solar characteristics, and the reflection and transmission characteristics.

The solid PC sheets are defined by their thickness, colour, texture and functional layer(s). A change of one of these characteristics affects the spectral characteristics of a solid PC sheet.

The spectral characteristics shall be measured according to EN 14500 considering the samples cut from solid PC sheets as thick translucent samples (for the definition of thick translucent samples, see EN 14500:2008, 6.3.2).

For accurate measurements, the sphere diameter should be much larger than the diameter of the light entrance port. The sphere diameter should be greater or equal to 1.000 mm and the entrance diameter equal to 100 mm.

NOTE 1 The normal-hemispherical light transmittance, $\tau_{v,n-h}$, and the normal-hemispherical solar transmittance, $\tau_{e,n-h}$, as designated in EN 14500 are corresponding respectively to the light transmittance, τ_v , and the solar direct transmittance, τ_e , as designated in EN 410.

NOTE 2 The normal-hemispherical light transmittance, $\tau_{v,n-h}$, is corresponding to the total luminous transmittance, τ_{D65} , as stated in EN 1873:2005 and ETA-Guideline 010.

The normal-normal light transmittance, $\tau_{v,n-n}$, should be determined according to EN 14500, where relevant.

Test samples shall be clean and dry, unless otherwise specified. The storage and the cleaning procedures stated by the manufacturer shall be followed.

The spectral characteristics, i.e. the light transmittance, τ_v , and the solar direct transmittance, τ_e , shall be declared and subsequent measurements shall be within ± 3 absolute value (or units) of the declared values.

EXAMPLE For a declared value of the light transmittance equal to 40 %, the actual light transmittance of a sheet may be included between 37 % and 43 %.

4.4 Total solar energy transmittance

The total solar energy transmittance of solid PC sheets shall be assessed when subject to regulatory requirement.

The total solar energy transmittance of flat solid PC sheets shall be measured when subject to outdoor uses.

The total solar energy transmittance, g , is given by Formula (1):

$$g = \tau_e + q_i \quad (1)$$

where

τ_e is the solar direct transmittance;

q_i is the secondary internal heat transfer factor.

NOTE 1 Formula (1) comes from EN 410:2011, 5.4.1.

The optical factors, i.e. the solar direct transmittance, τ_e , and the solar direct reflectance, ρ_e , are measured physical characteristics (see 4.3).

In the case of a flat solid PC sheet having an emissivity greater than 0,8, the secondary internal heat transfer factor, q_i , is given by the Formula (2):

$$q_i = \alpha_e \frac{h_i}{h_e + h_i} \quad (2)$$

where

α_e is the solar direct absorbance;

h_e is the external heat transfer coefficient, in watts per square metre Kelvin;

h_i is the internal heat transfer coefficient, in watts per square metre Kelvin.

For solid PC sheets, the standard values for h_e and h_i are 25 W/(m²·K) and 7,7 W/(m²·K), respectively.

The relation between the optical factors is given by Formula (3);

$$\tau_e + \rho_e + \alpha_e = 1 \quad (3)$$

where

α_e is the solar direct absorbance;

τ_e is the solar direct transmittance;

ρ_e is the solar direct reflectance.

NOTE 2 The value of heat transfer coefficient towards the outside corresponds to summer conditions.

NOTE 3 Formula (2) comes from EN 410:2011, 5.4.6.2 and Formula (3) comes from EN 410:2011, 5.4.2.

4.5 Impact resistance

4.5.1 Small hard body impact resistance

The small hard body impact resistance shall be assessed when subject to regulatory requirement.

The small hard body impact resistance shall be evaluated by determining the impact behaviour according to 5.4.

Failure occurs when a crack or a break appears on the test specimen. White discolorations are not considered as cracks.