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Agrément Certificate
05/4279
Product Sheet 2

BAUDER ROOFLIGHTS AND KERBS

BAUDER MODULAR ROOFLIGHTS WITH X3 KERBS

This Agrément Certificate Product Sheet(1) relates to Bauder Modular Rooflights with X3 Kerbs, for use on flat roofs of new and existing buildings, to provide natural light and ventilation.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Light and solar transmittance — the products provide natural lighting to the interior of a building (see section 6).
Thermal properties — for a typical 1.2 m by 1.2 m roof opening, a triple-skin fixed dome rooflight achieves a U value of 1.6 $W \cdot m^{-2} \cdot K^{-1}$ with a 175 mm aluminium kerb and 1.5 with a 175 mm galvanized steel kerb, when calculated in accordance with BS EN 1873 : 2014 + A1 : 2016 (see section 7).
Condensation risk — the risk of surface condensation on the products' internal surface will depend on the product selected and the building humidity class (see section 8).
Strength and stability — the products can withstand the wind and snow loads likely to be experienced in the UK (see section 9).
Watertightness — the products will provide satisfactory resistance to moisture ingress (see section 10).
Behaviour in relation to fire — the rigid, solid, 3 mm thick polycarbonate sheets can be classified as TP(a) rigid material in accordance with the national Building Regulations. When classified to BS EN 13501-1 : 2007, the 2 mm and 3 mm polycarbonate sheets achieved Class B- s1, d0 and can be regarded as having a $B_{ROOF}(t4)$ classification (see section 11).
Ventilation — opening rooflights can provide rapid ventilation (see section 13).
Unauthorised access — rooflights from within the range can contribute to preventing unauthorised access (see section 14).
Durability — the polycarbonate material and the other components will have a life of at least 25 and 20 years respectively in non-corrosive environments (see section 16).

The BBA has awarded this Certificate to the company named above for the products described herein. These products have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

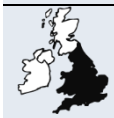
On behalf of the British Board of Agrément

Date of First issue: 28 May 2020

Hardy Giesler
Chief Executive Officer

Regulations

In the opinion of the BBA, Bauder Modular Rooflights with X3 Kerbs, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement: **A1** **Loading**
Comment: The products will have sufficient strength and stiffness to sustain the design loads. See sections 9.1, 9.2 and 9.5 of this Certificate.

Requirement: **B2(1)** **Internal fire spread (linings)**
Comment: The polycarbonate sheets used in the rooflights can be classified as TP(a) rigid material and Class B- s1, d0 to BS EN 13501-1 : 2007 and the use of the products is restricted by this Requirement. See sections 11.1, 11.2, 11.4 and 11.5 of this Certificate.

Requirement: **B4(2)** **External fire spread**
Comment: The polycarbonate sheets used in the rooflights can be classified as TP(a) rigid material and can be regarded as having a $B_{ROOF}(t4)$ classification and the use of the rooflights is restricted by this Requirement. See sections 11.1, 11.2, 11.4 and 11.5 of this Certificate.

Requirement: **C2(b)** **Resistance to moisture**
Comment: The products provide adequate resistance to the ingress of precipitation. See section 10.1 of this Certificate.

Requirement: **C2(c)** **Resistance to moisture**
Comment: The risk of surface condensation on the products will depend on the building humidity class. See section 8.2 of this Certificate.

Requirement: **F1** **Means of ventilation**
Comment: Opening rooflights can contribute to satisfying this Requirement. See section 13 of this Certificate.

Requirement: **K2(a)** **Protection from falling (applicable to England only)**
Comment: Provisions must be made for pedestrian guarding. See section 12.2 of this Certificate.

Requirement: **K5.3** **Safe opening and closing of windows etc (applicable to England only)**
Comment: Opening rooflights can satisfy this Requirement. See section 12.1 of this Certificate.

Requirement: **K5.4** **Safe access for cleaning windows etc (applicable to England only)**
Comment: Provisions must be made regarding the safe cleaning of rooflights. See section 12.2 of this Certificate.

Requirement: **L1(a)(i)** **Conservation of fuel and power**
Comment: The products can contribute to satisfying this Requirement although compensating fabric measures may be required. See sections 6.1, 7.3, 7.4 and 7.7 of this Certificate.

Requirement: **N3** **Safe opening and closing of windows, skylights and ventilators (applicable to Wales only)**
Comment: Opening rooflights can satisfy this Requirement. See section 12.1 of this Certificate.

Requirement: **N4** **Safe access for cleaning windows etc (applicable to Wales only)**
Comment: Provisions must be made regarding the safe cleaning of rooflights. See section 12.2 of this Certificate.

Regulation:	**7(1)**	**Materials and workmanship**
Comment:		The products are acceptable when used in accordance with this Certificate. See section 16.1 and the *Installation* part of this Certificate.
Regulation:	**26**	**CO_2 emission rates for new buildings**
Regulation:	**26A**	**Fabric energy efficiency rates for new dwellings (applicable to England only)**
Regulation:	**26A**	**Primary energy consumption rates for new buildings (applicable to Wales only)**
Regulation:	**26B**	**Fabric performance values for new dwellings (applicable to Wales only)**
Comment:		The products can contribute to satisfying these Regulations although appropriate compensating fabric and/or services measures may be required. See sections 6.1, 7.3, 7.4 and 7.7 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)(2)**	**Durability, workmanship and fitness of materials**
Comment:		The products can contribute to a construction satisfying this Regulation. See sections 15.1, 15.2 and 16.1 and the *Installation* part of this Certificate.
Regulation:	**9**	**Building standards applicable to construction**
Standard:	1.1(b)	Structure
Comment:		The products will have sufficient strength and stiffness to sustain design loads, with reference to clause 1.1.1(1)(2) of this Standard. See sections 9.1, 9.2 and 9.5 of this Certificate.
Standard:	2.5	Internal linings
Comment:		The polycarbonate sheets used in the rooflights can be classified as TP(a) rigid material, with reference to clauses 2.5.4(1)(2) and 2.5.6(1)(2) of this Standard, and the rooflights are unrestricted by this Standard. See sections 11.1, 11.3, 11.4 and 11.5 of this Certificate.
Standard:	2.8	Spread from neighbouring buildings
Comment:		The polycarbonate sheets used in the rooflights can be classified as TP(a) rigid material. The external glazing is classified 'low vulnerability' and the rooflights are unrestricted by this Standard, with reference to clauses 2.8.1(1)(2), 2.C.3(1) and 2.F.3(2). See sections 11.1, 11.3, 11.4 and 11.5 of this Certificate.
Standard:	3.10	Precipitation
Comment:		The products provide adequate resistance to the ingress of precipitation with reference to clause 3.10.1(1)(2) of this Standard. See section 10.1 of this Certificate.
Standard:	3.14	Ventilation
Comment:		Opening rooflights can contribute to satisfying this Requirement. See section 13 of this Certificate.
Standard:	3.15	Condensation
Comment:		The risk of surface condensation on the products will depend on the humidity class of the building, with reference to clauses 3.15.1(1) and 3.15.4(1) of this Standard. See section 8.2 of this Certificate.
Standard:	3.16	Natural lighting
Comment:		In calculating the contribution of the products to natural lighting, with reference to clauses 3.16.1(1) and 3.16.3(1) of this Standard, the area of glazing given in Table 1 of this Certificate can be used.
Standard:	4.8(c)	Danger from accidents
Comment:		The provisions described in clause 4.8.3(1)(2) of this Standard regarding the safe cleaning of rooflights, must be taken into account. See section 12.2 of this Certificate.

Standard:	4.8(e)	Danger from accidents
Comment:		The products can satisfy or contribute to satisfying this Standard, with reference to clauses 4.8.5[(1)] and 4.8.6[(2)]. See section 12.1 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Comment:		The products can contribute to satisfying this Standard when appropriate compensating fabric and/or services measures are taken. See sections 6.1, 7.4 and 7.7 of this Certificate.
Standard:	6.2	Building insulation envelope
Comment:		The products can contribute to satisfying this Standard when appropriate compensating fabric measures are taken. See sections 6.1, 7.3, 7.4 and 7.7 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The products can contribute to satisfying the relevant requirements of Regulation 9, Standards 1 to 6, and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard when appropriate compensating fabric and/or services measures are taken. See sections 6.1, 7.4 and 7.7 of this Certificate.
Regulation:	**12**	**Building standards applicable to conversions**
Comment:		All comments given for these systems under Regulation 9, Standards 1 to 6, also apply to this Regulation, with reference to clause 0.12.1[(1)(2)] and Schedule 6[(1)(2)].

(1) Technical Handbook (Domestic).
(2) Technical Handbook (Non-Domestic).

The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	**23**	**Fitness of materials and workmanship**
Comment:		The products are acceptable. See section 16.1 and the *Installation* part of this Certificate.
Regulation:	**28(b)**	**Resistance to moisture and weather**
Comment:		The products will not adversely affect the resistance of the roof to the passage of moisture. See section 10.1 of this Certificate.
Regulation:	**30**	**Stability**
Comment:		The products have sufficient strength and stiffness to sustain the design loads. See sections 9.1, 9.2 and 9.5 of this Certificate.
Regulation:	**34**	**Internal fire spread — Linings**
Comment:		The polycarbonate sheets used in the rooflights can be classified as TP(a) rigid material and Class B- s1, d0 to BS EN 13501-1: 2007 and the use of the rooflights is restricted by this Regulation. See sections 11.1, 11.2, 11.4 and 11.5 of this Certificate.
Regulation:	**36(b)**	**External fire spread**
Comment:		The polycarbonate sheets can be regarded as having a B_{ROOF}(t4) classification. See sections 11.1, 11.2, 11.4 and 11.5 of this Certificate.
Regulation:	**39(a)(i)**	**Conservation measures**
Comment:		The products can contribute to satisfying this Regulation although compensating fabric measures may be required. See sections 6.1, 7.3, 7.4 and 7.7 of this Certificate.
Regulation:	**40(2)**	**Target carbon dioxide emissions rate**
Comment:		The products can contribute to satisfying this Regulation when appropriate compensating fabric and/or services measures are taken. See sections 6.1, 7.3, 7.4 and 7.7 of this Certificate.

Regulation:	**65(1)**	**Means of ventilation**
Comment:		Opening rooflights can contribute to satisfying the requirements of this Regulation. See section 13 of this Certificate.
Regulation:	**98**	**Safe opening and closing of windows, skylights and ventilators**
Comment:		Opening lights can satisfy this Regulation. See section 12.1 of this Certificate.
Regulation:	**99**	**Safe means of access for cleaning glazing**
Comment:		Provisions must be made regarding the safe cleaning of rooflights. See section 12.2 of this Certificate.

Construction (Design and Management) Regulations 2015
Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See section: 3 *Delivery and site handling* (3.6) of this Certificate.

Technical Specification

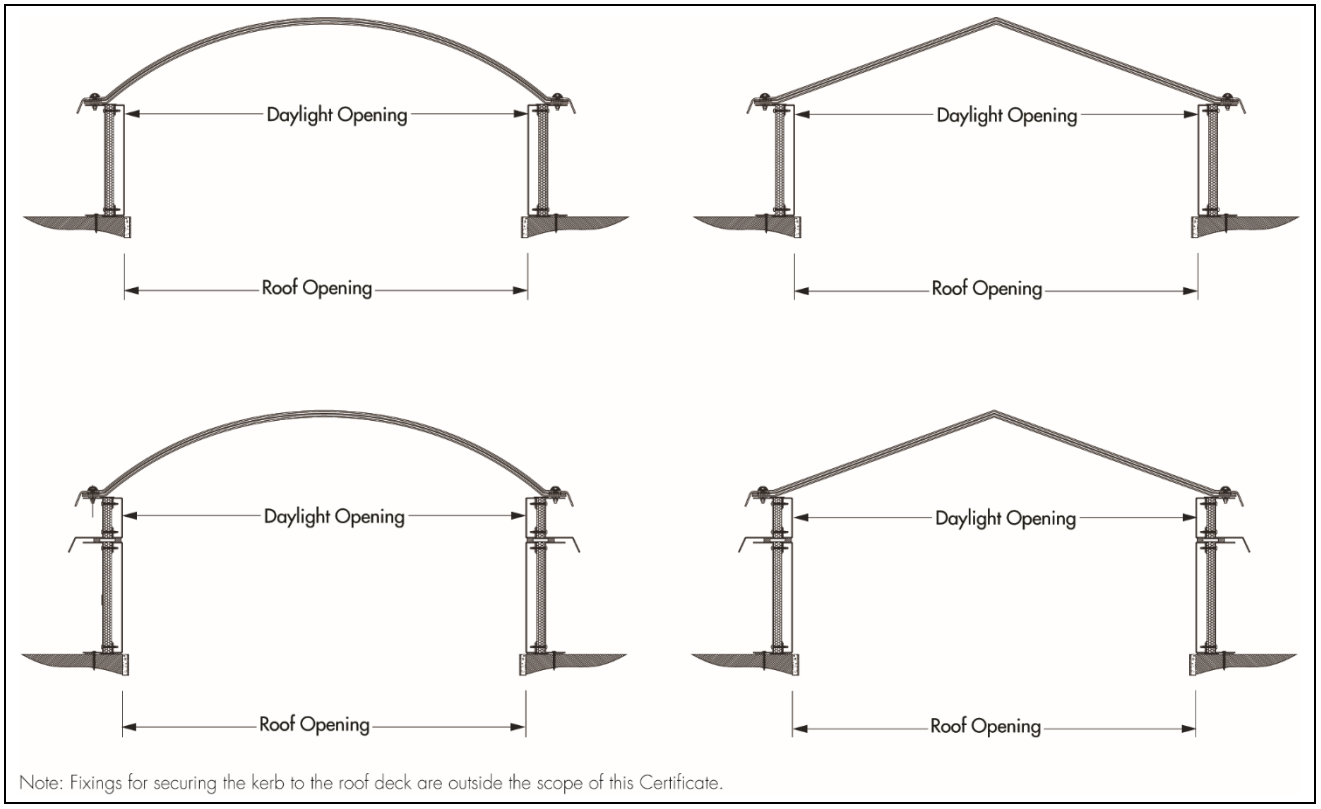
1 Description

1.1 Bauder Modular fixed and opening rooflights are thermoformed from 2 mm minimum thickness polycarbonate sheets (UV stabilised) and 3 mm minimum thickness polycarbonate sheets (coated on both sides with a UV protective film) and are for use as described in this Certificate. The 2 mm thick polycarbonate sheets are for use as internal skins only.

1.2 The rooflights are triple-skin and are available in clear (smooth and stipple), bronze and opal finishes, and are fixed onto a kerb or opening frame (see Figures 1 and 2). The rooflights are available as fixed or opening (the latter featuring a manual worm gear).

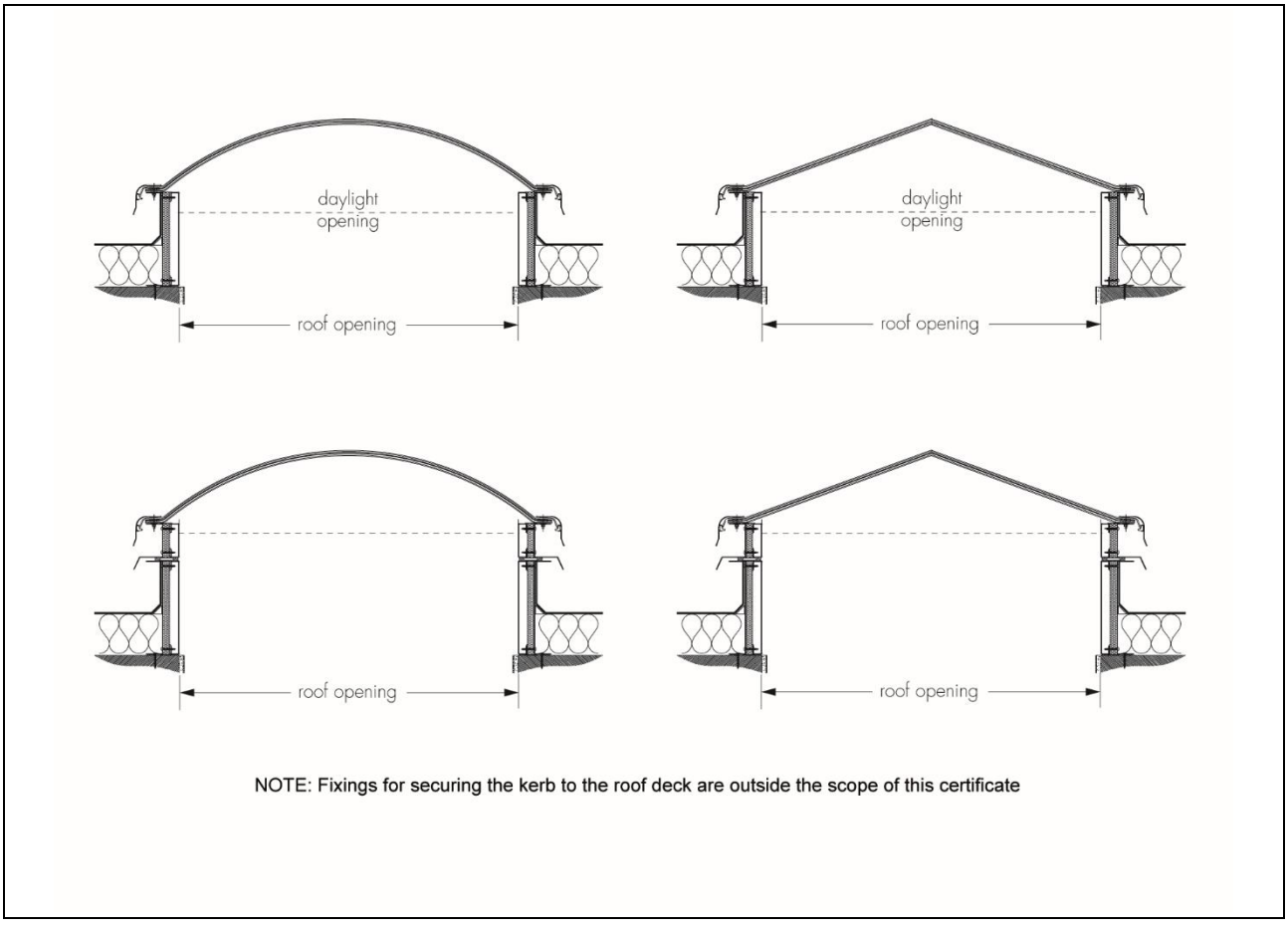
1.3 The glazing is available in dome or pyramidal shape. Rooflights are available in the styles and sizes listed in Table 1 and shown in Figures 1 and 2.

Figure 1 Typical Bauder Modular Rooflights with X3 Kerbs



Note: Fixings for securing the kerb to the roof deck are outside the scope of this Certificate.

Figure 2 Typical Bauder Modular Rooflights with X3 Kerbs fitted with Bauder Security frame



NOTE: Fixings for securing the kerb to the roof deck are outside the scope of this certificate

Table 1 Sizes of rooflights

	Size (mm)		
	Dome or pyramid base (mm)	**Daylight/roof opening (mm)**	**Internal rise (mm)**
Square	600 x 600	600 x 600	120
	750 x 750	750 x 750	150
	900 x 900	900 x 900	180
	1000 x 1000	1000 x 1000	200
	1050 x 1050	1050 x 1050	210
	1200 x 1200	1200 x 1200	240
	1350 x 1350	1350 x 1350	270
	1500 x 1500	1500 x 1500	300
	1800 x 1800	1800 x 1800	360
Rectangular	600 x 900	600 x 900	120
	600 x 1200	600 x 1200	120
	600 x 1500	600 x 1500	120
	600 x 1800	600 x 1800	120
	600 x 2400	600 x 2400	120
	900 x 1200	900 x 1200	180
	900 x 1350	900 x 1350	180
	900 x 1500	900 x 1500	180
	900 x 1800	900 x 1800	180
	900 x 2400	900 x 2400	180
	1000 x 1500	1000 x 1500	200
	1000 x 2000	1000 x 2000	200
	1200 x 1500	1200 x 1500	240
	1200 x 1800	1200 x 1800	240
	1200 x 2400	1200 x 2400	240
Circular	Ø600	Ø600	120
	Ø900	Ø900	180
	Ø1200	Ø1200	240
	Ø1500	Ø1500	300
	Ø1800	Ø1800	360

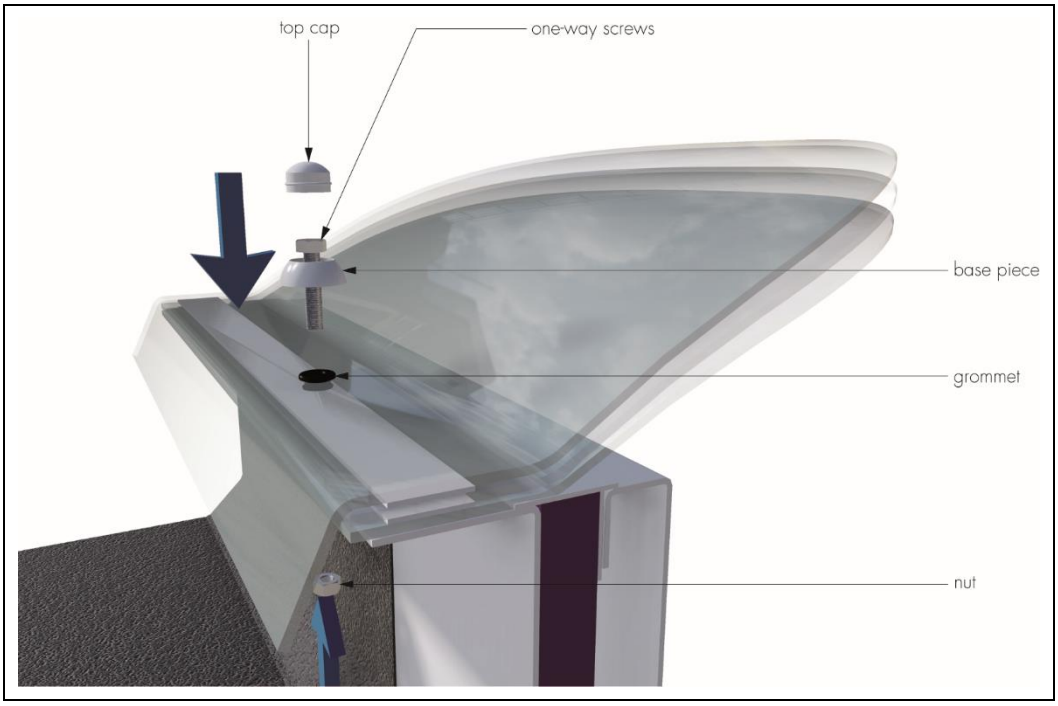
1.4 Other sizes within this size range can also be fabricated on request.

1.5 The X3 Kerbs are 175 to 350 mm high and are fabricated from thermally broken (partial-fill insulation, 20 mm wide) polyester-powder-coated aluminium or galvanized steel in white finish. Kerbs may be unvented or may incorporate vents(1). Holes for fixing kerbs onto the roof structure are drilled on site.

(1) Outside the scope of this Certificate.

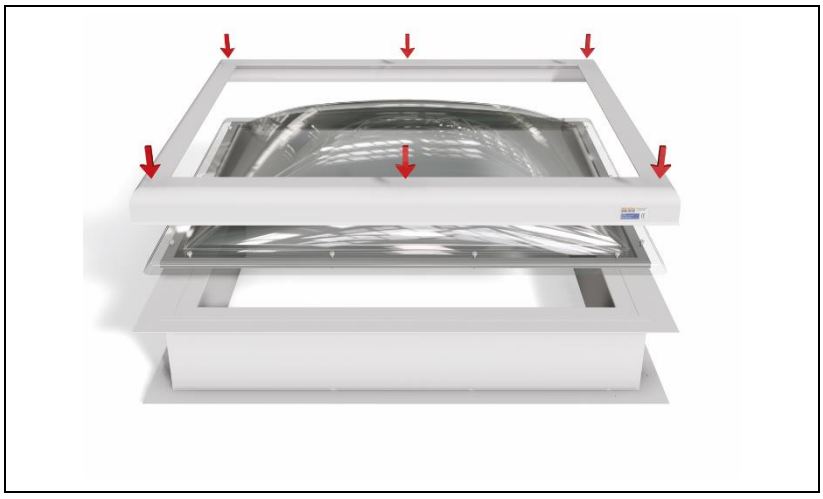
1.6 The rooflight glazing (supplied with 8 mm pre-drilled holes) is fixed onto the kerbs or opening frames (supplied with corresponding pre-drilled pilot holes of 3 mm diameter) using the Bauder screw system (see Figure 3), ensuring that the swarf is removed from the kerb/opening frame after drilling. Fixings are pre-mounted in the factory and delivered with the polycarbonate rooflights.

Figure 3 Bauder screw system



1.7 The rooflights can be pre-assembled with Bauder Security, a welded aluminium framework (see Figures 2 and 4). In this application, the polycarbonate rooflights are fixed to the top of the kerb using the one way screws.

Figure 4 Bauder Security frame



1.8 An opening frame is available in white finish (see Figures 1 and 2).

1.9 A grid, 75 by 75 mm, made from steel bar (5 mm diameter) to BS 1052 : 1980 with galvanized finish to BS EN ISO 1461 : 2009, welded onto a welded steel framework (typically 100 mm wide), can be fitted between the roofing deck and the kerb. The grid is polyester-powder coated in white. The grid is fixed to the roofing deck at 300 mm centres.

2 Manufacture

2.1 Polycarbonate sheets are thermoformed to the appropriate size. Metal kerbs are fabricated from thermally broken aluminium or galvanized steel profiles that are cut and welded together and then finished with a polyester-powder coating. Bauder Security frames are fabricated from aluminium profiles which are cut and welded together. Assembly of the triple-skin polycarbonate rooflights is carried out using a double-sided adhesive PVC strip and features a polycarbonate spacer between skins. Fittings are attached where required.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

3 Delivery and site handling

3.1 Opening and fixed rooflights and kerbs and Bauder Security products are supplied to site ready assembled. Components are packaged in bubble wrap.

3.2 Each rooflight carries a label bearing the company's mark.

3.3 The Certificate holder's recommendations for site handling and installation are provided with each delivery.

3.4 If the rooflights are to be stored on site, they should be stacked on edge with an air gap between each unit, on a dry, flat, level surface under cover. Multi-skin rooflights must not be nested at any time.

3.5 Before installation, the kerbs should be laid on timber packers placed on a level surface to avoid damage to finishes and accessories.

3.6 Smaller units may be lifted by hand to roof level but larger units will require lifting by crane. The weight of specific rooflights can be obtained from the Certificate holder.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Bauder Modular Rooflights with X3 Kerbs.

Design Considerations

4 General

4.1 Bauder Modular Rooflights with X3 Kerbs are suitable for use on the flat roofs of new and existing buildings (see section 14.1), to provide natural light and ventilation. New roofs should be designed in accordance with the relevant national Building Regulations.

4.2 The products are suitable as replacements for most existing roofs but it is important that the roof structure is checked by a suitably qualified and experienced individual to ensure that the possible removal of roof-supporting members will not cause undue weakening of the structure and that it can bear the additional loads imposed upon it by the installation of the products.

4.3 The products are suitable for replacing existing rooflights. The suitability of existing kerbs must be checked and replaced if necessary. If the rooflights are to be fitted onto a kerb other(1) than those shown in Figures 1 and 2, an adaptor kerb(1) from the Certificate holder can be used.

(1) Outside the scope of this Certificate.

5 Practicability of installation

The products are installed by installers(1) trained and approved by the Certificate holder.

(1) Outside the scope of this Certificate.

6 Light and solar transmittance

6.1 For design purposes, the approximate light and solar transmittance characteristics of new material at normal incidence are given in Table 2. These figures and the daylight opening areas given Table 1 may be used in SAP and SBEM calculations.

Table 2 Light and solar transmittance[1]

Polycarbonate finish	Light transmittance[2][3] (%)	Solar transmittance ($g_\perp$)
Single-skin		
2 mm clear finish	88	0.81
2 mm clear stipple finish	85	0.78
3 mm clear finish	87	0.79
3 mm stipple finish	87	0.78
Triple-skin		
3 mm clear finish / 3 mm clear finish / 3 mm clear finish	69	0.62[4]
3 mm clear finish / 2 mm clear finish / 2 mm clear finish	70	0.63[4]
3 mm clear finish / 2 mm clear finish / 2 mm clear stipple finish	68	0.60[4]
3 mm clear finish / 3 mm clear finish / 3 mm clear stipple finish	68	0.61[4]

(1) Values for other skin combinations must be calculated in accordance with BS EN 410 : 1998.
(2) In accordance with BS EN ISO 13468-1 : 1997.
(3) Other variations must be tested In accordance with BS EN ISO 13468-1 : 1997.
(4) Values calculated in accordance with BS EN 410 : 1998 for triple-skin rooflights separated by 15 mm air gaps.

6.2 The methods outlined in CIBSE Guide A (2006) *Environmental design*, Sections 5.7 and 5.8 and Appendix 5, should be used if the total solar gain of the building incorporating the products presents a significant heat input.

7 Thermal properties

7.1 Thermal transmittance (U) values should be derived in accordance with BS EN 1873 : 2014 + A1 : 2016 or NARM NTD 2 : 2014 (amended 2017) or measured in accordance with BS EN ISO 12567-2 : 2005.

7.2 In Scotland, thermal transmittance (U) values should be derived in accordance with BR 443 : 2006, Section 11.1.

7.3 The thermal transmittances for complete rooflights calculated in accordance with BS EN 1873 : 2014 + A1 : 2016 and NARM NTD 2 : 2014 (amended 2017) for standard daylight openings are given in Tables 3 and 4 respectively.

Table 3 Complete triple-skin fixed Bauder Modular rooflights with X3 Kerbs U values at standard daylight opening sizes to BS EN 1873 : 2014 + A1 : 2016

Kerb reference	Square dome	
	Daylight opening size 1.2 m by 1.2 m	
	U_{rc}-value ($Wm^{-2}\cdot K^{-1}$)	A_{rc} (m^2)
X3 175 mm galvanized steel	1.5	3.19
X3 175 mm aluminium	1.6	3.19

Table 4 Complete triple-skin fixed Bauder Modular rooflights with X3 Kerbs U values at standard daylight opening sizes to NARM NTD 2 : 2014 (amended 2017)

Kerb reference	Square dome	
	Daylight opening size 1.2m by 1.2 m	
	$U_{d,roof/kerb}$ ($Wm^{-2}K^{-1}$)	AD_{Tot} (m^2)
X3 175 mm galvanized steel	1.6	3.08
X3 175 mm aluminium	1.6	3.08

7.4 For rooflights with dimensions other than those in Tables 3 and 4, U values must be calculated using Tables 5 and 6 and the subsequent equations (1) to (12).

Table 5 Rooflight kerb parameters

Rooflight type	$X_{kerb,u}$ (m)	$X_{up,l}$ (m)	e_{kerb} (m)	$e_{e,v}$ (m)	$e_{e,h}$ (m)	$U_{kerb,e}$ ($Wm^{-2}\cdot K^{-1}$)	Ψ_t ($Wm^{-2}\cdot K^{-1}$)
X3 175 mm galvanized steel kerb, fixed	0.049	0.049	0.175	0.053	0.049	1.267	0.008
X3 175 aluminium kerb, fixed	0.049	0.049	0.175	0.053	0.049	1.370	0.008
X3 175 mm galvanized steel kerb, opening	0.049	0.049	0.390	0.053	0.049	1.286	0.010
X3 175 aluminium kerb, opening	0.049	0.049	0.390	0.053	0.049	1.394	0.012

Table 6 Rooflight glazing thermal transmittance

Glazing option	U_t ($W\cdot m^{-2}\cdot K^{-1}$)
Triple-skin polycarbonate (3/15/2/15/3) – air filled	1.72

Rooflight U value, U_{rc}, is given by:

(1)

$$U_{rc} = \frac{(A_{kerb} + A_e) \times U_{kerb,e} + A_t \times U_t + l_t \times \Psi_t}{A_{kerb} + A_e + A_t}$$

Where:

A_e is the outer exposed surface of the edge profile, in m^2

A_{kerb} is the outer exposed surface of the kerb, in m^2

A_t is the outer exposed surface of the translucent part, in m^2

l_t is the length of the transition between glazing and edge profile (=P_t), in m

$U_{kerb,e}$ is the thermal transmittance of the kerb and edge profile, in $Wm^{-2}\cdot K^{-1}$

U_t is the thermal transmittance of the translucent part, in $Wm^{-2}\cdot K^{-1}$

Ψ_t is the linear heat transfer coefficient in the transition zone of the translucent part and edge profile, in $Wm^{-1}\cdot K^{-1}$

(2)

$$A_{kerb} = \frac{(P_{kerb,l} + P_{kerb,u})}{2} \times e_{kerb}$$

Where:

$P_{kerb,u}$ is the upper outer perimeter of the kerb

$P_{kerb,l}$ is the lower outer perimeter of the kerb

e_{kerb} is the vertical height of the kerb which equates to the distance of $P_{kerb,u}$ and $P_{kerb,l}$

(3)

$$A_e = P_{kerb,u} \times (e_{e,h} + e_{e,v})$$

Where:

$e_{e,h}$ is the horizontal distance between the upper outside border of the insulation in the case of a kerb or the upper outside border of the joint sealing, if there is no kerb, and the clear opening of the translucent part

$e_{e,v}$ is the vertical distance between the upper level of the translucent part and the upper level of the kerb

Dome (circular):

(4)

$$A_t = 2\pi \left[\frac{\left(\frac{d}{2}\right)^{2p} + 2\left(\frac{d}{2}\right)^{p} c^{p}}{3} \right]^{1/p}$$

Where :

d is the diameter of the circular rooflight (see Table 1 for rooflight ranges)

c is the internal rise of the dome (see Table 1 for rooflight ranges)

π is a constant = 3.14159

p is a constant = 1.6075.

(5)

$$d = l_A + 2x_{kerb,l} - 2e_{e,h}$$

(6)

$$P_{kerb,u} = \pi(l_A + 2x_{kerb,u})$$

(7)

$$P_{kerb,l} = \pi(l_A + 2x_{kerb,l})$$

(8)

$$l_t = \pi \times d$$

Where:

l_A is the diameter of the rooflight opening

$x_{kerb,l}$ is the horizontal displacement from start point, P, to $P_{kerb,l}$

$x_{kerb,u}$ is the horizontal displacement from start point, P, to $P_{kerb,u}$ (if this falls to the right of start point P then enter as negative value).

Dome or pyramidal (square/rectangular):

(9)

$$A_t = ab - \pi\frac{ab}{4} + 2\pi \left[\frac{\left(\frac{a}{2}\right)^{p}\left(\frac{b}{2}\right)^{p} + \left(\frac{a}{2}\right)^{p} c^{p}\left(\frac{b}{2}\right)^{p} c^{p}}{3} \right]^{1/p}$$

(10)

$$a = l_A + 2x_{kerb,l} - 2e_{e,h}$$
$$b = l_B + 2x_{kerb,l} - 2e_{e,h}$$
$$P_{kerb,u} = 2(l_A + 4x_{kerb,u} + l_B)$$

(11)

$$P_{kerb,l} = 2(l_A + 4x_{kerb,l} + l_B)$$

(12)

$$l_t = 2(l_A + 4x_{kerb,l} - 4e_{e,h} + l_B)$$

Where :

a is the major axis of the ellipsoid (see Table 1 for rooflight ranges)

b is the minor axis of the ellipsoid (see Table 1 for rooflight ranges)

Note: for square domes, a = b

L_A is the major axis of the rectangle

L_B is the minor axis of the rectangle

Note: for square domes, $L_A = L_B$

c is the internal rise of the dome (see Table 1 for rooflight ranges)

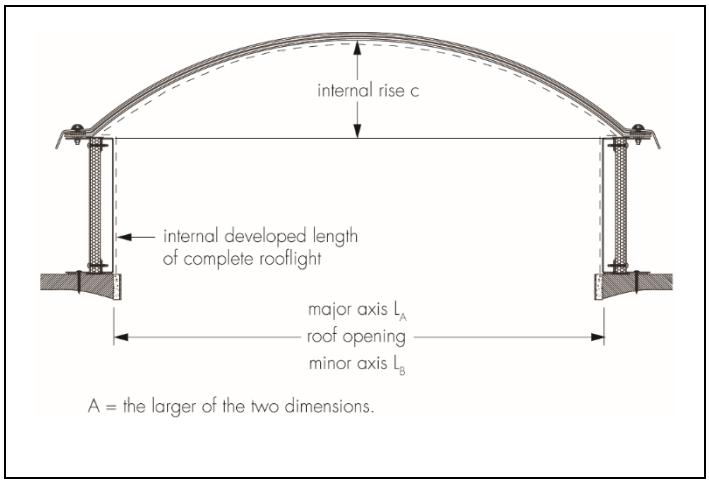
p is a constant = 1.6075

π is a constant = 3.14159

$x_{kerb,l}$ is the horizontal displacement from start point, P, to $P_{kerb,l}$

$x_{kerb,u}$ is the horizontal displacement from start point, P, to $P_{kerb,u}$ (if this falls to the right of start point P then enter as negative value).

Figure 5 Typical rooflight cross section



7.5 Rooflight assemblies are permeable to air at the junction between rooflight and kerb, particularly where an opening mechanism is present. Air permeability is beneficial for the control of condensation but can also have an effect on heat loss and may affect the airtightness of the building envelope.

7.6 Care must be taken in the design and detailing of kerbs/roof junctions in order to minimise excessive heat loss.

7.7 In the opinion of the BBA, the U values of rooflights fitted with the Bauder Security frame would be the same as those given in Tables 5 to 7.

8 Condensation risk

8.1 The risk of condensation forming on an internal surface of the rooflight is dependent on its temperature and the temperature and humidity of the adjacent air. The minimum temperature factor is dependent on the building type, external temperature and external relative humidity for the location and can be calculated for a particular situation in accordance with BS EN ISO 13788 : 2012. Alternatively, default critical temperature factors for limiting the risk of surface condensation and mould growth values can be obtained from BRE Information Paper IP 1/06.

8.2 Modelling of the rooflights in accordance with BS EN ISO 10211 : 2007 indicates the temperature factors shown in Table 7 of this Certificate

Table 7 Temperature factors(1)

Rooflight type(2)	Temperature factor f_{Rsi}
X3 (fixed frame) with kerb	0.53
X3 (opening frame) with kerb	0.53

(1) The ratio of temperature drop between the internal rooflight surface and the external environment and the total temperature drop between internal and external environments.
(2) Triple-skin.

8.3 Where the temperature factors given in Table 7 are less than the calculated or default values for the relevant building type, there is a risk of surface condensation forming. However, limited intermittent condensation, appearing initially on the kerb, frame or glazing, will not be detrimental to the rooflight. By way of comparison, minimum temperature factors for typical PVC-U windows are between 0.50 and 0.65.

8.4 In all cases, the risk of surface condensation can be reduced by limiting activities which produce large amounts of moisture and providing means for adequate ventilation; in particular, airflow from trickle ventilators(1) can alleviate localised surface condensation.

(1) Outside the scope of this Certificate.

9 Strength and stability

9.1 The products can be selected to have adequate resistance to wind loads calculated in accordance with BS EN 1991-1-4 : 2005 and its UK National Annex.

9.2 When tested under laboratory conditions, the rooflights withstood an imposed load of 750 $N \cdot m^{-2}$ for 60 minutes. The magnitude of the actual snow load imposed will depend upon a number of factors, such as height above sea level, geographical location, roof arrangement, and type and configuration of rooflights. Therefore, it is recommended that BS EN 1991-1-3 : 2003 and its UK National Annex are used to calculate the actual snow load when the roof is used in situations where a load greater than 750 $N \cdot m^{-2}$ can be expected.

9.3 Details of the connections between the kerb and the roof must be determined by a suitably competent and experienced individual. Guidance is available from the Certificate holder.

9.4 The polycarbonate rooflight material has a good resistance to impact from hard bodies, such as hailstones, or impacts due to vandalism. Tests on typical rooflight samples showed that an impact energy of 2.5 J did not cause damage when applied to various points on the rooflights.

9.5 Resistance to imposed snow and wind loads is dependent on size and configuration of the rooflight. As a guide, small pyramid-shape rooflights are more resistant to imposed loads, whilst large, domed rooflights are the least resistant. Rooflights, therefore, should be selected according to the loads expected for a particular location. The results of tests for an individual rooflight carried out in accordance with BS EN 1873 : 2014 are given in Table 8 of this Certificate.

Table 8 Example resistance to downward and upward loads

Rooflight type	Dimensions (mm)	Downward load (DL) ($N \cdot m^{-2}$)	Upward load (UL) ($N \cdot m^{-2}$)
Dome, fixed, triple-skin with Bauder Security frame	1200 x 2400	750(1)	1500(2)(3)

(1) Downward load. Snow load was simulated by the use of air pressure.
(2) Upward load. Wind load was simulated by the use of air pressure.

9.6 The products have adequate resistance to soft body impacts, such as a person accidentally falling against them. The result of a test for an individual rooflight, carried out in accordance with BS EN 1873 : 2014, is given in Table 9 of this Certificate.

Table 9 Resistance to soft body impact

Rooflight type	Dimensions (mm)	Designation to BS EN 1873 : 2014
Domed, opening frame, triple-skin	600 x 600	SB 1200

10 Watertightness

10.1 When installed in accordance with the Certificate holder's instructions and sections 18 and 19 of this Certificate, the rooflights and kerbs will provide adequate resistance to the ingress of moisture.

10.2 Particular attention must be paid to the correct fitting of all components and to the detailing of sealants and roofing materials.

10.3 The installation of vents(1) will affect the air permeability performance. The type of vent specified and its location should take into account the prevailing weather conditions (for example, in locations where driving snow is likely).

(1) Outside the scope of this Certificate.

11 Behaviour in relation to fire

11.1 When classified in accordance with BS EN 13501-1 : 2002 the polycarbonate material (2 and 3 mm thick) achieved a European Class B- s1, d0 classification.

11.2 In England, Wales and Northern Ireland, the polycarbonate sheets can be regarded as having a $B_{ROOF}(t4)$ classification in accordance with the relevant regulatory guidance and should not be used within 1500 mm of a boundary with a compartment wall.

11.3 In Scotland, the rooflights' external glazing is classified as 'low vulnerability'.

11.4 The rooflights' internal glazing (3 mm) is classified as TP(a) rigid material. For the purposes of classifying the performance of ceiling linings, the frame and kerb need not be considered.

11.5 The rooflights may therefore be used, in accordance with the documents supporting the national Building Regulations, as follows:

England, Wales and Northern Ireland – the products may not be used over a protected stairway.

Scotland – the products are unrestricted.

11.6 The external rating of the kerb will depend on the performance of the roof waterproofing system covering it. The performance of individual roof waterproofing systems is outside the scope of this Certificate.

12 Safety

12.1 Opening rooflights feature manual worm gear that can be operated from ground level, allowing the rooflight to be opened for ventilation.

12.2 Under no circumstances should anyone venture onto a polycarbonate rooflight. The external surfaces of opening rooflights cannot be cleaned from the inside of the building. For maintenance and cleaning purposes special precautions must be taken, such as the provision of a catwalk, to allow safe access and to prevent the possibility of falling through the polycarbonate rooflight.

12.3 If the rooflight is located on a roof which is generally accessible to the public, provision must be made to prevent people falling onto the glazed part (eg guard rails). However, if, as a result of an accidental fall, contact is made with the glazing, the polycarbonate material shows good resistance to impact (see section 9.6 of this Certificate).

13 Ventilation

Opening rooflights can contribute to providing purge (natural) ventilation. This contribution will depend on the daylight area of the rooflight (see Table 1), the accessibility of worm gear and the floor area of the ventilated space.

14 Unauthorised access

14.1 The rooflights are suitable for use:

England and Wales and Northern Ireland – other than as easily accessible rooflights in new domestic buildings
Scotland – other than as easily accessible rooflights in new and existing domestic buildings.

14.2 The rooflights are supplied with one-way fixings to make removal of the rooflight from the kerb more difficult (see Figure 3). The rooflights can be fitted with the grid described in section 1.9 of this Certificate.

14.3 The rooflights have a good resistance to impact, making breakage very difficult.

15 Maintenance

15.1 If damage occurs, the rooflights can be re-glazed and the fixings replaced, but these operations should be carried out using the materials recommended by the Certificate holder and covered by this Certificate.

15.2 Cleaning of the rooflights must be carried out using water containing non-abrasive, neutral household detergent. To avoid scratching the surface, only soft cloths should be used when cleaning.

15.3 If damage occurs, the peel-head rivets used to attach the hinges and the worm gear cannot be replaced.

16 Durability

16.1 The polycarbonate material and the other components will have a service life of at least 25 and 20 years respectively in non-corrosive environments.

16.2 Under normal conditions, the polyester-powder coating will have an anticipated decorative life of at least 15 years in heavily polluted areas and at least 20 years in other areas.

16.3 After natural weathering, some slight change in colour of the polycarbonate will occur. However, the change will be even across the sheet and will not significantly decrease properties, although light transmittance and haze may be slightly affected.

16.4 Fittings, as described in this Certificate, may need to be replaced within the life of the rooflights, particularly when exposed to aggressive environments, such as coastal or industrial locations.

17 Reuse and recyclability

The products comprise aluminium or galvanised steel and polycarbonate, each of which can be recycled.

Installation

18 General

18.1 Installation of the rooflights and kerbs must be carried out in accordance with the Certificate holder's instructions.

18.2 The rooflight kerb should be checked dimensionally to ensure the fit, and the rooflight should be checked for size before the unit is lifted to the roof.

18.3 A rooflight should never be left in position without ensuring all its fixings are present and fully tightened.

18.4 Fixings for securing the kerbs or kerb adaptors onto the roof structure must be selected so as to be structurally adequate and suitably corrosion resistant. These fixings are not supplied by the Certificate holder and are outside the scope of this Certificate.

18.5 Where the roof covering is dressed below the rooflight and on top of an existing kerb, precautions should be taken to prevent bitumen or other agents damaging internal surfaces.

18.6 All packaging is removed, apart from the packaging protecting the glazing.

19 Procedure

Fixing X3 Kerb to roofs

19.1 Silicone sealant is applied around the roof opening and the kerb is placed on the roof deck and screwed to the roof at a maximum distance of 50 mm from corners and at approximately 450 mm centres, using appropriate corrosion-resistant fixings(1). Insulation is fitted to the roof, an angle fillet(2) is placed on top of the insulation against the kerb and the roof covering is then dressed to the external face of the top flange of the kerb.

(1) Details of appropriate fixings are available from the Certificate holder and are outside the scope of this Certificate.
(2) Outside the scope of this Certificate.

Fixing X3 opening frame to the X3 Kerb

19.2 The opening frame is placed on top of the kerb and the stainless steel hinges are fixed to the opening frame and kerb.

Fixing the glazing to the X3 kerb or opening frame

19.3 The polycarbonate glazing is placed on the kerb or opening frame. The TPE grommets are inserted in the holes of the polycarbonate glazing; the one-way screws are inserted through the white base piece, through the polycarbonate, and the nut is attached (see Figure 3). The screws are tightened and the cap clicked into place. Alternatively, if the Bauder Security frame is fitted to the polycarbonate rooflight, the assembly is pressed evenly around the perimeter and clicked into place. Insulation is fitted to the roof, an angle fillet(1) (except for circular rooflights) is placed on top of the insulation against the kerb and the roof covering is then dressed to the external face of the top flange of the kerb.

(1) Outside the scope of this Certificate.

Technical Investigations

20 Tests

Tests were carried out to determine:

- watertightness
- resistance to upward load
- resistance to downward load
- resistance to snow load
- resistance to impact load: small, hard body impact
- resistance to impact load: large, soft body impact
- basic security
- suitability of materials.

21 Investigations

21.1 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

21.2 Thermal performance and temperature factors of glazed rooflights were assessed using thermal simulation.

21.3 An examination was made of existing data in relation to:

- performance in fire
- luminous transmittance.

Bibliography

BS 1052 : 1980 *Specification for mild steel wire for general engineering purposes*

BS EN 410 : 1998 *Glass in building — Determination of Luminous and Solar Characteristics of Glazing*

BS EN 1873 : 2014 *Prefabricated accessories for roofing — Individual roof lights of plastics — Specification and test methods*
BS EN 1873 : 2014 + A1 : 2016 *Prefabricated accessories for roofing — Individual roof lights of plastics — Specification and test methods*

BS EN 1991-1-3 : 2003 + A1 : 2015 *Eurocode 1 : Actions on structures — General actions — Snow loads*
NA to BS EN 1991-1-3 : 2003 UK National Annex to *Eurocode 1 : Actions on structures — General actions — Snow loads*
BS EN 1991-1-4 : 2005 + A1 : 2010 *Eurocode 1 : Actions on structures — General actions — Wind actions*
NA to BS EN 1991-1-4 : 2005 UK National Annex to *Eurocode 1 : Actions on structures — General actions — Wind actions*

BS EN 13501-1 : 2007 + A1 :2009 *Fire Classification of construction products and building elements — Classification using test data from reaction to fire tests*

BS EN ISO 1461 : 2009 *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

BS EN ISO 10211 : 2007 *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*

BS EN ISO 12567-2 : 2005 *Thermal performance of windows and doors construction – Determination of thermal transmittance by hot box method – Construction – Roof windows and other projecting windows*

BS EN ISO 13468-1 : 1997 *Plastics — Determination of the total luminous transmittance of transparent materials — Single-beam instrument*

BS EN ISO 13788 : 2012 *Hygrothermal performance of building components and building elements — Internal surface temperature to avoid critical surface humidity and interstitial condensation — Calculation methods*

BRE Information Paper IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings*

BRE Report 443 : 2006 *Conventions for U-value calculations*

NARM Technical Document NTD 2 (2014) (amended 2017) *Assessment of thermal performance of out-of-plane rooflights*

22 Conditions

22.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

22.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

22.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

22.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

22.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

22.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.