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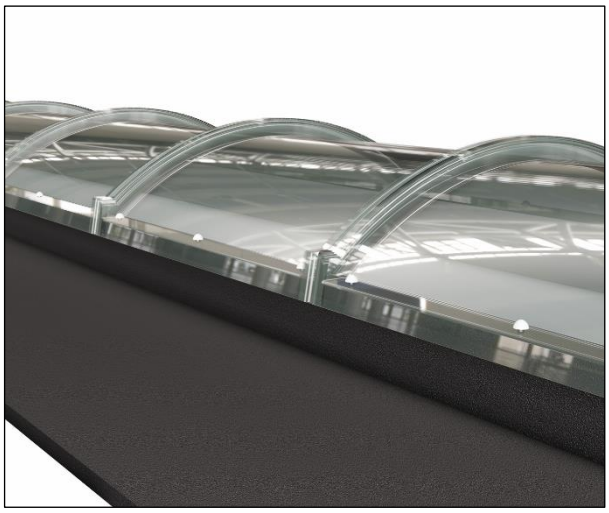
Agrément Certificate
05/4279
Product Sheet 3

BAUDER ROOFLIGHTS AND KERBS

BAUDER FIXED CONTINUOUS BARREL VAULT ROOFLIGHTS AND KERBS

This Agrément Certificate Product Sheet(1) relates to Bauder Fixed Continuous Barrel Vault Rooflights and Kerbs, for use on flat roofs of new and existing buildings, to provide natural light.

(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 3.0 m by 1.2 m roof opening, triple-skin rooflights can achieve U values between 1.6 $W \cdot m^{-2} \cdot K^{-1}$ and 1.9 $W \cdot m^{-2} \cdot K^{-1}$ 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).
Unauthorised access — rooflights from within the range can contribute to preventing unauthorised access (see section 13).
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 15).

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.

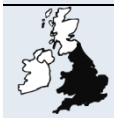
On behalf of the British Board of Agrément

Date of First issue: 28 May 2020

Hardy Giesler
Chief Executive Officer

Regulations

In the opinion of the BBA, Bauder Fixed Continuous Barrel Vault Rooflights and Kerbs, if installed, used and maintained in accordance with this Certificate, will 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 product 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 and the product selected. See section 8.2 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: **K5.4** **Safe access for cleaning windows etc (applicable to England only)**
Comment: Provisions must be made regarding the safe cleaning of rooflights. See section 12.1 of this Certificate.

Requirement: **L1(a)(i)** **Conservation of fuel and power**
Comment: The products can contribute to satisfying this Requirement although compensating measures may be required. See sections 6.1, 7.3 and 7.4 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 12.1 of this Certificate.

Regulation: **7(1)** **Materials and workmanship**
Comment: The products are acceptable when used in accordance with this Certificate. See section 15.1 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 and 7.4 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 14 and 15.1 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:	3.15	Condensation
Comment:		The risk of surface condensation will depend on the humidity class of the building, with reference to clauses 3.15.1[(1)] and 3.15.4[(1)]. 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 12.1 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 and 7.4 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 and 7.4 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 and 7.4 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 15.1 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 measures may be required. See sections 6.1, 7.3 and 7.4 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 and 7.4 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 12.1 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 Fixed Continuous Barrel Vault 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 products are available with PVC-U kerbs (X2 and X2V, which sit at 45° and 90° to the roof structure respectively) or metal kerbs (X3, thermally broken aluminium or galvanized steel).

1.3 The rooflights are triple-skin, fixed units and are available in clear (smooth and stipple), bronze and opal finishes, and are fixed onto a kerb (see Figures 1 and 2).

1.4 The glazing is available in a curved dome with interlocking sections of one metre maximum (nominal) width to form continuous runs, with thermoformed jointing pieces (see Table 1). Domed ends vary to allow for non-modular lengths. Kerb adaptors(1) are available from the Certificate holder for non-standard roof openings, in order to provide a suitable fit onto the prepared builder's kerb(1).

(1) Outside the scope of this Certificate.

1.5 The products are available in the sizes listed in Table 1 and shown in Figures 1 and 2.

Figure 1 X2 kerb components

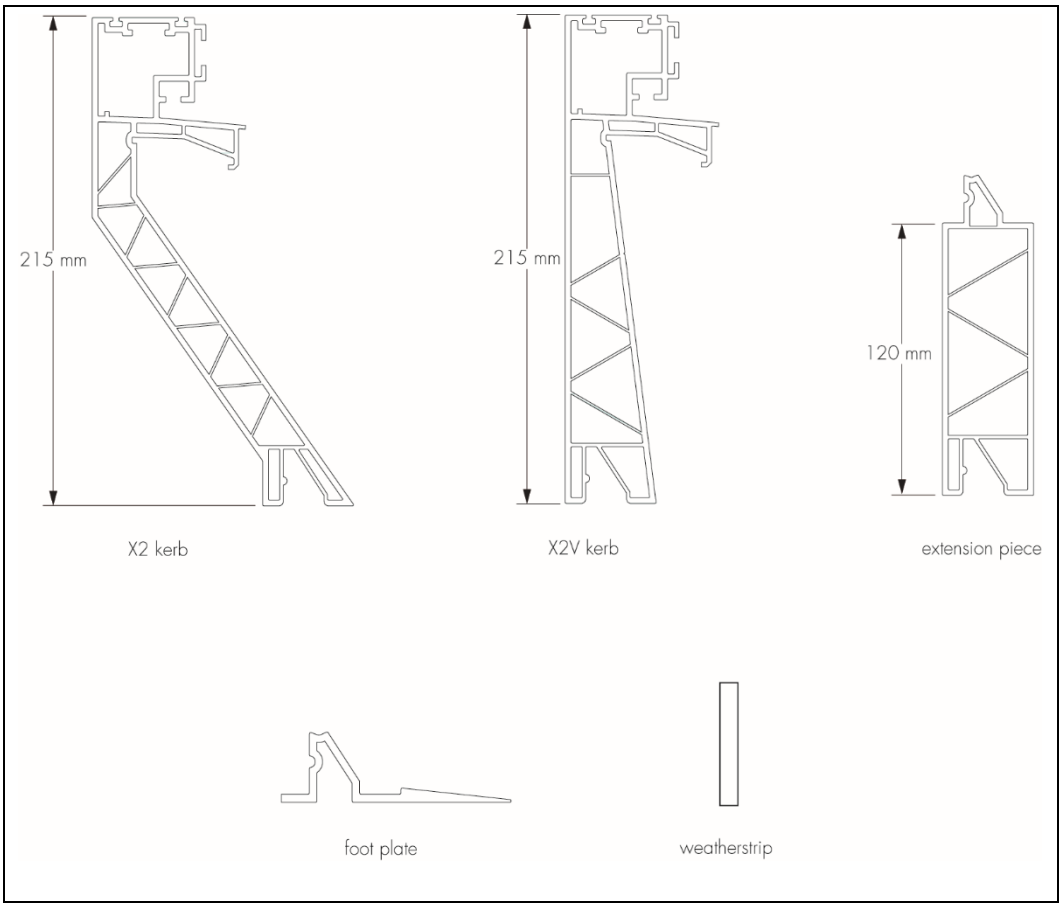
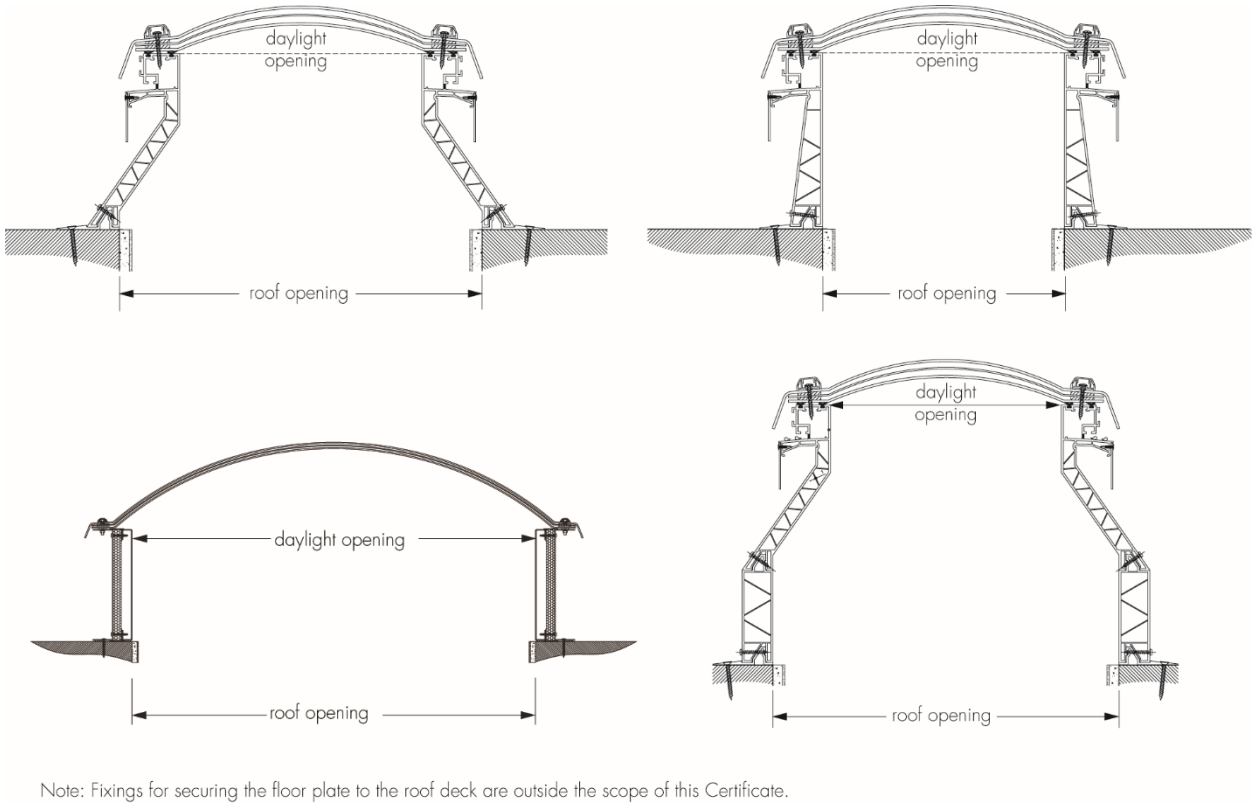


Figure 2 Cross sections of Bauder Continuous Barrel Vault Rooflights and Kerbs



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

Table 1 Sizes of Barrel Vault Rooflights

Size[1] (mm)				
X2 kerb with or without extension piece			X2V kerb with or without extension piece X3 kerb	
Roof opening width (mm)	**Daylight opening width (mm)**	**Internal rise (mm)**	**Daylight/ roof opening width (mm**	**Internal rise (mm)**
600	450	99	600	132
750	600	132	750	165
900	750	165	900	198
1050	900	198	1050	231
1200	1050	231	1200	264
1350	1200	264	1350	297
1500	1350	297	1500	330
1800	1650	363	1800	396
2000	1850	407	2000	440
2100	1950	429	2100	462
2250	2100	462	2250	495
2400	2250	495	2400	528

(1) Length as required in 1 m sections.

1.6 Other sizes within these size ranges can also be fabricated on request.

1.7 The X2 and X2V PVC-U kerbs, extension pieces and foot plates are manufactured from rigid, white unplasticised polyvinyl chloride (PVC-U) profiles. The kerbs are 215 mm high and may be unvented or can incorporate vents(1). Where a taller kerb is required, an extension piece can be fitted by clipping it into the kerb and securing it to the kerb using zinc-coated carbon steel screws (Phillips 4.3 x 31 mm or 25 mm). The foot plate is clipped into the kerb or the extension piece and secured using zinc-coated carbon steel screws (Phillips 4.3 x 31 mm). The decorative weather strip(1) is fixed to the kerb using stainless steel screws (4.2 x 16 mm). Holes for fixing kerbs onto the roof structure are drilled on site.

(1) Outside the scope of this Certificate.

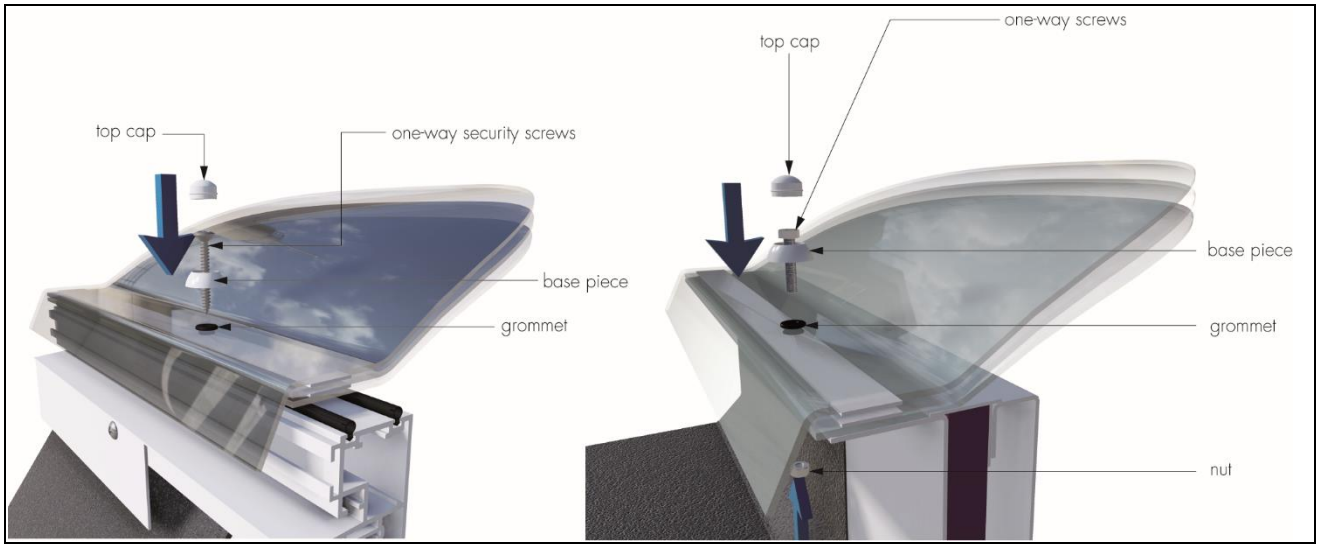
1.8 The X3 Kerbs are 175 to 350 mm high and are fabricated from thermally broken (partial fill insulation, 20 mm wide) polyester-powder-coated aluminium or galvanized steel and are available in a white finish. Holes for fixing kerbs onto the roof structure are drilled on site.

1.9 The Bauder kerbs are joined together as described in sections 18.1 to 18.3 and Figure 3 of this Certificate.

Figure 3 Joining Bauder kerbs

1.10 The rooflight glazing (supplied with 8 mm pre-drilled holes) is fixed on the kerbs (supplied with corresponding pre-drilled pilot holes of 3 mm diameter), using the Bauder screw system (see Figure 4), ensuring that the swarf is removed from the kerb/opening frame after drilling. Fixings are pre-mounted in the factory. TPE gaskets rolled-in the PVC-U kerbs provide an inner seal between the kerb and the rooflight.

Figure 4 Bauder screw system



1.11 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 and is fixed to the roofing deck at 300 mm centres.

2 Manufacture

2.1 Polycarbonate sheets are thermoformed to the appropriate size. PVC-U kerbs are fabricated from white PVC-U profiles produced by conventional extrusion techniques, which are cut and welded together. 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. Assembly of the triple-skin polycarbonate rooflights is carried out using a double-sided adhesive PVC strip and features a polycarbonate spacer between skins.

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 Rooflights and kerbs are supplied to site separately. 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 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 Fixed Continuous Barrel Vault Rooflights and Kerbs.

Design Considerations

4 General

4.1 Bauder Fixed Continuous Barrel Vault Rooflights and Kerbs are suitable for use on flat roofs of new and existing buildings (see section 13.1), to provide natural light. New roofs should be designed in accordance with the relevant national Building Regulations.

4.2 The products are suitable for use on 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 as replacements for 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 rooflight U values at standard daylight opening sizes to BS EN 1873 : 2014 + A1 : 2016

Kerb reference	Barrel vault	
	Daylight opening size 1.2 m by 3.0 m	
	U_{rc}-value ($Wm^{-2}\cdot K^{-1}$)	A_{rc} (m^2)
X2 with extension	1.9	6.97
X2 without extension	1.8	5.95
X2V with extension	1.8	7.73
X2V without extension	1.7	7.42
X3 175 mm galvanized steel	1.6	6.54
X3 175 mm aluminium	1.6	6.54

Table 4 Complete triple-skin fixed rooflight U values at standard daylight opening sizes to NARM NTD 2 : 2014 (amended 2017)

Kerb reference	Barrel vault	
	Daylight opening size 1.2 m by 3.0 m	
	U_d roof/kerb ($Wm^{-2}·K^{-1}$)	AD_{Tot} (m^2)
X2 with extension	2.3	5.82
X2 without extension	1.9	5.83
X2V with extension	2.1	6.54
X2V without extension	1.8	7.29
X3 175 mm galvanized steel	1.6	6.35
X3 175 mm aluminium	1.6	6.35

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 (7).

Table 5 Rooflight kerb parameters

Rooflight type	$X_{kerb,u}$ (m)	$X_{kerb,l}$ (m)	e_{kerb} (m)	$e_{e,v}$ (m)	$e_{e,h}$ (m)	$U_{kerb,e}$ ($Wm^{-2}·K^{-1}$)	Ψ_t ($Wm^{-2}·K^{-1}$)
X2 with extension, fixed	-0.025	0.040	0.338	0.026	0.050	2.015	0.015
X2 without extension, fixed	-0.020	0.040	0.218	0.026	0.050	2.005	0.009
X2V with extension, fixed	0.050	0.040	0.338	0.026	0.050	1.824	0.009
X2V without extension, fixed	0.050	0.040	0.218	0.026	0.050	1.728	0.009
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

Table 6 Rooflight glazing thermal transmittance

Glazing option	U_t ($W·m^{-2}·K^{-1}$)
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 $Wm^{-2}·K^{-1}$

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

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

(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

Barrel vaults:

(4)

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

(5)

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

(6)

$$P_{kerb,l} = 2(L_A + 4x_{kerb,l} + L_B)$$

(7)

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

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)

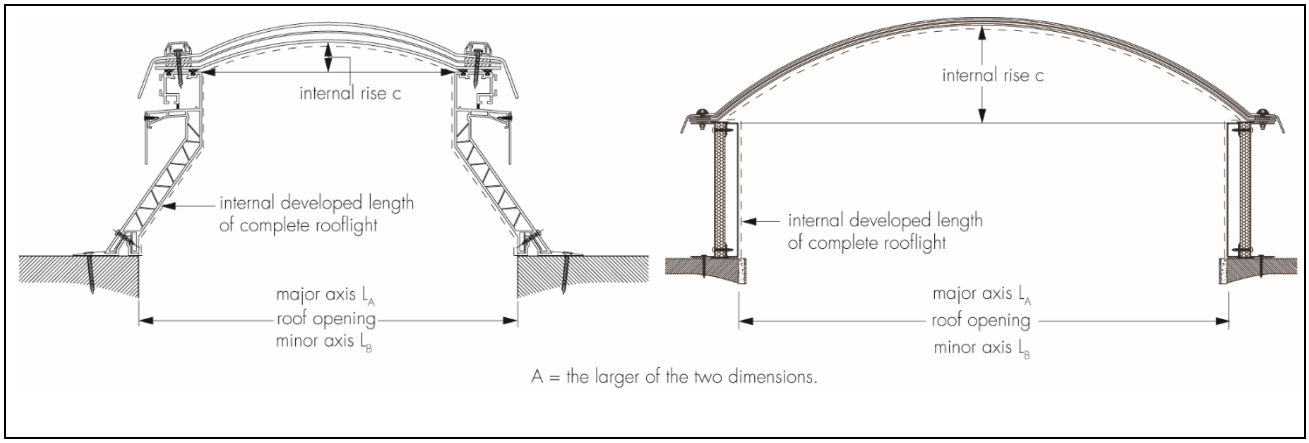
p is a constant = 1.6075

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 sections



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.

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}
With X2 kerb	0.57
With X2V kerb	0.57
With X3 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, air gap 15 mm each.

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 1991-4 : 2005 and its UK National Annex.

9.2 When tested under laboratory conditions, the rooflights can withstand 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 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 kerbs and the roof must be determined by a suitably qualified 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 domed rooflights are more resistant to imposed loads, whilst large, domed rooflights are the least resistant. The results of tests for selected individual rooflights 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) ($N \cdot m^{-2}$)
X2 kerb, dome, opening frame, triple-skin	1200 x 2400	750(1)	1500(2)(3)
X3 kerb, dome, fixed, triple-skin with Bauder Security frame	1200 x 2400	750(1)	1500(2)

(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.
(3) During the test, the opening corners were bent upwards by the internal pressure and the weatherseal had to be heavily taped up to maintain the pressure.

9.6 The products have adequate resistance to soft body impacts, such as a person accidentally falling against them. When tested to BS EN 1873 : 2014, an individual rooflight achieves the result 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 17 and 18 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 : 2007 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 Under no circumstances should anyone venture onto a polycarbonate rooflight. 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.

12.2 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 Unauthorised access

13.1 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.

13.2 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 1.11 of this Certificate.

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

14 Maintenance

14.1 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.

14.2 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 Durability

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

15.2 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.

15.3 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 haze may be slightly affected.

15.4 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.

16 Reuse and recyclability

The products comprise PVC-U, aluminium or galvanized steel and polycarbonate, each of which can be recycled.

Installation

17 General

17.1 Installation of the products should be carried out in accordance with the Certificate holder's installation instructions.

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

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

17.4 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.

17.5 Individual barrel vault units are dry joined together, as shown in Figure 6.

17.6 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.

17.7 All packaging is removed apart from the packaging protecting the glazing.

18 Procedure

18.1 The kerb sections are laid out over the opening to ensure correct positioning.

Joining X2 and X2V kerbs

18.2 Three aluminium strips (each 6 mm thick and 400 mm long) are pre-inserted and riveted (rivets 4.8 by 20 mm) in the factory into the end of the first kerb.

18.3 During installation, the second kerb is slid over the strips, ensuring a tight fit. The backing of the double-sided tape, attached to the profiled interior strip, is removed and the strip is adhered to the inside of the kerb, and lapped over the joint of the kerbs (see Figure 3).

Joining X3 kerbs

18.4 Depending on the material specification of the kerb, aluminium or galvanized steel plates (100 mm wide by the height of the kerb, less 5 mm) are welded to the internal and external faces of the kerb, overlapping the kerb by 50 mm. Holes (5 mm) are factory pre-drilled, 25 mm from the joint and 25 mm from the top and bottom. The two kerbs are slid together, ensuring that the external lapper plate remains outside the assembly and the inner lapper plate slides between the internal face and the insulation. Two 5 mm holes are drilled through the internal face of the kerb, 25 mm from the joint and 25 mm from the top and bottom. Holes are drilled through the pre-drilled external lapper plate into the kerb. The kerb sections are secured with rivets (4.8 mm x 20 mm, supplied by the Certificate holder) internally and externally (see Figure 3).

Fixing Bauder Continuous Barrel Vault Kerb to roofs

18 5 The position of the assembly is adjusted so that it sits evenly over the roof opening and its position is marked on the roof deck before removing.

18.6 Silicone sealant is applied around the roof opening, and the kerb sections are placed on the roof deck. Temporary bracing rods at approximately 2 m centres are recommended when kerbs exceed 3 m lengths. These are removed when fixing the rooflights.

18.7 The assembled kerb is then screwed to the roof at a maximum distance of 50 mm from corners and at approximately 300 mm centres, using appropriate corrosion-resistant fixings(1). The weather strip is unscrewed from the PVC-U kerbs and the roof covering is dressed to the external face up to the top flange of the kerb, and the weather strip is screwed back onto the kerb.

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

Fixing Bauder polycarbonate glazing to the Bauder Continuous Barrel Vault Kerb

18.8 Temporary spacer bars are placed over the X2 and X2V kerbs, approximately 100 mm from the edge of the polycarbonate panel being installed, to provide stability to the kerb whilst fitting the skins.

18.9 The triple-skin polycarbonate sections are loosely laid over the kerb, without fixing, to ensure fit.

18.10 The polycarbonate sections are removed, except for the first section (the shaped end of which is pre-fitted with black foam).

18.11 When installing onto X2 and X2V kerbs, the transportation bolts are removed from the assembly (leaving the grommets in place), and the polycarbonate units are temporarily fixed to the kerb through two holes only (one each side), using standard Phillips head screws (not provided, and outside the scope of this Certificate). The central sections are temporarily fixed, one at a time, using standard Phillips head screws into two holes of each barrel section (one screw each side — not provided and outside the scope of this Certificate), ensuring that the transportation bolts and temporary spacer bars are removed as installation is progressing along the length of the rooflight.

18.12 When installing onto X3 kerbs, the transportation bolts and grommets are removed from the assembly, and holes (6 mm) are drilled through the metal flange. The grommets are replaced and the polycarbonate units are temporarily fixed to the kerb through two holes only (one each side), using the M5 bolts and nuts (not using the base piece). The bolts are hand tightened. The central sections are temporarily fixed, one at a time, using the M5 bolts and nuts provided, into two holes of each barrel section (one each side), ensuring that the transportation bolts and temporary spacer bars are removed as installation is progressing along the length of the rooflight. Grommets must be removed before drilling and replaced afterwards.

18.13 All the temporary spacer bars are removed, and the final end polycarbonate unit is secured using the same technique.

For X2 and X2V kerbs

18.14 The polycarbonate units are fixed down through all remaining holes (through the black grommets) to the X2 and X2V kerbs using the one-way screws, base pieces and caps. The standard Phillips head screws are then removed and the installation is completed using the one-way screws, base pieces and caps provided (see Figure 6).

For X3 kerbs

18.15 The polycarbonate units are fixed down through all remaining holes (through the black grommets) to the X3 kerb using the M5 bolts, base piece, top cap and nuts. The hand tight fixings are removed and the installation is completed using the M5 bolts, base pieces, caps and nuts provided (see Figure 6).

Figure 6 Typical installation details

19 Tests

Tests were carried out to determine:

- effect of snow loads
- effect of impact
- suitability of materials.

20 Investigations

20.1 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.

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

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

- 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
- performance in fire
- luminous transmittance
- suitability of materials.

Bibliography

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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*

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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*

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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*

21 Conditions

21.1 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.

21.2 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.

21.3 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.

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

21.5 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.

21.6 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.