BS EN 16240:2013

BSI Standards Publication

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

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National foreword

This British Standard is the UK implementation of EN 16240:2013.

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A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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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'éclairement 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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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of an identical text or by endorsement, at the latest by June 2014, and conflicting national standards shall be withdrawn at the latest by June 2014.

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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.

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.

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 mm^2 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.

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

The normal-normal light transmittance, $\tau_{v,n\text{-}n}$, 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):

$$q_i = \alpha_e \frac{h_i}{h_e + h_i} \tag{2}$$

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/(m^2·K) and 7,7 W/(m^2·K), respectively.

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

$$\tau_e + \rho_e + \alpha_e = 1 \tag{3}$$

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.

When ten test specimens taken from three sheets are submitted to the test, no failure shall occur.

4.5.2 Large soft body impact resistance

The resistance to large soft body impact depends very heavily on the method of installation and the roof system into which the light transmitting sheet is incorporated, rather than a property of the sheet itself.

The large soft body impact resistance of the same product is likely to be different when the same product is used in different roofing systems and/or installed with different methods of installation, and therefore cannot be declared for a particular product.

In the absence of an appropriate European test method for sheets, the manufacturer may declare the method of installation for each application, which shall consider the large soft body impact resistance. The manufacturer shall assess the large soft body impact resistance separately in accordance with ETAG 010, EN 1873, EN 14963 or individual national safety requirements for each such application. The test report shall record the test method and the manufacturer's instructions for the installation.

NOTE At the date of publication of this document, the following national safety requirements have been identified: DS 1133:1987 [1] and ACR[M]001:2005 [2].

The user should not assume that the large soft body impact resistance for any one application shall apply to any other application or method of installation.

4.6 Durability

4.6.1 Solid PC sheets for external use

4.6.1.1 General

The durability shall be assessed when subject to regulatory requirement.

The durability of the solid PC sheets shall be demonstrated by testing after artificial ageing the variation of the yellowness index and the light transmittance with the same level of radiant exposure in the total daylight and declaring the results according to 4.6.1.2.

4.6.1.2 Classification according to the radiant exposure

The exposure to artificial ageing shall be carried out in accordance with 5.2 using one of the classes given in Table 3.

Table 3 — Artificial ageing classification

Class	Radiant exposure in the total daylight range (300 nm to 2 500 nm) GJ/m^2	Uncoloured sheets		Coloured sheets	
		Variation of yellowness index	Variation of light transmittance	Variation of yellowness index	Variation of light transmittance
		ΔYI absolute value (or unit)	**Δ** τ_v %	***ΔYI*** absolute value (or unit)	**Δ** τ_v %
ΔA	18	≤ 10	≤ 5	≤ 10	≤ 5
ΔD	18	Not applicable	Not applicable	≤ 20 [a]	≤ 10 [a]
ΔE	10	≤ 10	≤ 10	≤ 10	≤ 10
Δ*F*	10	Not applicable	Not applicable	≤ 20 [b]	≤ 10 [b]

[a] A coloured sheet made from the same PC resin as an uncoloured sheet classified Δ*A* and having the same UV protection shall be classified Δ*D* without further testing.

[b] A coloured sheet made from the same PC resin as an uncoloured sheet classified ΔE and having the same UV protection shall be classified *ΔF* without further testing.

In the case of an exposure to a radiant exposure greater than 18 GJ/m^2, the actual value may be declared by the manufacturer to allow the customer to determine the suitability of the sheets to exposure in areas where the conditions are particularly severe.

EXAMPLE An uncoloured sheet, with the following characteristics:

— *YI* = 2 before ageing and *YI* ≤ 12 after ageing: *ΔYI* ≤ 10

— τ_v = 80 % before ageing and τ_v ≥ 75 % after ageing: $\Delta\tau_v$ ≤ 5 %

is classified *ΔA.*

4.6.1.3 Variations of yellowness index and light transmittance after artificial ageing

To evaluate the durability, the variations of the yellowness index and light transmittance after artificial ageing shall be assessed when subject to regulatory requirement.

The variation of the yellowness index shall be determined in accordance with 5.3.

The variation of the light transmittance shall be determined in accordance with 4.3.

The sheets shall be classified into one of the four classes given in Table 3.

The variations of the yellowness index and of light transmittance shall be declared.

The yellowing behaviour of sheets is depending on the performance of the UV-protected layer. Therefore, the correlation between levels of yellowing index and radiant exposure in the total daylight for its UV-protection system shall be demonstrated.

These results shall be valid also for increased layer thicknesses or/and higher UV-absorber concentrations of a given UV-protection system. Different UV-protecting systems (e.g. containing different UV-absorbers) require testing on each system separately.

4.6.1.4 Variation of deformation behaviour

If the characteristics of a sheet conform to Table 3 for a declared class, the variation of the mechanical properties (deformation behaviour, i.e. flexural modulus and tensile strength) after the corresponding exposure is assumed to be less than 10 %.

NOTE Therefore, the sheet is in conformance with:

a) the requirements of class Cu 1, as given in EN 14963:2006, Table 2 and EN 1873:2005, Table 2;

b) the requirements of class Ku 1, as given in EN 14963:2006, Table 3 and EN 1873:2005, Table 3.

4.6.2 Solid PC sheets for internal use

The durability shall be assessed when subject to regulatory requirement.

The durability of the solid PC sheets shall be demonstrated by testing the hard body impact resistance according to 5.4.

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

When 10 test specimens taken from three sheets are submitted to the test, no failure shall occur.

4.7 Deformation behaviour

The deformation behaviour shall be assessed when subject to regulatory requirement.

For unaged flat solid PC sheets, the standard value (mean value) of the flexural modulus, E_f, is ≥ 2 200 MPa and the characteristic value (5 % fractile) is ≥ 2 000 MPa. These two values shall be declared.

For unaged flat solid PC sheets, the standard value (mean value) of the tensile stress at yield, σ_M, is ≥ 60 MPa and the characteristic value (5 % fractile) is ≥ 55 MPa. These two values shall be declared.

When a higher performance of a flat solid PC sheet is sought for declaration, the flexural modulus and the tensile stress at yield of the flat solid PC sheet shall be determined according to 5.5 for both unaged and aged sheets.

The value of the limit of strains for visco-elasticity εlim is 0,8 % (without influence of aggressive chemicals, e.g. alkaline substances and frozen-in strains).

The value of Poisson's ratio, μ, as defined in EN ISO 527-1, is 0,35.

4.8 Airborne sound insulation

The method(s) of installation shall consider the airborne sound insulation.

The sound reduction index, R_w (C;C_{tr}), of the solid sheets shall be assessed when subject to regulatory requirement.

The sound reduction index, R_w (C;C_{tr}), shall be measured in accordance with 5.6 and declared.

4.9 Thermal transmittance

The thermal transmittance, *U* value, shall be assessed when subject to regulatory requirement.

The thermal transmittance, *U* value, shall be calculated in accordance with EN ISO 6946 considering the flat solid PC sheet like a homogeneous PC layer, coated or not with other plastic materials having an emissivity greater than 0,8.

The thermal transmittance, *U* value, in watts per square metre Kelvin ($W/m^2 \cdot K$), is given by the Formula (4):

$$U = \frac{1}{R_T} \tag{4}$$

where

R_T is the total thermal resistance, in square metres Kelvin per watt ($m^2 \cdot K/W$), given by Formula (5):

$$R_T = \frac{h}{\lambda} + R_{se} + R_{si} \tag{5}$$

where

h is the thickness of the flat solid PC sheet, in metres;

λ is the design thermal conductivity of PC material, in watts per metre Kelvin;

R_{se} is the external surface resistance in square metres Kelvin per watt;

R_{si} is the internal surface resistance in square metres Kelvin per watt.

R_{se} is given by Formula (6):

$$R_{se} = \frac{1}{h_e} \tag{6}$$

where

h_e is the external heat transfer coefficient, in watts per square metre Kelvin (see 4.4).

R_{si} is given by Formula (7):

$$R_{se} = \frac{1}{h_i} \tag{7}$$

where

h_i is the internal heat transfer coefficient, in watts per square metre Kelvin (see 4.4).

For PC material, the design thermal conductivity, λ, is 0,20 W/(m·K).

In the absence of specific information on the boundary conditions, considering a horizontal thermal flux crossing and normal to the face of the flat PC sheet, R_{se} and R_{si} are equal to respectively, 0,04 $m^2 \cdot K/W$ and 0,13 $m^2 \cdot K/W$ (from EN ISO 10456).

The value of the thermal transmittance, *U* value, shall be round off to one decimal place.

4.10 Water vapour permeability

The water vapour permeability, δ, shall be assessed when subject to regulatory requirement.

The standard value of the water vapour permeability, δ, of PC sheets is 3,8 × 10^{-5} mg/m·h·Pa and it shall be declared. When a higher performance is sought for declaration, the water vapour permeability of the material used for the sheet shall be determined according to EN ISO 12572.

4.11 Water/air tightness

The water/air tightness shall be assessed when subject to regulatory requirement.

PC sheets are deemed to satisfy the water/air tightness requirement without the need for testing provided that there are no defects in the sheets. The absence of defects (e.g. holes) shall be evaluated by examination of visual appearance according to 4.1.

4.12 Linear thermal expansion

The linear thermal expansion, α, shall be assessed when subject to regulatory requirement.

The value of the coefficient of linear thermal expansion, α, of the PC material is 65 × 10^{-6} K^{-1}. When a higher performance is sought for declaration, the thermal expansion coefficient of the material used for the sheet shall be determined according to ISO 11359-2.

For practical purposes, the coefficient of linear thermal expansion is valid for temperatures in the range −20 °C to 70 °C.

4.13 Reaction to fire

The reaction to fire shall be assessed when subject to regulatory requirement.

The reaction to fire performance of the sheets shall be determined in accordance with 5.7 and declared by the manufacturer according to EN 13501-1.

4.14 External fire performance

External fire performance shall be assessed when subject to regulatory requirements.

The product shall be tested using the test method(s) as referred to and classified in accordance with EN 13501-5. The products to be tested shall be installed, in addition to the general provisions given in the relevant test method, in a manner representative of their intended end use.

4.15 Resistance to fire

Resistance to fire shall be assessed when subject to regulatory requirements.

The product shall be tested using the test method(s) as referred to and classified in accordance with EN 13501-2.

In general, the product cannot be classified. “No performance determined” (NPD) should therefore be used.

Where required by a particular test method, and in addition to any specific requirements in that test method, the product shall be mounted and fixed for testing in a manner representative of its intended end use.

4.16 Net heat of combustion

The value of the net heat of combustion for PC polymer is 29,8 MJ/kg [3]. When a better performance is sought for declaration, the net heat of combustion of the material used for the sheet shall be determined according to EN ISO 1716.

4.17 Presence of functional layers

The manufacturer shall declare the presence and function of layers (coating, co-extruded layer, etc.), if relevant.

The side of the sheet with the functional layer(s) shall be indicated.

NOTE The functional layer (UV protected layer) is typically on the exposed face of the sheet.

4.18 Release of dangerous substances

National regulations on dangerous substances may require verification and declaration on release, and sometimes content, when construction products covered by this standard are placed on those markets.

In the absence of European harmonized test methods, verification and declaration on release/content should be done taking into account national provisions in the place of use.

NOTE An informative database covering European and national provisions on dangerous substances is available at the Construction website on EUROPA accessed through: http://ec.europa.eu/enterprise/construction/cpd-ds/.

4.19 Resistance to fixings

The principles of fixing of the sheets shall be declared.

The method(s) of installation shall consider resistance to wind loads, snow loads and resistance to large soft body impact which may be assessed separately, e.g. in accordance with the requirements given in EN 14963, EN 1873, ETAG 010, or individual safety national requirements.

4.20 Temporary protective coverings

For shipping and handling, the surfaces of the sheets, as delivered, may be protected by suitable materials, e.g. a polyethylene film, which is removable without causing surface contamination or damage.

5 Test and calculation methods

5.1 Dimensional tolerances and mass per unit area

5.1.1 General

Measurements should preferably be made under the standard conditions (23 ± 2) °C and (50 ± 10) % relative humidity. For measurements made under ambient conditions, due allowance shall be made for dimensional changes due to the differences in temperature and relative humidity at the place of measurement from the preferred temperature and relative humidity. For correction factor, see 4.12.

All tolerances shall apply to the declared values.

5.1.2 Apparatus

5.1.2.1 Micrometer, capable of measuring to an accuracy of 0,01 mm, with hemispherical anvils of 5 mm in diameter.

5.1.2.2 Measuring quick-test gauges, capable of measuring to an accuracy of 0,01 mm, with hemispherical anvils of 1,5 mm.

5.1.2.3 Calliper gauges, capable of measuring to an accuracy of 0,01 mm.

5.1.2.4 Measuring tape, capable of measuring the full length of the test specimen to an accuracy of 1,0 mm.

5.1.2.5 Short metal ruler, capable of measuring to an accuracy of 0,5 mm.

5.1.2.6 Metal straight edge, 1 metre long, the straightness of which is accurate to 0,5 mm.

5.1.2.7 Balance, with an accuracy of 0,1 g.

5.1.3 Sampling

The samples shall be complete sheets, as delivered.

5.1.4 Overall sheet thickness

The overall thickness of the sheet shall be measured to the nearest 0,05 mm, excluding the masking film and without damaging the surface, at intervals of approximately 200 mm across the extrusion width.

All the measured values shall fulfil the tolerances given for overall sheet thickness in Table 2.

5.1.5 Mass per unit area

The mass per unit area shall be determined as follows:

— Cut a test specimen in the width of the sheet with a length L_{sp} of at least 100 mm.

— Weigh the test specimen to the nearest gram.

— Calculate the mass per unit area, ρ_a, in kilograms per square metre, using the following Formula (8):

$$\rho_a = \frac{m}{W_s \times L_{sp}} \tag{8}$$

where

m is the mass, in grams, of the test specimen;

W_s is the width, in millimetres, of the sheet;

L_{sp} is the length, in millimetres, of the test specimen.

Record the value of ρ_a to the nearest 10 g/m^2.

All the measured values shall fulfil the tolerances given in Table 2.

5.1.6 Sheet length and sheet width

The total length of the sheet shall be measured along both edges, to the nearest millimetre. Record the values so obtained.

The results shall be expressed as follows: the average of the two values, expressed in millimetres, to the nearest millimetre.

5.1.7 Deviation from rectangular shape (only for rectangular sheets)

The test specimen shall be a whole sheet.

The lengths of the two diagonals of the test specimen shall be measured, to the nearest millimetre. Calculate the difference between the two measured values and record it.

All the measured values shall fulfil the tolerances given in Table 2.

5.1.8 Flatness of a sheet surface

5.1.8.1 Test specimens

The length of the test specimen shall be at least two times the extrusion width of the sheet. If the sheet is shorter, then it shall be the test specimen.

5.1.8.2 Flatness across the width of the sheet

Place the test specimen with its edges in contact with a flat surface.

Measure by means of a rule to the nearest 0,5 mm the maximum distance, d_1, between the flat surface and the adjacent sheet surface. See Figure 1.

Record the maximum value measured for each end of the test specimen.

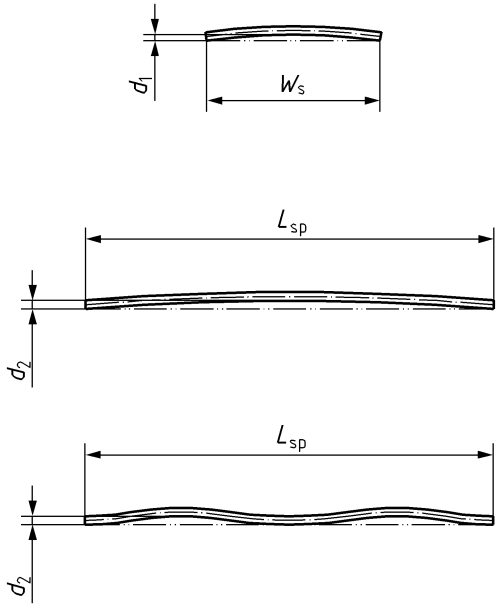
5.1.8.3 Flatness along the length of the sheet

Place the test specimen on a flat surface.

Place a straight edge along the centre line of the test specimen in the extrusion direction.

Measure by means of a rule, to the nearest 0,5 mm, the maximum distance, d_2, between the straight edge and the adjacent surface of the test specimen. See Figure 1.

Record the maximum value measured at the sheet centre line and adjacent to each edge of the sheet.



Key

L_{sp} sheet length
W_s sheet width
d_1 flatness across the sheet width
d_2 flatness along the sheet length

Figure 1 — Determination of the flatness

5.2 Artificial ageing

The exposure to artificial ageing shall be carried out according to EN ISO 4892-2:2013, Method A, cycle No 1.

The UV range is corresponding to 300 nm to 400 nm.

According to EN ISO 4892-1:2000, Table 1, the UV radiant exposure, corresponding to the 300 nm to 400 nm range, is representing 6,8 % of the radiant exposure in the total daylight, expressed in GJ/m^2.

The duration of testing shall be determined so as to fulfil one of the levels of radiant exposure in the total daylight given in Table 3.

With an irradiance of 60 W/m^2, the test durations corresponding to the four levels of radiant exposure in the total daylight range are given in Table 4.

Table 4 — Test duration for artificial ageing

Radiant exposure in the total daylight range (300 nm to 2 500 nm) GJ/m^2	**Radiant exposure in the range 300 nm to 400 nm** GJ/m^2	**Test duration 60 W/m^2 (300 nm to 400 nm)** h
18	1 224	5 666
10	0,68	3 148

The dimensions of the exposed test specimens shall be sufficient to allow carrying out the light transmission test and the subsequent specific tests.

5.3 Yellowness index

5.3.1 Apparatus

5.3.1.1 Spectrocolorimeter with integrating sphere (hemispherical illumination and viewing the transmitting portion at an angle perpendicular to the test specimen surface or illumination perpendicular to the specimen surface and viewing the transmitted portion with an integrating sphere).

5.3.2 Test specimens

The same test specimens as used for the change in the light transmission shall be used.

5.3.3 Procedure

Calibrate and operate the spectrocolorimeter and other instruments in accordance with instructions supplied by their manufacturer.

Obtain spectral transmittance data illuminant D65 relative to air in the wavelength range of 380 nm to 780 nm.

5.3.4 Expression of results

Calculate the tristimulus values, X, Y and Z, for CIE standard illuminant D 65 as given by EN ISO 11664-2 and CIE standard colorimetric observer 2° as given by EN ISO 11664-1 by numerical integration from recorded spectral data or by automatic integration during spectrocolorimeter operation.

Calculate the magnitude and sign of the yellowness from Formula (9):

$$YI = \frac{100(1{,}2985X - 1{,}1335Z)}{Y} \quad (9)$$

Calculate the magnitude and direction of change of the yellowness from Formula (10):

$$\Delta YI = YI - YI_0 \quad (10)$$

*w*here

YI is the yellowness index of a test specimen exposed to ageing;

YI_0 is the yellowness index of a test specimen unexposed to ageing;

ΔYI is the change of the yellowness index after ageing.

5.4 Small hard body impact resistance

The impact resistance shall be determined according to the method given in EN ISO 6603-1, by using the test arrangement shown in Figure 2, on ten test specimens taken from the three sheets samples from separated production batches.

The test specimens shall be conditioned at (23 ± 4) °C for a minimum of 24 h.

The dimensions of the test specimens shall be at least (300 ± 5) mm x (300 ± 5) mm.

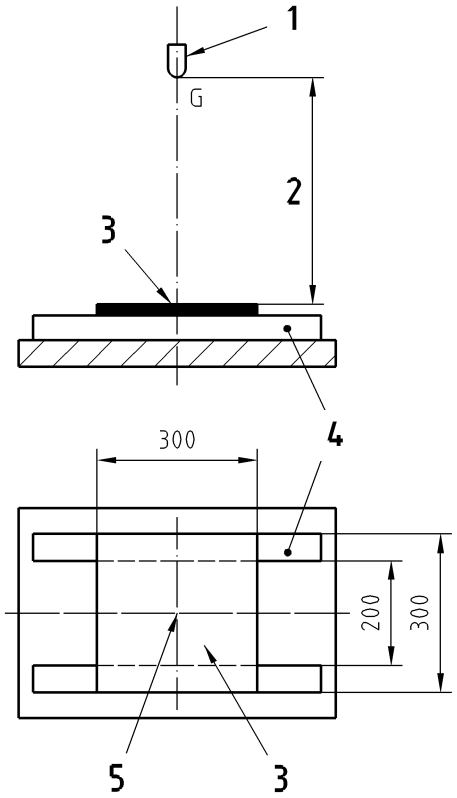
The test conditions shall be as follows:

— height of fall: (1 000 ± 5) mm;

— falling mass (solid steel ball): (250 ± 2,5) g;

— test temperature: (23 ± 4) °C.

Dimensions in millimetres



Key

1 striker
2 height of fall
3 test specimen
4 supports
5 drop point

Figure 2 — Impact resistance test rig

NOTE For practical purposes, the mechanical properties of polycarbonate material are retained in a temperature range of −25 °C to 80 °C.

5.5 Deformation behaviour

5.5.1 Determination of the flexural modulus

The flexural modulus of the solid PC sheet shall be determined according to EN ISO 178.

For the test speed, select a value from EN ISO 178:2010, Table 1, which gives a flexural strain rate as near as possible to 1 % per minute.

A minimum of five specimens shall be tested in each direction of the sheet.

5.5.2 Determination of the tensile strength

The tensile strength of the solid PC sheet shall be determined according to EN ISO 527-1 and EN ISO 527-2.

For the test speed, select a value from EN ISO 527-1:2012, Table 1, which gives a tensile strain rate as near as possible to 1 % per minute.

A minimum of five specimens shall be tested in each direction of the sheet.

5.5.3 Test report

The properties shall be evaluated statistically according to EN 1990:2002, Annex D, assuming a log-normal distribution. For the statistical evaluation, the 5 % fractile for unknown coefficient of variation V_x shall be determined with a confidence level of 75 %. The 5 % fractile corresponds to the characteristic value of the respective properties.

The test report shall include the following information:

a) a reference to this European Standard: EN 16240;

b) all information necessary for the identification of the sheet tested;

c) name, trade mark or other means for the identification of the manufacturer;

d) the flexural modulus E_f;

e) the tensile strength σ_M;

f) the sheet thickness, h, (with an accuracy of 0,05 mm) of the test specimens;

g) the mass per unit area (with an accuracy of 1 g) of the test specimens.

5.6 Airborne sound insulation

The sound reduction index, R_w (C;C_{tr}), of the sheet shall be determined in accordance with EN ISO 10140-1, EN ISO 10140-2, EN ISO 10140-4 and EN ISO 10140-5.

The size of the test sample and the mounting conditions shall conform to EN ISO 10140-1:2010, Annex D. For the evaluation of the results, the single value R_w (C;C_{tr}), in dB, shall be calculated according to EN ISO 717-1.

5.7 Reaction to fire

5.7.1 Principle

The product shall be tested in accordance with EN ISO 11925-2 and EN 13823, and classified in accordance with EN 13501-1.

5.7.2 Ignitability test (EN ISO 11925-2)

Specimens shall be tested in accordance with EN ISO 11925-2.

The flame shall be applied to the surface of the test specimen.

5.7.3 Single burning item test (EN 13823) – Specimens, mounting and fixing of specimens

5.7.3.1 General

For solid PC sheets for external use in roof and wall applications, the internal face and/or the external face shall be tested, depending on the end use conditions and the regulatory requirements in the Member State of use.

5.7.3.2 Test specimens

The corner specimen consists of two wings, designated the short and long wings.

The specimens shall have the following dimensions:

a) short wing: (495 ± 5) mm x (1 500 ± 5) mm,

b) long wing: (1 000 ± 5) mm x (1 500 ± 5) mm.

The long wing shall be tested without joint.

5.7.3.3 Mounting of test specimens

Specimens shall be mounted and fixed as described in EN 13823 with the configuration shown in Figure 3 and Figure 4.

The wing shall be mounted in a right-angled frame made of steel shown in a Figure 3 and Figure 4. In addition, a backing frame shown in Figure 3 and Figure 4 are put behind each wing and is held in place mechanically at minimum three points by pressure. This setting secures specimens in vertical position during testing.

The test assembly shall be positioned immediately behind the drip trays of the test unit. A spacer frame and a 12 mm thick calcium silicate backing board shall be positioned behind each wing of the test assembly to give a maximum air gap between the rear surface of the specimen and the backing board.

5.7.4 Rules for extended application of the test results

Where there is a range of thicknesses/mass per unit area of product, two or more thicknesses/mass per unit area of sample shall be tested, and the lowest of the results shall be declared for all thicknesses/mass per unit areas between the two extremes tested.

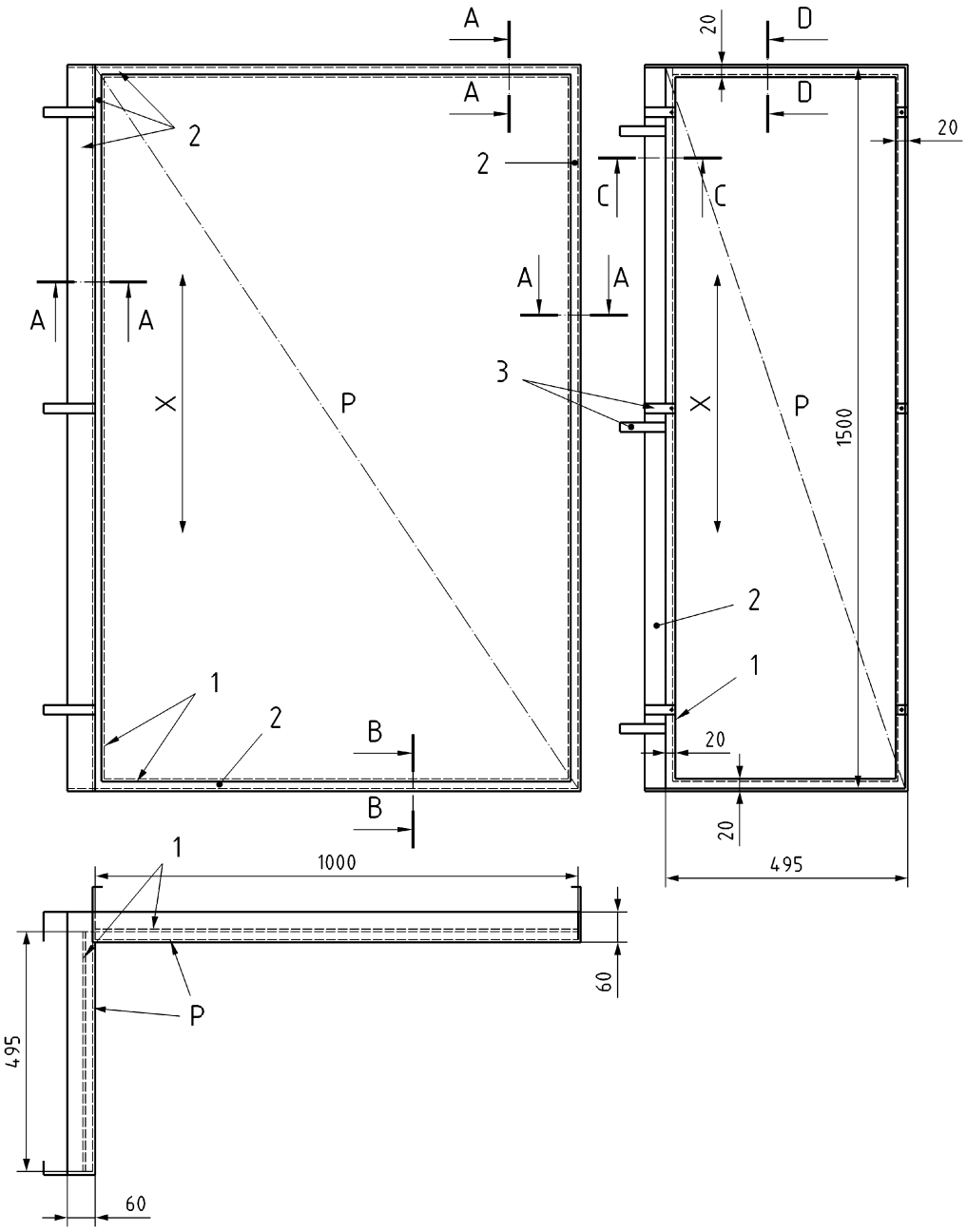
The same procedure shall be applied for a range of mass per unit area.

If a range of colour is proposed, three different colours (a clear light one, an intermediate one and an opaque dark one) shall be chosen for each SBI test. If the same classification (e.g. class B, C, etc.) is kept so it is possible to extend to various colours with lowest additional classifications for smoke and flaming droplets. Otherwise, it is necessary to test two additional specimens with the colour which gives the lowest result. The classification shall be given by the mean of the three specimens with the colour specified before.

Surface coatings of varying chemical composition (e.g. UV protective coating) shall be considered when testing the sheets. If only one surface of the sheet is covered or various coatings are applied on both surfaces of the sheet, a two-sided test is required. In case different classifications are obtained, the more unfavourable classification shall apply to the entire sheet.

Every extrusion material with different chemical composition and construction products made from that should be tested.

Dimensions in millimetres



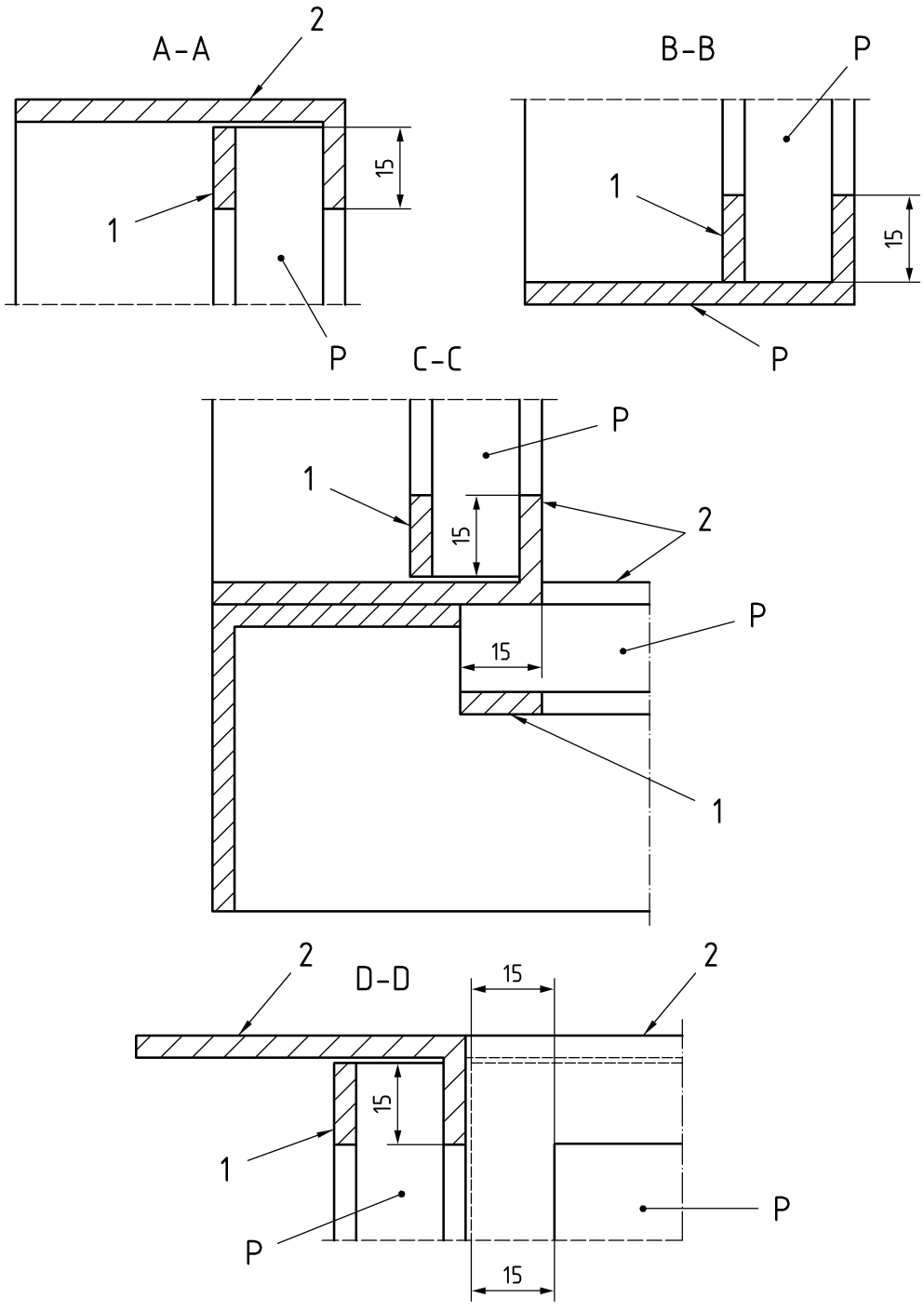
Key

P solid PC sheet
X extrusion direction
1 counter-support (15 mm x 4 mm)
2 steel angle (60 mm x 20 mm x 4 mm)
3 bindings

For sections A-A, B-B, C-C and D-D, see Figure 4.

Figure 3 — Steel-based frame for fixing of specimens

Dimensions in millimetres



Key

P solid PC sheet
1 counter-support (15 mm x 4 mm)
2 steel angle (60 mm x 20 mm x 4 mm)

Figure 4 — Sections of the steel-based frame

6 Assessment and verification of constancy of performance – AVCP

6.1 General

The compliance of light transmitting flat solid PC sheets with the requirements of this document and with the stated values (including classes) shall be demonstrated by:

— product type determination,

— factory production control by the manufacturer, including product assessment.

For the purposes of testing, the manufacturer's products may be grouped into families, where it is considered that the results for one or more characteristics from any one product within the family are representative for that same characteristics for all products within that same family (a product may be in different families for different characteristics).

6.2 Product type determination

Product type determination (PTD) shall be performed to show conformity with this document. Tests previously performed in accordance with the provisions of this document (same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.) may be taken into account.

The characteristics subjected to PTD are listed in Table 5.

Whenever a change occurs in the product design, the raw material or supplier of the components, or the production process (subject to the definition of a family), which would change significantly one or more of the characteristics, the type tests shall be repeated for the appropriate characteristic(s).

All products tested shall be representative of the manufacturer's normal production.

Where raw materials are used whose characteristics have already been determined, by the raw material manufacturer, on the basis of conformity with this or other product standards, these characteristics need not be reassessed provided that the raw materials' performance or method of assessment remain the same, that the characteristics of the raw material are suitable for the intended end use of the finished product, and insofar as the manufacturing process does not have a detrimental affect on the determined characteristics.

Table 5 — Product type determination of flat solid PC sheets

Characteristic	Requirement clause	Assessment method
Visual appearance	4.1	–
Dimensional tolerances and mass per unit area [a]	4.2	5.1
Light transmittance [a]	4.3	EN 14500
Total solar energy transmittance [a]	4.4	–
Small hard body impact resistance [a]	4.5.1	5.4
Large soft body impact resistance [a]	4.5.2	See 4.5.2
Durability (after ageing)(sheets for external use):		
variation of yellowness index after ageing [a]	4.6.1.3	5.3
variation of light transmittance after ageing [a]	4.6.1.3	EN 14500
Durability (sheets for internal use):		
Small hard body impact resistance [a]	4.6.2	5.4
Deformation behaviour [a]	4.7	5.5

Airborne sound insulation [a]	4.8	EN ISO 10140-1, EN ISO 10140-2, EN ISO 10140-4, EN ISO 10140-5, and EN ISO 717-1
Thermal transmittance [a]	4.9	EN ISO 6946
Water vapour permeability [a]	4.10	EN ISO 12572
Water/air tightness [a]	4.11	–
Linear thermal expansion [a]	4.12	ISO 11359-2
Reaction to fire [a]	4.13	5.7
External fire performance [a]	4.14	EN 13501–5
Resistance to fire [a]	4.15	EN 13501–2
Presence of functional layers [b]	4.17	–
Resistance to fixings [c]	4.19	See 4.19
[a] Only where required. [b] If relevant. [c] Appropriate method(s) of fixing to be declared at PTD according to the design of assembly.		

When a sheet requires a new PTD as a result of an enforced raw material change by the supplier, and that change affects the raw material composition or grade, the sheet manufacturer may, at his own risk, benefit from a presumption of conformity to the existing PTD for defined characteristic(s). These shall be durability – variation of yellowness index and light transmission, because these are the subject of long-term testing procedures. The presumption of conformity shall be subject to the following:

a) the raw material supplier's written confirmation that the new composition or grade is no less durable than the previous grade or composition (only if this information is available),

or

if the new material is considered less durable, the manufacturer shall estimate the new durability based upon relevant information from the material supplier (only if this information is available),

b) the new PTD is commenced at the earliest practical time,

c) if the new PTD indicates a reduced performance than that declared by the manufacturer, the manufacturer shall have suitable traceability procedures and advise the purchaser accordingly,

d) the presumption of conformity shall cease when the period of time has elapsed that would permit the test to provide comparable results with the PTD.

6.3 Factory production control (FPC)

6.3.1 General

The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product to ensure that the products placed on the market conform with the stated performance characteristics.

All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures. This production control system documentation shall ensure a common understanding of conformity evaluation and enable the achievement of

the required component characteristics and the effective operation of the production control system to be checked.

Factory production control therefore brings together operational techniques and all measures allowing maintenance and control of the conformity of the component with its technical specifications. Its implementation may be achieved by controls and tests on measuring equipment, raw materials and constituents, processes, machines and manufacturing equipment and finished components, including material properties in components, and by making use of the results thus obtained.

6.3.2 General requirements

Manufacturers having an FPC system, which complies with EN ISO 9001 [6] standard and which addresses the requirements of this European Standard are recognized as satisfying the FPC requirements.

6.3.3 FPC requirements for all manufacturers

6.3.3.1 Product specific requirements

The FPC system shall:

— address this document; and

— ensure that the products placed on the market conform with the stated performance characteristics.

The results of inspections, tests or assessments requiring action shall be recorded, as shall any action taken. The action to be taken when control values or criteria are not met shall be recorded and retained for the period specified in the manufacturer's FPC procedures.

6.3.3.2 Raw materials and components

The specifications of all incoming raw materials and components shall be documented, and the inspection scheme for ensuring their conformity shall be in accordance with Table 6.

Table 6 — Inspection scheme for raw materials and components

Material/component	Control	Method	Frequency
Raw material and component	Conformity of supplier's declaration with manufacturer's requirement [a]	Document examination	Each delivery
[a] This also applies where the manufacturer of the sheets is also the producer of the raw materials.			

6.3.3.3 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of all of the characteristics are maintained. The characteristics, and the means of control, shall be as given in Table 7.

Table 7 — Characteristics and minimum sampling frequencies for FPC testing

Characteristic [a]	Requirement clause	Factory production control [b]	Minimum frequency of testing [c]	Compliance criteria
Visual appearance	4.1	Visual inspection	Continuous	As defined in 4.1
Water/air tightness	4.11	Visual inspection	Continuous	No holes
Dimensional tolerances and mass per	4.2	Measurement	Once per 8 h	Within the

unit area		according to 5.1		tolerances as defined in Table 2
Light transmittance Total solar energy transmittance	4.3 4.4	Raw material and process control	See Table 6 for raw material and continuous process control	Within manufacturer's specification
Hard body impact resistance	4.5.1	Raw material and process control	See Table 6 for raw material and continuous process control	Within manufacturer's specification
Soft body impact resistance	4.5.2			
Durability (after ageing) (sheets for external use): – variation of yellowness index – variation of light transmittance	 4.6.1.3 4.6.1.3			
Durability (after ageing) (sheets for internal use): Hard body impact resistance	 4.5.1			
Deformation behaviour	4.7			
Airborne sound insulation	4.8			
Thermal transmittance	4.9			
Water vapour permeability	4.10	[d]		
Linear thermal expansion	4.12	[e]		
Reaction to fire	4.13			
External fire performance	4.14			
Resistance to fire	4.15			
Presence of functional layers [f]	4.17	[g]		
Resistance to fixing	4.19		[h]	

[a] FPC is performed only if the characteristic is being declared.

[b] Indirect methods of measurement (e.g. process control) are allowed provided that they give the same degree of confidence as if the specified minimum sampling frequency had been followed.

[c] Hourly frequencies relate to production time.

[d] No control necessary if using the reference value given in 4.10.

[e] No control necessary if using the reference value given in 4.12.

[f] Not necessary for any uncoated product.

[g] Raw material control is required only where raw material is purchased with protective coating already applied.

[h] When the design of the installed assembly/kit is changed.

6.4 Initial inspection of factory and of FPC

Initial inspection of FPC shall be carried out when the production process has been finalized and in operation. The factory and FPC documentation shall be assessed to verify that the requirements of 6.3.2 and 6.3.3 are fulfilled.

During the inspection it shall be verified:

a) that all resources necessary for the achievement of the product characteristics required by this European Standard are in place and correctly implemented, and

b) that the FPC-procedures in accordance with the FPC documentation are followed in practice,

and

c) that the product complies with the initial type testing/type testing samples, for which compliance with this European Standard has been verified.

All locations where final assembly or at least final testing of the relevant product is performed, shall be assessed to verify that the above conditions a) to c) are in place and implemented. If the FPC system covers more than one product, production line or production process, and it is verified that the general requirements are fulfilled when assessing one product, production line or production process, then the assessment of the general requirements does not need to be repeated when assessing the FPC for another product, production line or production process.

All assessments and their results shall be documented in the initial inspection report.

6.5 Continuous surveillance of FPC

Surveillance of the FPC shall be undertaken. The surveillance of the FPC shall include a review of the FPC test plan(s) and production processes(s) for each product to determine if any changes have been made since the last assessment or surveillance. The significance of any changes shall be assessed.

Checks shall be made to ensure that the test plans are still correctly implemented and that the production equipment is still correctly maintained and calibrated.

The records of tests and measurement made during the production process and to finished products shall be reviewed to ensure that the values obtained still correspond with those values for the samples submitted to type testing and that the correct actions have been taken for non-compliant devices.

7 Marking and labelling

Sheets complying with this European Standard shall be durably marked with the name or trade mark of the manufacturer, and a means of traceability to documentation showing the classes according to this standard.

When the sheets are protected by a coating/treatment on one side only, this side shall be identified.

The following information shall be clearly indicated on the delivery note, invoice or supplier declaration, supplied with the delivery of light transmitting solid PC sheets:

a) name, trade mark or other means of identification of the manufacturer;

b) reference to this European Standard: EN 16240;

c) identification of the sheet;

d) type of material;

e) identification symbol of any third party, if relevant;

f) nominal overall sheet thickness (see 4.2);

g) nominal mass per unit area (see 4.2);

h) light transmittance, and the solar direct transmittance (see 4.3);

i) total solar energy transmittance (see 4.4);

j) small hard body impact resistance (see 4.5.1) and the large soft body impact resistance (see 4.5.2), if relevant;

k) class for the durability for external use (see Table 3), if relevant;

l) variation of the yellowness index after thermal ageing (see Table 3) for external use;

m) variation of the light transmittance after artificial ageing (see Table 3) for external use;

n) flexural modulus and tensile strength (see 4.7);

o) airborne sound insulation (see 4.8), if relevant;

p) thermal transmittance (see 4.9), if relevant;

q) water vapour permeability (see 4.10), if relevant;

r) linear thermal expansion (see 4.12), if relevant;

s) class for the reaction to fire (see 4.13);

t) class for the external fire performance (see 4.14), if relevant;

u) class for the resistance to fire (see 4.15), if relevant;

v) presence of functional layers (see 4.17), if relevant;

w) statement that the sheets are not suitable to walk on and that safety guards are needed when the sheets are used on roofs, if relevant.

NOTE Where ZA.3 covers the same requirements as this clause, the requirements of this clause are met.

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Regulation

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under Mandate M/121 “Internal and external wall and ceiling finishes” as amended and Mandate M/122 “Roof coverings, rooflights, roof windows and ancillary products” as amended given to CEN by the European Commission and the European Free Trade Association.

If this European Standard is cited in the Official Journal of the European Union (OJEU), the clauses of this standard, shown in this annex, are considered to meet the provisions of the relevant mandate, under the Regulation (EU) No. 305/2011.

This annex deals with the CE marking of the light transmitting flat solid polycarbonate (PC) sheets for internal and external use in roofs, walls and ceilings intended for the uses indicated in Table ZA.1.1 to Table ZA.1.3 and shows the relevant clauses applicable.

This annex has the same scope as in Clause 1 of this standard related to the aspects covered by the mandate and is defined by Table ZA.1.1 to Table ZA.1.3.

Table ZA.1.1 — Relevant clauses for light transmitting flat solid polycarbonate sheets intended for roof coverings for buildings

Products: Light transmitting flat solid polycarbonate sheets **Intended use:** Roof covering for buildings			
Essential characteristics	**Clauses in this and other European Standard(s) related to essential characteristics**	**Regulatory classes**	**Notes**
Mechanical resistance	4.7	–	Flexural modulus E_f and tensile strength σ_M
External fire performance	4.14	–	Declared class
Reaction to fire	4.13	Class A1 to F	Declared class
Water/air tightness	4.11	–	“Pass” or “fail”
Dimensional tolerances	4.2	–	“Pass” or “fail”
Water vapour permeability	4.10	–	Coefficient from 4.10 or acc. to EN ISO 12572
Release of dangerous substances	4.18	–	
Impact resistance	4.5.1 4.5.2	– –	“Pass” or “fail” See Footnote [a]
Direct airborne sound insulation	4.8	–	Sound reduction index R_w ($C;C_{tr}$)

Thermal properties, as			
- thermal transmittance	4.9	–	Thermal transmittance *U* value
Radiation properties, as:			
- Light transmittance	4.3	–	Declared τ_v
- Total solar energy transmittance	4.4	–	Declared g and τ_e
Durability, as:			
- variation of yellowness index	4.6.1.3	–	Class ΔA, ΔD, ΔE or ΔF according to Table 3
- variation of light transmittance	4.6.1.3	–	Class ΔA, ΔD, ΔE or ΔF according to Table 3
Durability – variation of deformation behaviour	4.6.1.4	–	Classes Cu 1 and Ku 1 from EN 14963:2006 and EN 1873:2005
[a] Large soft body impact resistance depends highly on the method of installation. Large soft body impact resistance of a fully installed assembly/kits shall be declared separately by the manufacturer or designer of assembly/kits as stated in 4.5.2 where subject to regulation, otherwise "NPD" may be declared. The test method and configuration of the roof assembly/kits shall be declared.			

Table ZA.1.2 — Relevant clauses for light transmitting flat solid polycarbonate sheets intended for external wall and ceiling finishes

Products: Light transmitting flat solid polycarbonate sheets **Intended use:** External wall and ceiling finishes			
Essential characteristics	**Clauses in this and other European Standard(s) related to essential characteristics**	**Regulatory classes**	**Notes**
Reaction to fire	4.13	Class A1 to F	Declared class
Release of dangerous substances	4.18	–	
Water vapour permeability	4.10	–	Coefficient from 4.10 or acc. to EN ISO 12572
Water/air tightness	4.11	–	"Pass" or "fail"
Shatter properties (safe breakability), as:			
- Impact resistance	4.5.1	–	"Pass" or "fail"
Flexural/tensile strength, as			
- deformation behaviour	4.7	–	Flexural modulus E_f and tensile strength σ_M
Resistance to fixings [a]	4.19	–	Declaration of method of fixing
Radiation properties, as:			
- Light transmittance	4.3		Declared τ_v
- Total solar energy transmittance	4.4		Declared g and τ_e
Durability, as:			

- variation of yellowness index	4.6.1.3	–	Class ΔA, ΔD, ΔE or ΔF according to Table 3
- variation of light transmittance	4.6.1.3	–	Class ΔA, ΔD, ΔE or ΔF according to Table 3
- variation of flexural modulus and tensile strength	4.6.1.4	–	Classes Cu 1 and Ku 1 from EN 14963:2006 and EN 1873:2005
[a] When used for external wall finishes subject to requirements against accidental fall of objects on to transit areas.			

Table ZA.1.3 — Relevant clauses for light transmitting flat solid polycarbonate sheets intended for internal wall and ceiling finishes

Products: Light transmitting flat solid polycarbonate sheets **Intended use:** Internal wall and ceiling finishes			
Essential characteristics	**Clauses in this and other European Standard(s) related to essential characteristics**	**Regulatory classes**	**Notes**
Reaction to fire	4.13	Class A1 to F	Declared class
Resistance to fire	4.15	–	Declared class
Release of dangerous substances	4.18	–	
Water vapour permeability	4.10	–	Coefficient from 4.10 or acc. to EN ISO 12572
Water/air tightness	4.11	–	“Pass” or “fail”
Shatter properties (safe breakability), as:			
- Impact resistance	4.5.1	–	“Pass” or “fail”
Flexural/tensile strength, as:			
- deformation behaviour	4.7	–	Flexural modulus E_f and tensile strength σ_M
Resistance to fixings	4.19	–	Declaration of method of fixing
Radiation properties, as:			
- Light transmittance	4.3		Declared τ_v
- Total solar energy transmittance	4.4		Declared g and τ_e
Durability, as:			
- impact resistance	4.6.2	–	“Pass” or “fail”

The declaration of the product performance related to certain essential characteristics is not required in those Member States (MS) where there are no regulatory requirements on these essential characteristics for the intended use of the product.

In this case, manufacturers placing their products on the market of these MS are not obliged to determine nor declare the performance of their products with regard to these essential characteristics and the option “No performance determined” (NPD) in the information accompanying the CE marking and in the declaration of performance (see ZA.3) may be used for those essential characteristics.

ZA.2 Procedure for AVCP of light transmitting flat solid polycarbonate sheets

ZA.2.1 Systems of AVCP

The AVCP systems of light transmitting flat multiwall polycarbonate sheets indicated in Table ZA.1.1 to Table ZA.1.3, established by EC Decisions:

— the Decision of the Commission 98/436/EC of 1998-06-22 (published the 10.07.98 under L194) amended by the Decision 01/596/EC (published the 2.08.01 under L209) as given in Annex III of the mandate for “Roof coverings, roof lights, roof windows and ancillary products”,

— the Decision of the Commission 98/437/EC of 1998-06-30 (published the 10.07.98 under L194) amended by the Decision 01/596/EC (published the 2.08.01 under L209) as given in Annex III of the mandate for “Internal and external wall and ceiling finishes”,

are shown in Table ZA.2 for the indicated intended use(s) and relevant level(s) or class(es) of performance.

Table ZA.2 — Systems of AVCP

Products	**Intended uses**	**Level(s) or class(es)**	**Attestation of conformity systems**
Flat and profile sheets	As roofing coverings subject to reaction to fire regulations	A1*, A2*, B* and C* A1**, A2**, B**, C**, D and E (A1 to E)***, F	1 3 4
	As roof coverings subject to external fire performance regulations	Products requiring testing Products 'deemed to satisfy' without testing	3 4
	As roof coverings subject to regulations on dangerous substances	–	4
	As roof coverings for all other uses	–	4
Panels	As external finishes in ceilings subject to reaction to fire regulations	A1*, A2*, B* and C* (A1, A2, B, C)**, D and E F	1 3 4
	As internal or external finishes in walls or ceilings, as relevant, subject to regulations on dangerous substances	–	3
* Products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material). Fire retardant products are under conformity system 1. ** Products for which there is no clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardant or limiting of organic material). *** Products/materials that do not require to be tested for reaction to fire (e.g. products/materials of Class A1 according to Commission Decision 96/603/EC).			
System 1: See Regulation (EU) No. 305/2011 (CPR) Annex V, 1.2 System 3: See Regulation (EU) No. 305/2011 (CPR) Annex V, 1.4 System 4: See Regulation (EU) No. 305/2011 (CPR) Annex V, 1.5			

The AVCP of the light transmitting flat solid polycarbonate sheets in Table ZA.1.1 to Table ZA.1.3 shall be according to the AVCP procedures indicated in Table ZA.3.1 to Table ZA.3.3 resulting from application of the clauses of this or other European Standard indicated therein. The content of tasks of the notified body shall be limited to those essential characteristics as provided for, if any, in Annex III of the relevant mandate and to those that the manufacturer intends to declare.

Table ZA.3.1 — Assignment of AVCP tasks for light transmitting flat solid polycarbonate sheets under system 1 (for reaction to fire classes A1*, A2*, B*, C*) with system 3 (for external fire performance subject to testing and dangerous substances for internal or external wall finishes)

Tasks		Content of the task	AVCP clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use which are declared	6.3
	Determination of the product-type on the basis of type testing, type calculation, tabulated values or descriptive documentation of the product	Essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use which are declared except external fire performance (subject to testing) reaction to fire and dangerous substances (for internal or external finishes)	6.2
	Further testing of samples taken at factory according to the prescribed test plan	Essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use which are declared	6.3
Tasks for a notified testing laboratory	Determination of the product-type on the basis of type testing (based on sampling carried out by the manufacturer), type calculation, tabulated values or descriptive documentation of the product	Release of dangerous substance (only for internal or external wall finishes) and external fire performance, if relevant.	6.2
Tasks for the notified product certification body	determination of the product type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product	Reaction to fire (Classes A1*, A2*, B*, C*)	6.2
	Initial inspection of manufacturing plant and of FPC	Parameters related to essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use which are declared, namely reaction to fire. Documentation of the FPC.	6.3,6.4
	Continuous surveillance, assessment and evaluation of FPC	Parameters related to essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use which are declared, namely reaction to fire Documentation of FPC	6.3,6.5

Table ZA.3.2 — Assignment of AVCP tasks for light transmitting flat solid polycarbonate sheets under system 3 (for reaction to fire classes A1, A2**, B**, C**, D and E) (and for external fire subject to testing)**

Tasks		Content of the task	AVCP clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use which are declared	6.3
	Determination of the product-type on the basis of type testing, type calculation, tabulated values or descriptive documentation of the product	Essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use which are declared except reaction to fire, external fire subject to testing and dangerous substances (for internal or external wall finishes)	6.2
Tasks for a notified testing laboratory	Determination of the product-type on the basis of type testing (based on sampling carried out by the manufacturer), type calculation, tabulated values or descriptive documentation of the product	Reaction to fire (Classes A1**, A2**,B**, C**, D and E), external fire performance and release of dangerous substances (only for internal or external wall finishes), if relevant	6.2
** See footnote to Table ZA.2.			

Table ZA.3.3 — Assignment of AVCP tasks for light transmitting flat solid polycarbonate sheets under system 4

Tasks		Content of the task	AVCP clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use	6.3
	Determination of the product-type on the basis of type testing, type calculation, tabulated values or descriptive documentation of the product	Essential characteristics of Tables ZA.1.1, ZA.1.2 and/or ZA.1.3 relevant for the intended use which are declared	6.2

ZA.2.2 Declaration of performance (DoP)

ZA.2.2.1 General

The manufacturer draws up the DoP and affixes the CE marking on the basis of the different AVCP systems set out in Annex V of the Regulation (EU) No 305/2011:

In case of products under system 1

— The factory production control and further testing of samples taken at the factory according to the prescribed test plan, carried out by the manufacturer; and

— the certificate of constancy of performance issued by the notified product certification body on the basis of determination of the product type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product; initial inspection of the manufacturing plant and of factory production control and continuous surveillance, assessment and evaluation of factory production control.

In case of products under system 3

— The factory production control carried out by the manufacturer; and

— the determination of the product-type on the basis of type testing (based on sampling carried out by the manufacturer), type calculation, tabulated values or descriptive documentation of the product, carried out by the notified testing laboratory.

In case of products under system 4

— The factory production control carried out by the manufacturer;

— the determination by the manufacturer of the product-type on the basis of type testing, type calculation, tabulated values or descriptive documentation of the product.

ZA.2.2.2 Content

The model of the DoP is provided in Annex III of the Regulation (EU) No 305/2011.

According to this Regulation, the DoP shall contain, in particular, the following information:

— the reference of the product-type for which the declaration of performance has been drawn up;

— the AVCP system or systems of the construction product, as set out in Annex V of the CPR;

— the reference number and date of issue of the harmonized standard which has been used for the assessment of each essential characteristic;

— where applicable, the reference number of the Specific Technical Documentation used and the requirements with which the manufacturer claims the product complies.

The DoP shall in addition contain:

(a) the intended use or uses for the construction product, in accordance with the applicable harmonized technical specification;

(b) the list of essential characteristics, as determined in the harmonized technical specification for the declared intended use or uses;

(c) the performance of at least one of the essential characteristics of the construction product, relevant for the declared intended use or uses;

(d) where applicable, the performance of the construction product, by levels or classes, or in a description, if necessary based on a calculation in relation to its essential characteristics determined in accordance with the Commission determination regarding those essential characteristics for which the manufacturer shall

declare the performance of the product when it is placed on the market or the Commission determination regarding threshold levels for the performance in relation to the essential characteristics to be declared.

(e) the performance of those essential characteristics of the construction product which are related to the intended use or uses, taking into consideration the provisions in relation to the intended use or uses where the manufacturer intends the product to be made available on the market;

(f) for the listed essential characteristics for which no performance is declared, the letters “NPD” (No Performance Determined);

Regarding the supply of the DoP, article 7 of the Regulation (EU) No 305/2011 applies.

The information referred to in Article 31 or, as the case may be, in Article 33 of Regulation (EC) No 1907/2006, (REACH) shall be provided together with the DoP.

ZA.2.2.3 Example of DoP

The following gives an example of a filled-in DoP for light transmitting flat solid polycarbonate sheets:

DECLARATION OF PERFORMANCE
No. 001DoP2013-07-14

1. Unique identification code of the product-type:

Light transmitting flat solid polycarbonate sheets
PCS 345

2 Type, batch or serial number or any other element allowing identification of the construction product as required under Article 11(4):

Light transmitting flat solid polycarbonate sheets
PCS 345

3. Intended use or uses of the construction product, in accordance with the applicable harmonized technical specification, as foreseen by the manufacturer:

For internal and external use in roofs, walls and ceilings

4. Name, registered trade name or registered trade mark and contact address of the manufacturer as required under Article 11(5):

AnyCo SA,
PO Box 21
B-1050 Brussels, Belgium
Tel. +32987654321
Fax: +32123456789
Email: anyco.sa@provider.be

5. Where applicable, name and contact address of the authorized representative whose mandate covers the tasks specified in Article 12(2):

Anyone Ltd
Flower Str. 24
West Hamfordshire
UK-589645 United Kingdom
Tel. +44987654321
Fax: +44123456789
e-mail: anyone.ltd@provider.uk

6. System or systems of assessment and verification of constancy of performance of the construction product as set out in CPR, Annex V:

System 1

7. In case of the declaration of performance concerning a construction product covered by a harmonized standard:

Notified factory production control certification body No. 0123 performed the determination of the product type (for reaction to fire) the initial inspection of the manufacturing plant and of factory production control and the continuous surveillance, assessment and evaluation of factory production control and issued the certificate of constancy of performance of the product.

8. Declared performance

Essential characteristics	Performance	Harmonized technical specification
External fire performance	**F_{ROOF} (NPD)**	EN 16240:2013
Reaction to fire	**B, s2,d0**	
Resistance to fire	**NPD**	
Water vapour permeability	**$3{,}8 \cdot 10^{-5}$ mg/m·h·Pa**	
Water/air permeability	**Pass**	
Release of dangerous substances	**NPD**	
Dimensional tolerances	**Pass**	
Shatter properties (safe breakability) as:		
- Small hard body impact resistance	**Pass**	
-large body impact resistance (assembly)	**Pass**	
Mechanical resistance (deformation behaviour)	**$E_{f,mean}$ = 2 200 Nm^2** **$E_{f,charac}$ = 2 000 Nm^2** **$\sigma_{M,mean}$ = 60 MPa** **$\sigma_{M,charac}$ = 55 MPa**	
Direct airborne sound insulation	**29 dB**	
Thermal transmittance	**U = 5,1 W/(m^2·K)**	
Light transmittance	**τ_v = 85 %**	
Total solar energy transmittance	**τ_e = 77 %** **g = 80 %**	
Resistance to fixings	**Method of fixing** (see manufacturer's datasheet)	
Durability, as variation (after ageing):		
- of yellowness index	**8 (ΔA)**	
- of the light transmittance	**3 % (ΔA)**	
- of flexural modulus	**Cu 1**	
-of tensile strength	**Ku 1**	

10. The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 8.

This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by:

……

(name and function)

…… ……

(place and date of issue) (signature)

ZA.3 CE marking and labelling

The CE marking symbol shall be in accordance with the general principles set out in Article 30 of Regulation (EC) No 765/2008 and shall be affixed visibly, legibly and indelibly:

— to the light transmitting flat solid polycarbonate (PC) sheets for internal and external use in roofs, walls and ceilings

or

— to a label attached to it.

Where this is not possible or not warranted on account of the nature of the product, it shall be affixed:

— to the packaging

or

— to the accompanying documents.

The CE marking shall be followed by:

— the last two digits of the year in which it was first affixed,

— the name and the registered address of the manufacturer, or the identifying mark allowing identification of the name and address of the manufacturer easily and without any ambiguity,

— the unique identification code of the product-type,

— the reference number of the declaration of performance *[see example of DoP]*,

— the level or class of the performance declared,

— the dated reference to the harmonized technical specification applied,

— the identification number of the notified body, *[only for products under systems 1, and 3]*,

— the intended use as laid down in the harmonized technical specification applied.

The CE marking shall be affixed before the construction product is placed on the market. It may be followed by a pictogram or any other mark notably indicating a special risk or use.

Figure ZA.1 gives an example of the information related to products subject to AVCP under each of the different systems to be given on the product, label, packaging or accompanying documents.

CE 0123	*CE marking, consisting of the "CE"-symbol* *Identification number of the product certification body*
AnyCo Ltd, PO Box 21, B-1050, Brussels, Belgium 13 001DoP2013–07–14	*Name and the registered address of the manufacturer, or identifying mark* *Last two digits of the year in which the marking was first affixed* *Reference number of the DoP*
EN 16240:2013	No. of European Standard applied, as referenced in OJEU
Light transmitting flat solid polycarbonate sheets – PCS345 - for roof covering for buildings and/or - for internal and external wall and ceiling finishes - uncoloured sheet, thickness 6 mm, UV protected	Unique identification code of the product-type Intended use of the product as laid down in the European Standard applied
External fire performance: F_{roof} (NPD) **Reaction to fire:** B,s2,d0 **Resistance to fire:** NPD **Water vapour permeability:** $3{,}8 \cdot 10^{-5}$ mg/m·h·Pa **Water/air permeability:** Pass **Release of dangerous substances**: NPD **Dimensional tolerances**: Pass **Shatter properties (safe breakability) as:** **- small hard body impact resistance**: Pass **- large body impact resistance(assembly):** Pass **Mechanical resistance (deformation behaviour):** $E_{f,mean}$ = 2 200 Nm^2 $E_{f,charac}$ = 2 000 Nm^2 $\sigma_{M,mean}$ = 60 MPa $\sigma_{M,charac}$ = 55 MPa **Direct airborne sound insulation:** 29 dB **Thermal transmittance**: U = 5,1 W/(m^2·K) **Light transmittance:** τ_v = 85 % **Total solar energy transmittance**: τ_e = 77 % g = 80 % **Resistance to fixings: method of fixing** (see manufacturer's datasheet) **Durability as variation** (after ageing) - of yellowness index: 8 (ΔA) - of the light transmittance: 3 % (ΔA) - of flexural modulus: Cu 1 - of tensile strength: Ku 1	Level or class of the performance declared

Figure ZA.1 — Example of CE marking information of products under AVCP system

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