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THE ROOFLIGHT  
ASSOCIATION

# A GUIDE TO ROOFLIGHTS FOR PROFILED SHEETED ROOFS



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# 1 SCOPE

This The Rooflight Association Technical Document provides details and guidance on the use of all forms of rooflights with profiled roofing systems. This includes profiled roofs made from metal and fibre cement, single skin, built up and composite panel roofs, including secret fix and standing seam roofs. It also includes both in-plane and out-of-plane rooflights (including barrel vaults and modular domes), and covers both specification and installation recommendations.

The contents are consistent with guidance within BS5427 “Code of practice for the use of profiled sheet for roof and wall cladding on buildings”.

This Guide should be read in conjunction with BS5427, and other The Rooflight Association Technical documents which can be downloaded free-of-charge from the The Rooflight Association website at <http://www.rooflightassociation.org.uk/downloads/guidance/>

# 2 INTRODUCTION

The members of The Rooflight Association offer a complete cross section of rooflight types, including modular domes, pyramids and flat glass rooflights; in-plane profiled rooflights; continuous barrel vaults, panel glazing systems and architectural glazing systems for skylights, lantern lights and atria.

Rooflights can help to provide natural light with qualities appropriate to the use of the building. The Rooflight Association members can provide a knowledge base second to none on matters relating to the provision of high quality natural daylight into all types of buildings.

For those of us living in temperate Northern climates, the beneficial effect of sunlight is easy to recognise; a couple of sunny days seem to lift everyone’s spirits. There is a growing body of evidence to suggest that buildings enjoying high levels of natural light are literally more successful than those more reliant on artificial light. In all environments the eye and brain functions respond better to natural light, so people perform better, while passive solar gain can reduce energy costs.

Rooflights can provide three times more daylight than the same area of vertical glazing as they may be distributed over the whole building space with no obstacles to light transmission. They can also provide a much more even distribution of light, particularly in larger structures. Where vertical glazing exists, the effective area for natural lighting will only be within 6m of the wall containing the window. These facts are well understood by most people involved in building design. However, the huge potential of rooflights to provide exactly the amount, type and distribution of natural light required, meeting any given specification, is not always appreciated.

Daylight design will be influenced by the building size and its usage. For smaller buildings vertical glazing will generally be adequate but only for areas within 6m of a window. For larger buildings, rooflighting or a combination of both roof and wall glazing will be needed.

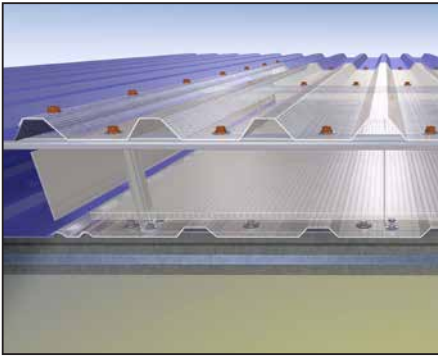
At the design stage the rooflight specification and area within the roof will have been selected and calculated to provide the optimum levels of daylight required for the building type, along with the thermal transmission, solar transmission and the fire resistance to provide compliance with Building Regulations. In addition, the appropriate level of non-fragility to satisfy the requirements of the HSE CDM Regulations and the potential frequency of roof access should have been selected. It is therefore essential that the rooflight specification is not changed for cost reasons for example, as any of the factors referred to above could be compromised. In the worst case non-fragility or fire resistance may be adversely affected.

The use of rooflights manufactured by a The Rooflight Association member will ensure that the intended specification and performance is achieved.



# 3 ROOF TYPES, ROOFLIGHT TYPES & ROOFLIGHT MATERIALS

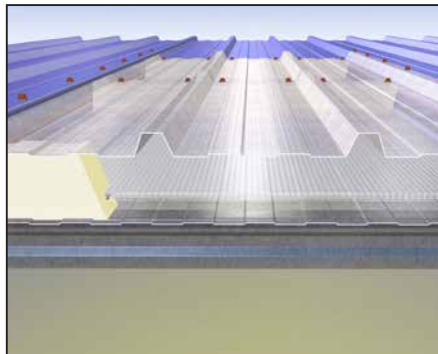
## 3.1 Roof Types



### ***Built-up and single-skin profiled metal roofs***

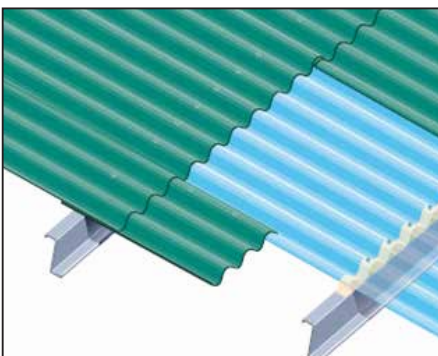
Built-up (site assembled) roof systems are normally comprised of a profiled steel or aluminium liner sheet, spacer system, quilt insulation layer and a profiled steel or aluminium outer sheet that are assembled by the roofing contractor. Single skin systems are also available when Building Regulations allow the use of uninsulated roofs. There are through fixed systems that are secured to the roof support structure with purpose made self-drilling fasteners; secret fix systems that have outer sheets with no exposed main fasteners and which are locked onto clips that are fixed to the support structure; and standing seam systems that have their outer sheets mounted and seamed together tightly onto special halter upstands and that also have

no exposed fasteners. Built-up profiled metal roof systems may be used on pitched roofs, curved barrel roofs and some systems may be used for waveform roof designs.



### ***Composite panel roofs***

Composite panels consist of a profiled metal outer sheet and liner that are bonded on either side of a solid insulation core that allows installation by the roofing contractor as a single unit. There are through fixed systems that are installed using purpose made self-drilling fasteners and secret fix and standing seam systems that have no exposed fasteners. Composite panels may be used on pitched roofs and large radius curved barrel roofs.



### ***Built-up and single-skin profiled fibre cement roofs***

Profiled fibre cement roof systems are available with a profiled metal or fibre cement liner, spacer system, quilt insulation and a profiled fibre cement outer sheet that are assembled by the roofing contractor. Single skin systems are also available when Building Regulations allow the use of uninsulated roofs. There are through fixed systems that are installed using purpose made self-drilling fasteners. Hookbolts or similar may also be used. Built-up profiled fibre cement systems are suitable for pitched roofs.

## 3.2 ROOFLIGHT TYPES

### In-plane rooflights



#### *In-plane site assembled rooflights*

Site assembled (built-up) rooflights are supplied as translucent sheet profiled to match both the weather sheet and liner panels, with a separate intermediate layer for thermal performance.

Sealing the rooflight and adjacent metal liner panels creates an effective vapour barrier, achieving very low air tightness levels, whilst contributing to the non-fragile performance of the liner panel assembly.

Ventilation which occurs throughout the main roof of built-up cladding systems can be used to ventilate the rooflight.

This is the best rooflight solution for a built-up roof, to minimise the risk of condensation in the surrounding roof. Site assembled rooflights should not generally be used with composite panel systems.

#### *In-plane Factory Assembled Insulating Rooflights (FAIRs)*

These are designed specifically for use with a composite panel roof system where they are the best solution. They are usually supplied as at least triple skin or better (or incorporating alternative insulation).

FAIRs should not generally be fitted with a built-up roof system as they cannot be effectively sealed against the adjacent liner, increasing risk of air-leakage and condensation in the surrounding roof.

There may be restrictions regarding how many may be side lapped together to form a run across a roof. This is due to potential minor width tolerance differences between the panels and rooflights that would create an accumulative difference the longer a run becomes.

For some roof systems with a profile difficult to match such as certain standing seam or secret fix systems (whether built up or composite), the rooflights have a simplified profile shape and are designed to be installed from the ridge down. This normally means that they will only end lap onto the roof cladding system, not the other way around.

## Barrel-vault rooflights



A number of proprietary barrel-vault systems are available. They are usually specified with Secret Fix Systems and for very low pitches. They can be used with single skin, built-up or composite roofs, with secret fix systems, curved roofs, flat roofs, along a ridge and in other low pitch applications.

They can be a feature element and also allow the inclusion of smoke and/or natural ventilation but are more expensive and require greater detailing to create apertures and upstands. In pitched roof applications, they should usually run from the ridge down, or will require a soaker detail. They can be supplied as triple skin units or better or as a single or double skin barrel over a separate liner to construct a triple skin assembly.

It is often preferable to use a separate rooflight liner in a built-up roof application to allow easy sealing of the rooflight and adjacent metal liner panels to improve condensation control, air-tightness, non-fragility and ventilation. Where an in-plane liner is not to be used, care must be taken to address these issues.

## Modular rooflights



Many proprietary individual modular rooflights (including polycarbonate domes and pyramids, and flat glass units) are available, and can be used in conjunction with profiled roofing systems. They should be fitted onto upstands: care is required to provide drainage around the upstand where these are formed mid-slope. Proprietary soaker units are available for use with through fix systems with end laps. At lower pitches (including standing seam systems) welded upstands or site fabricated upstands (for example in-situ GRP or PU weathering by specialist sub-contractor) should be used. Modular rooflights are available in fixed and opening formats; opening variants are typically for natural ventilation but can also include access hatches and smoke vent variants.

*NOTE: For kerb construction and detailing recommendations around the perimeter of modular and barrel-vault rooflights, please refer to NFRC guidelines and system manufacturer's recommendations.*

## 3.3 ROOFLIGHT MATERIALS

In-plane rooflights are typically manufactured from either GRP or polycarbonate. They are available in a range of thicknesses and grades to suit individual applications, but are almost always significantly thicker than surrounding metal sheets (and thinner than surrounding fibre cement sheets). Profile definition of extruded polycarbonate and thinner GRP sheet is usually very good; thicker GRP sheets are more rigid, compressing sealant more effectively, so can form a better seal with surrounding sheets even where increased thickness means the match with surrounding sheet is not as good.

### **Glass Reinforced Polyester (GRP)**

GRP is a thermosetting material which is converted from a liquid into the finished product in a single operation. Once formed it cannot be reformed by the application of heat as with thermoplastics. For rooflight applications, The Rooflight Association members that manufacture GRP rooflights use a pultrusion manufacturing process to produce profiled sheets or flat sheets that can be used for many different applications. In profiled form there are many hundreds of GRP rooflight types available.

In profiled sheeted roofs GRP is used for in-plane rooflights or out-of-plane continuous barrel vault rooflights. GRP is not normally used for other out-of-plane rooflight types such as domes due to manufacturing constraints.

GRP sheeting is manufactured with clear resins that incorporate UV inhibitors and UV absorbing film protection to exposed surfaces to prolong their useful service life and in natural translucent form provide high levels of light transmission in combination with good diffusion. Correctly installed GRP rooflights provide good, even light distribution throughout the interior building space. The addition of pigment during the manufacturing process allows any coloured tint to be available.

There are many variants of GRP rooflights available with a range of thicknesses and glass fibre reinforcement types to provide the non-fragility performance and durability required, with some variants matching or exceeding the impact and load resistance of the metal profiled sheeting that they are used with.

GRP is not affected by contact with any other materials commonly used in construction, but care should be taken when handling and installing GRP rooflights to ensure that the external surface protection layer is not damaged as this could lead to a reduction in service life and have an adverse affect on the non-fragility status of the rooflight.

As there is a vast range of GRP rooflights available it is extremely important to comply with the manufacturers' recommendations for handling, storage and installation of a specific type.



## Polycarbonate Material

Polycarbonate is a thermoplastic material, often extruded into flat sheets for use in glazing bar systems. It can be reformed (for example by vacuum forming) into 3-dimensional products (such as domes), curved for continuous barrel applications or extruded into a profiled sheet.

Polycarbonate can also be extruded into a multiwall structured sheet for use in similar applications to flat sheets, offering greater rigidity and thermal performance and reduced cost but with a different aesthetic effect.

In metal roofs polycarbonate is generally used either as a multi-wall profile in-plane rooflight profile, or an out-of-plane skylight dome or continuous barrel rooflight.

Polycarbonate is a naturally clear material offering high levels of light transmission with direct un-diffused light, and can also be manufactured with an opal tint or other additives designed to diffuse light or reduce solar heat gain with reduced levels of light transmission. In some applications polycarbonate is also available with a textured inner surface, which can offer diffusion with high levels of light transmission.

Good-quality polycarbonate is supplied with an integrated UV-absorbing surface layer of co-extruded UV protective material. Polycarbonate with integral UV absorbing protective surfaces will both retain light transmission and resist discolouration well when handled and installed correctly, however the UV protection is required to maintain its basic structural properties. Therefore, while polycarbonate boasts exceptional impact strength and generally provides good non-fragility it can be vulnerable to premature failure if there is any rough or incorrect handling which damages its UV protection, such as seemingly minor scratches that could penetrate the UV co-extruded layer.

Additionally, a number of common chemicals such as plasticisers attack polycarbonate. Direct contact with either plastisol-coated profiled metal or PVC tape can result in rapid degradation and must be avoided, typically by using manufacturers' installation details. Polycarbonate is hygroscopic meaning it naturally absorbs small amounts of moisture, and has a high rate of linear thermal expansion; therefore, it is essential to follow manufacturers' installation and application recommendations to ensure problem free use.

# 4 NON-FRAGILITY AND DURABILITY

## 4.1 Non-Fragility

The Health and Safety Executive (HSE) clearly state that those persons responsible for the design of a roof structure should consider carefully the potential to eliminate or reduce the hazard of using materials which are of a fragile nature.

The Advisory Committee for Roofwork (now Advisory Committee for Roofsafety - ACR), founded by HSE in conjunction with a number of roofing Trade Associations in the 1990's, developed a test which defines non-fragility classifications, ACR[M]001, and roof systems including rooflights should now be tested and classified non-fragile to this standard.

All rooflight manufacturers in the UK now make rooflights which can be classified as non-fragile when new and correctly installed. Non-fragility is a function of an installed assembly, and it is vital that a rooflight manufacturer's installation recommendations are followed correctly: use of incorrect details or deviations from installation instructions can result in a fragile assembly with potentially fatal consequences. Factors such as purlin centres, and number of spans can also affect performance, as well as details such as number, position and type of fasteners, the use of appropriate edge sealants, and the thickness (or weight) of rooflights.

A non-fragile rooflight is not designed to be walked on. It is designed to save lives by preventing people or objects falling through it accidentally when accessing roof areas not designed for regular foot traffic. However, a person or other object falling onto a non-fragile rooflight may cause damage to the rooflight, resulting in it becoming fragile.

Most rooflights should be designed to be non-fragile, with the non-fragility classification matching that of the surrounding roof.

Non-fragility is not a characteristic of any individual component, so cannot be guaranteed by the supplier of any component. Instead, it is a measure of performance of an entire roof assembly. Each component of the assembly has its own bearing on the final non-fragility status, including the number of fasteners, the angle the fasteners have been driven into the purlins and their placement into the purlins. The final assembly is not within the control of the rooflight manufacturer and therefore not in its gift to provide non-fragility guarantees (see The Rooflight Association NTD08 for further details).

Whilst rooflight manufacturers and component suppliers cannot guarantee non-fragility in the long term, they can provide guidance on specifications necessary in order to reasonably expect non-fragility to be maintained for 25 years. Systems suppliers should be consulted separately.

At some point in its existence, any roof assembly, whether or not it includes rooflights, will become fragile. Therefore, any existing roof and/or rooflights should always be treated as if it were fragile unless there is clear documented evidence to the contrary.

The Rooflight Association Technical Document NTD08 *Guidance on non-fragility for specifiers of in plane rooflights* provides further guidance for specifiers of in-plane rooflights, and The Rooflight Association Technical Document NTD03 *Application of ACR[M]001 'Test for Non-Fragility of Profiled Sheeting Roofing Assemblies' to GRP Profiled Rooflight Sheeting* provides guidance on specification of GRP rooflights which can be expected to remain non-fragile in the long term.

For further information refer to HSG 33 *Health and Safety in Roofwork*, *ACR(M)001 Test for the Non -Fragility of Large Element Roofing Assemblies*, *ACR (CP)001 Recommended Practice for Work on Profiled Sheeted Roofs' and ACR(CP)002 Guidance Note for Safe Working on Fragile Roofs or Roofs with Fragile Elements*.

## 4.2 Durability

GRP is inherently stable, inert and will provide excellent long term performance under most circumstances. Polycarbonate is a strong, high-performance material which will give good long-term performance when used in correct applications.

Both these plastic materials require protection from the effects of UV light to give their best aesthetic performance in the long term and function correctly as rooflights, however there is a significant difference between them when considering the need for UV protection for long term structural performance which must always be taken into consideration.

If unprotected, GRP will slowly yellow and the surface may slowly erode but the inherent strength of unprotected GRP is maintained in the long term. There are many very old GRP rooflights which have had no UV protection at all yet remain structurally sound, although now exhibiting significant discoloration and reduction in light transmission. On the other hand, polycarbonate requires UV protection not only to resist discoloration and maintain light transmission but also to maintain its basic structural properties. This makes it vulnerable to premature failure if there is any damage, for example through rough or incorrect handling, which compromises its UV protective layer. Polycarbonate can also be compromised by direct contact with a range of chemicals including plasticisers found in plastisol-coated profiled metal or PVC tape, and some common cleaning materials. Direct contact with these chemicals can result in rapid degradation of the polycarbonate sheet and must be avoided. Polycarbonate is also affected by its greater rate of thermal expansion, and should not be subjected to permanent stress, so it is vital that installation details accommodate thermal movement, for example by use of oversized fixing holes or as detailed in manufacturers' system details.

The expected service life of rooflights can be summarised as follows: -

Polycarbonate: Typically 15-20 years, but up to 25 years depending on application

GRP: Typically 25-30 years, but may be longer depending on application

For further information, refer to The Rooflight Association Technical Document NTD 09 *Rooflights: glass, polycarbonate or GRP?*.

## 5 LOAD RESISTANCE

The loads that rooflights will be subjected to during their service life should be considered when selecting the appropriate rooflight specification and application required to resist such loads. Rooflights are more flexible than the surrounding profiled roof sheeting and can deflect greater distances without failure. The loads that can affect rooflights are described below.

### Snow loads

Snow loads will vary depending upon the roof shape, size and the geographical location of the building that it is covering. The highest roof snow loads are usually in a valley between adjacent roofs or at the eaves or verge junction with a parapet wall. Snow loads on a roof will have been calculated at the design stage along with the location and specification of any rooflights to either avoid areas of high local loadings or to ensure that the rooflights can withstand the expected loads.

When subjected to snow loads in-plane rooflights should not deflect more than  $L/30$  where  $L$  = purlin span, and no greater than 50mm to prevent end lap seals from being adversely affected.

The snow load resistance of out of plane rooflights such as continuous barrel vaults or domes can be affected by their design, shape, any structural framing or any internal structural elements for example.

### Wind loads

Wind loads also vary depending upon roof shape, size and geographical location with some parts of the UK having far greater wind speeds than others. Wind suction can occur when wind passes over a roof and can be particularly high at the corners of buildings and around roof perimeters and the ridges. Wind loads can tear rooflights over their fasteners if the rooflights and their fixing method are not of the appropriate specification.

When designing for wind loads in-plane rooflights should not deflect more than  $L/30$  where  $L$  = purlin span, and no greater than 50mm to prevent fixing holes from becoming oval that could lead to sheet tear-over or localised cracking.

The wind load resistance of out of plane rooflights is subject to the same factors as for snow load resistance.

For detail see BS5427 (clause 5.4.4)

## Concentrated loads

Foot traffic on rooflights used in profiled sheeted roofs must always be avoided. Rooflights should always be designed and installed to be non-fragile to ACR[M]001 to minimise risk of injury to anyone accidentally walking or falling onto a rooflight – but non-fragile rooflights may be damaged by such loads, requiring replacement.

There are rooflight systems available which can withstand accidental foot traffic without damage – but any foot traffic may result in the rooflights surface protection being damaged which will cause premature degradation and reduce load resistance and is never recommended.

Building Regulations Approved Document A paragraph 4.1 includes a requirement that all materials used to cover the roof shall be capable of withstanding the concentrated imposed loads specified in BS EN 1991-1-1 *Eurocode 1: Actions on structures Part 1: General actions. Densities, self-weight, imposed loads for buildings* (which defines a concentrated load of 0.9kN), but explicitly states that rooflights (transparent covering materials) are excluded from this requirement but only provided that they are non-fragile.

## Impact loads



There is always the risk of trips and falls on profiled sheeted roofs. A falling person will generate an impact load on the area of roof where they land. Modern rooflight systems are designed to be impact resistant or non-fragile as defined by test to ACR[M]001, although they will often be damaged by large impacts and will require replacement. This is covered in Section 4: Non-fragility and durability.

Whatever the load type, rooflights will be specified at the building design stage to withstand or avoid the load. In addition to the rooflight specification, the way that they are

fixed, and the components used to fix them with will play a crucial part in their resistance to load. It is therefore extremely important that the manufacturers' recommendations are always followed.

For further information, refer to BS5427:2016+A1:2017 *Code of practice for the use of profiled sheet for roof and wall cladding on buildings*

## 6 ROOFLIGHT INSTALLATION

Correct installation is the key to success with rooflights. Non-fragility classification, weather-tightness, airtightness, structural performance and resistance to wind and snow loads, long term performance and warranties all depend on correct installation.

The need for safe roof access should always be considered when determining rooflight layout to avoid risk of accidental foot traffic damaging rooflights. For example, close proximity of rooflights to access hatches and safety lines or to any areas where regular access is required (for example to PV panels for cleaning) should be avoided.

Roof ancillaries and services (for example lightning conductors or cables from PV panels, cable trays or any pipework) should not be in direct contact with, or supported by, rooflights.

Manufacturers and suppliers should provide detailed installation details; these may vary from system to system and from manufacturer to manufacturer, and it is crucial that the correct installation instructions from the rooflight supplier must be identified and ALWAYS followed in detail.

Installation details for out-of-plane rooflights vary significantly from rooflight to rooflight: no generic advice is possible.

### 6.1 INSTALLATION OF IN-PLANE ROOFLIGHTS

Generic advice for installation of in-plane rooflights is included within BS5427 and below, but manufacturers recommendations should always take precedence. Particular attention should be paid to the following details:

#### *Main Fixing*

- **Roof pitch.** Through fixings, end laps or both should generally only be used in accordance with the minimum pitch requirements defined in BS5427 (see section 5.1.3) unless system suppliers confirm otherwise. These show a minimum design pitch of 5.5 degrees to achieve a minimum finished pitch of at least 4 degrees.
- **Number and type of fasteners, and type of washer.** Typically, trapezoidal profiles should be trough fixed at end laps with at least 5 fasteners per metre width, maximum 200mm apart, fitted with large, minimum 29mm diameter, washers with bonded soft EPDM seals, typically 40 - 50 shore hardness. Some profiles (particularly factory assembled rooflights) require more than one fastener per trough. Less fixings may be required at intermediate purlin locations unless specifically recommended otherwise by the rooflight or system manufacturer. In high wind load applications (including verges, eaves and ridge of large buildings) additional fasteners, heavier sheet or reduced purlin span may be required. If smaller washers are used, additional fasteners will usually be required.

Factory coloured poppy red fasteners (main and secondary) to secure rooflights are used to highlight the position of rooflights on the roof, to reduce risk of inadvertent foot traffic. Avoid use of lightweight washers: large diameter washers, if not thick enough, can easily flatten or invert under tightening loads; they then form stress raisers -worse than when using 19mm washers. Fasteners should generally be austenitic stainless steel, grades 304 or 316, where long term performance is required

- **Choice of trough or crown fixing.** Trough fixings are usually essential at end laps to ensure good compression of sealants in the trough, where a seal is most important. Where crown fixings are used at intermediate purlins a saddle washer is normally required in conjunction with a 19mm bonded washer. However it is essential to follow manufacturer guidance where given.
- **Size and specification of sealants.** Preformed beads are usually preferable to gun applied sealant for a reliable seal. Sealant should be pale coloured (e.g. light grey) Class A as defined in NFRC Technical Bulletin 36. Bead size should be selected to fill gaps, whilst still possible to compress where necessary - typically pale coloured 6x5mm, 8mm round bead or U-section 22x5mm. Thin wide rectangular sections are generally less effective. Care must be taken to ensure sealant is not stretched across corrugations when applied.
- **Relative position of sealants, fixings, laps and supporting structure.** Good compression of the end lap sealant is crucial to good sealing. Fasteners should generally be in the centre of the lap, with 2 beads of sealant positioned equally above and below fixing line to prevent bird mouthing; sealants should be positioned close to the line of fasteners (and there should be a sufficient number of trough fasteners) to ensure good compression of the sealant (generally sealant should be within 25mm of the fixing line). Increased length laps do not help and can be counter productive; use of shorter laps can sometimes help ensure sealant is correctly positioned to give good compression. On roofs where 3 and 4 way lap joints occur that include rooflights, the correct application of lap seals is shown in NFRC Technical Bulletin 44. Although this document only illustrates profiled metal sheeting the recommendations provided may also be applied to in-plane rooflights.
- **Workmanship.** Workmanship and quality of installation of roof systems become more critical as roof pitch decreases. Ensure fasteners go in straight, and perpendicular to sheet purlin surface; they must be correctly tightened to ensure the washer seal is properly compressed, but must not be overtightened, which can dish the rooflight creating ponding over the fastener. Particular care is required to ensure fasteners into Factory Assembled rooflights are inserted into the middle third of the filler block (where present on intermediate purlins) and not overtightened to prevent damage to the rooflight.
- **Fixing sequence.** Always fix progressively from one end of the rooflight. Do not pin both ends first, especially in windy weather, as stress deformation can result. Avoid fixing in windy weather.
- **Accommodate thermal movement.** Always follow manufacturer's specific installation instructions. With polycarbonate, if no installation instructions are available pre-drill carefully with oversize holes (typically 1mm larger diameter per metre of sheet length) using slow speed drill. Position fasteners at centres of holes.
- **Separation.** Always isolate incompatible materials (for example polycarbonate must never come into direct contact with plastisol coatings or PVC tape). Where necessary isolate laps with durable tape (NOT PVC), preferably pale coloured.

### **Secondary Fixing (side-laps)**

Rooflight side laps should be sealed and stitched with purpose-designed self-drilling stitching fasteners at not more than 450mm centres (300mm for high wind-loads or in exposed areas).

If the rooflight material is the underlapping material, rubber or metal grommet type fasteners must be used, but this should be avoided if possible, by:

- specifying a metal strip in the underlap side of all factory assembled rooflights.
- lapping site assembled rooflights over metal at both sides wherever possible.

## Liner Panels

- fit rooflight liners over metal at both sides wherever possible.
- with flexible/shallow profile liner panels, seal side laps (with 50mm wide film or foil backed butyl tape applied over the lap) at both sides to maintain vapour check.
- with more rigid profile liners used with 0.7mm steel sheets, seal laps at both sides either with 50mm wide film or foil backed butyl tape applied over the lap, or stitch with a butyl seal within the lap.
- Do not leave liner panels exposed in windy weather. They should be over-sheeted before being exposed to significant loads.

## 6.2 Special considerations when installing in-plane rooflights

- It is vital when installing a rooflight from a particular manufacturer that the installation instructions or recommendations from that manufacturer are followed in detail – even if these vary from generic details for rooflight installation provided by the supplier of the surrounding roof system. Care should be taken not to install rooflights of one type or from one manufacturer when installing a rooflight of a different type or from another manufacturer (which could result in the wrong fastener types or sealant being used or for those components to be incorrectly located). There are important reasons for the fastener methods recommended for the specific rooflight types and following instructions for alternative rooflight types or suppliers can result in leaks or other failures.
- At least one sealant run should always be located on the exposed side of the main fasteners in an end lap or the stitch fasteners in a side lap. This is to ensure water cannot enter the lap joint, travel down the fastener shaft and on into the building space.
- For long term rooflight non-fragility, austenitic stainless-steel fasteners are recommended to avoid the risk of carbon steel fasteners corroding that could compromise long term non-fragility.
- Rooflight non-fragility is also affected by the frequency of fixing, the fastener sealing washer size or type and the location and type of sealants. Manufacturers' instructions or recommendations must be followed to ensure a non-fragile rooflight.
- In-plane rooflights are normally designed to span a minimum and maximum distance between purlins in order to maintain their intended level of non-fragility. Rooflights should not be fitted to purlin spacings above or below the minimum and maximum recommendations as this could affect non-fragility and/or mid-span deflection. It should be noted that rooflights have different spanning characteristics than the metal or fibre cement sheets that they are used with and react very differently under load.
- Through fixed in-plane rooflights should not be fitted at pitches below the minimum pitch recommendations for through fixed roofs as shown in BS5427 (see clause 5.1.3). the sequence of fixing can also be an important factor to prevent defects. For example, it is recommended that in-plane rooflights are fixed first at the bottom downslope end and then at each subsequent purlin position until finishing at the top upslope end (rather than pinning at both ends before fixing at intermediate purlins) to avoid distortion of the rooflight or damage around fasteners.
- Some rooflight types such as factory assembled insulating rooflights for use with composite panel systems are not suitable for use in roofs on buildings that have a high internal humidity, such as laundries or composting plants. Moisture may enter the rooflight box and build up until it leaks out into the building or causes discolouration due to algae growth. For swimming pool applications incorporating rooflights consult the rooflight, sealant and fastener manufacturers for specific advice.



- Rooflights may need to have a minimum strength to withstand various load types. Rooflights of a lesser strength than that required may fail when subjected to the loads in question. See Section 5, Load Resistance.

For further information, refer to manufacturers' published installation recommendations and BS5427:2016+A1:2017 *Code of practice for the use of profiled sheet for roof and wall cladding on buildings*

## 7 BUILDING REGULATIONS

### 7.1 Conservation of Fuel and Power

This subject is covered by Approved Document L2A & L2B (England and Wales), Technical Booklet F2 (Northern Ireland) and Technical Handbook – Non-Domestic, 2017, Section 6 – Energy (Scotland).

For further information, refer to The Rooflight Association Technical Document NTD06.2 *Designing with Rooflights – Supporting Part L Building Regulation Guidance in England*.

Over time the UK Building Regulations have been continually updated to improve the carbon footprint of all buildings. As a result, considerable changes have been made on a step by step basis requiring roofing material manufacturers to improve their products to contribute to the reduction of carbon emissions that are created by the use of a building.

The requirements for England, Wales, Northern Ireland and Scotland are very similar but each have their own guidance documents and there are some differences. Should there be any doubt regarding what the requirements are, the appropriate authorities for the country should be consulted.

All regions of the UK have common requirements for a TER (Target Emission Rate). This will be affected by factors including air tightness and limiting U-values. For a roofing contractor there is a need to understand the basic mandatory requirements and to understand that by changing a specification on rooflight requirements, the building may fail to achieve the TER, giving rise to consequential costs to satisfy the mandatory requirements.

## 7.1.1 Designing with Rooflights to achieve the TER

The TER is the maximum Carbon Dioxide (CO<sub>2</sub>) emission rate that is allowable for any new building. It is expressed in terms of the mass of CO<sub>2</sub> emitted per year per square metre of the total useful floor area of the building (kg/m<sup>2</sup>/year). The TER is calculated using an approved software implementation of an NCM (National Calculation Methodology), such as SBEM (Simplified Building Energy Model) - energy calculation program, for a Notional Building of the same size, shape, location, orientation, and usage as the actual building, but with performance of fabric, services and controls all as defined in the guide documents for the country in question.

There has previously been a widely held view that whilst rooflights are an excellent way of bringing the many benefits of natural light into a building, the poorer insulation value allowed more heat to escape compared with the rest of the structure thus increasing the running costs of the building. Research has confirmed this view is wrong. Increased rooflight area will bring more daylight into the building and when this happens the on-site lighting system can be turned down/switched off, saving considerably on the energy to run the building, and more than is lost in heat energy through the rooflights.

A well-designed building will have: -

1. 12% - 15% of the roof area made up as rooflights providing natural daylight.
2. Rooflights that are triple skin or otherwise insulated.
3. Electric lighting that is automatically controlled to dim or switch off when satisfactory lighting levels are achieved with natural daylight.

The combination of this building design/specification will provide a major saving - up to 50% - in energy costs to run the building. The natural daylight will also provide a “feel good factor” with people working more efficiently and more effectively.

The use of automatic lighting control is essential to achieve the energy savings demanded by Building Regulations to achieve the TER. Note: manual light switching does not save energy for the BER (Building Emission Rate), since SBEM assumes that normal lights get turned on in the morning and stay on all day until the last person leaves.

## 7.1.2 Limiting U-values for Rooflights

The U-values shown below are the limits that should not be exceeded other than for specific circumstances such as for buildings that have high internal heat gains from a manufacturing process for example.

Building type	England, Wales & Northern Ireland	Scotland
Non-domestic, new build	2.2W/m <sup>2</sup> K	2.0W/m <sup>2</sup> K Shell & fit out: 1.6W/m <sup>2</sup> K
Non-domestic, refurbishment & extensions	1.8W/m <sup>2</sup> K	1.6W/m <sup>2</sup> K

These limiting U-values for rooflights are based on the glazing being assessed in the vertical orientation, even though rooflights are usually used horizontally. If U-values are quoted for rooflights assessed horizontally (i.e. as they are used), adjustments to the limiting value should be made in accordance with BR443 Conventions for U-value conventions section 11 (adding 0.3 W/m<sup>2</sup>K for triple skin rooflights); for example, the limiting value for non-domestic new build in England and Wales should be adjusted from 2.2W/m<sup>2</sup>K to 2.5W/m<sup>2</sup>K for triple skin rooflights.

This adjustment is explained explicitly in Regulations for England, Wales and Northern Ireland, and also applies to Regulations in Scotland (where paragraphs 6.04 and 6.05 reference guidance in BR443, and the example in 6.A.1 also shows the same adjustment).

There is also a separate requirement in Scottish regulations for a shell and fit out building. This is a building that has been erected before the type and specification of building services such as heating, and ventilation is known. The requirements are more onerous to ensure limitation of CO<sub>2</sub> emissions.

The above table defines the worst acceptable performance for rooflights; it should be noted that those within the Notional Building have a higher performance, and if an actual building only complies with the worst acceptable values for building fabric, including rooflights, and services, then it will be considerably poorer performance than the Notional Building and will fail to achieve the TER. Specifiers may therefore opt to specify rooflights with an improved U-value to match or exceed the U-values used in the Notional Building as one way of achieving the TER.

Note that “plastic” rooflights will need to be at least triple skin to achieve the worst- case U-values above. To achieve higher levels of performance, rooflight manufacturers will modify the internal air gap and the internal design of the middle skin. Since there are many inter-related design variables that are critical to achieving the TER, builders and contractors need to be fully aware that changing the specification or the nominated supplier, for whatever reason, could result in them inheriting design responsibility and may result in the completed building failing to meet compliance, thus incurring far greater additional cost to reinstate the correct specification.

### 7.1.3 Rooflights and the Air Pressure Test

The Regulations for all UK regions require that most buildings that are not dwellings must be tested for air tightness on completion of the building and the worst case acceptable value is  $10\text{m}^3/\text{hr.m}^2$  at 50 Pa. In Scotland the requirement for a shell and fit-out building is  $7\text{m}^3/\text{hr.m}^2$  at 50 Pa. All of the roofing and cladding will have an influence on the results of the air pressure test.

For rooflights, attention to the detail of the fixings process is critical. The correct type, size and position of sealants, and correct compression of sealants by using the correct number, position, size and type of fasteners is crucial. It must be noted that in-plane rooflights to match the opaque sheeting of the roof and cladding, have a different performance and fixing specification than the opaque sheeting. This must be observed by the fixers to ensure both water and air tightness. The consequences of failing the air pressure test will mean that remedial work will need to be carried out and be likely to prove very expensive for those concerned.

Building Regulations have been changing periodically over several years; the latest guidance documents from each country are all free to download. A considerable amount of literature has been published with each successive update, and care should be taken to ensure current guidance is followed.

### 7.1.4 Solar Gain

Solar gain is often a benefit, countering any additional heat loss due to poorer insulation of the rooflight compared to surrounding opaque sheeting, but care should be taken to avoid direct solar glare, or excessive solar gain which could lead to solar overheating. Care should always be taken if the rooflight area exceeds 18% to 20% of the roof or where there are particularly high process gains.

## 7.2 Fire Safety

Approved Document B (England and Wales), Technical Booklet E (Northern Ireland) and Technical Handbook, 2017, Non-Domestic – Fire (Scotland).

Section B2 (England and Wales), Section 3 (Northern Ireland) and Clause 2.5.1 and Annex 2.E (Scotland) covers internal fire spread and apply to linings of roofs and walls; in general, these are fire resistance requirements to BS476 Part 7 or to BS EN13501 Part 1.

Section B4 (England and Wales), Section 5 (Northern Ireland) and Clause 2.8 and Annex 2.F (Scotland) covers external fire spread and apply to external coverings of roofs and walls; in general, these are fire resistance requirements to BS476 Part 3 or to BS EN13501 Part 5.

The normal requirement for non-domestic applications in England, Wales and Northern Ireland is that:

- a rooflight liner should achieve either Class 1 to BS476 part 7 or Class C-s3,d2 to EN13501 part 1 (the requirements which apply to the inner skin of the whole ceiling) or achieve Tp(a).
- a rooflight outer skin should achieve either AC to BS476 part 3 or BROOF(t4) to EN13501 part 5 (the requirements which apply to the outer skin of the whole roof) or achieve Tp(a).

There are no restrictions on use of these materials for roofs except for certain limitations within 1.5m of a compartment wall.

There are concessions to allow use of lower ratings if the area of each rooflight is small, and rooflights are sufficiently well separated, and not within 6m of a boundary.

A single skin rooflight must meet the requirements for both the inner ceiling and outer roof surfaces.

For most non-domestic applications in Scotland, the requirements can be summarised as follows:

- a rooflight liner is defined as low, medium or high risk, with required performance depending on application. For many non-domestic applications, ceilings should be medium risk (see Table 2.4 & clause 2.5.1) which requires a rooflight liner to achieve either Class 1 to BS476 part 7 or Class C-s3,d2 to EN13501 part 1 or Tp(a) (see Table 2.20, Annex 2.E), although low risk materials are required in certain applications, and high risk materials can be used in limited applications.
- a rooflight outer skin is defined as low, medium or high vulnerability, with required performance depending on application. Generally rooflights which achieve either AC to BS476 part 3 or BROOF(t4) to EN13501 part 5, and certain specifications of thermoplastic sheet are defined as low vulnerability (see Table 2.23, Annex 2.F), and can be used without restriction (see Clause 2.8.1)

With some rooflight materials (typically GRP), different fire-retardant grades can be specified to meet the different requirements for inner and outer sheets. For other materials, (typically polycarbonate) the same grade of material is usually supplied for both inner and outer skins.

For further information, refer to The Rooflight Association Technical Document NTD13 *Recommendations for good practice – fire performance of rooflight components* and *The Rooflight Association Quickguide 02 Fire safety and rooflights: a summary of the regulations*.

## 8 MAINTENANCE

It is generally considered good practice to include rooflights in a regular maintenance regime, typically involving annual and post-storm inspection, to avoid dirt build up and maintain good light transmission. Under no circumstances should rooflights, new or old, be walked on.

An inspection regime should form part of the operations and maintenance programme for the building, with safety as its primary concern in accordance with CDM requirements. An inspection should look for obvious damage, accumulation of dirt or debris, discolouration, loose fasteners or accumulations of condensation in unexpected areas. Should a maintenance issue be identified then a safe method of remedial works should be determined prior to any work commencing. Where possible, manufacturer's recommendations should be followed.

Cleaning of rooflights generally is accomplished with water and a weak or mild detergent solution. Abrasive cleaning substances or tools must never be used as these could seriously affect rooflight performance and compromise durability. High pressure jet washing should always be avoided as this has a high probability of disturbing weather seals or driving dirt and moisture into the system and may also damage the rooflight surface.

Always refer to manufacturers for maintenance recommendations. If damage to a rooflight is evident the manufacturer should be consulted.

If in any doubt and unless proven otherwise any rooflight should be considered as fragile and the appropriate safety precautions taken before accessing the roof. It is essential that all inspection procedures, cleaning operations or working on the roof is carried out only by operatives fully trained in safe methods of working at height.

## 9 REFERENCES

### **Advisory Committee for Roofsafety**

ACR[M]001 *Test for Non-Fragility of Large Element Roofing Assemblies*

ACR[CP]001 *Recommended Practice for Work on Profiled Sheeted Roofs*

ACR[CP]002 *Guidance Note for Safe Working on Fragile Roofs or Roofs with Fragile Elements*

### **BRE**

BR443 *Conventions for U-value conventions*

### **British Standards**

BS5427:2016+A1:2017 *Code of practice for the use of profiled sheet for roof and wall cladding on buildings*

### **European Standards**

BS EN 1991-1-1 *Eurocode 1: Actions on structures Part 1: General actions. Densities, self-weight, imposed loads for buildings*

### **Health and Safety Executive**

HSG 33 *Health and Safety in Roofwork*

### **The Rooflight Association**

NTD01.2 *An Introduction to Natural Daylight Design through Rooflighting*

NTD03 *Application of ACR[M]001 'Test for Non-Fragility of Large Element Roofing Assemblies' to GRP Profiled Rooflight Sheeting*

NTD06.2 *Designing with Rooflights, Supporting Part L Building Regulation Guidance in England; Approved Documents L1A, L1B, L2A and L2B (2013 editions)*

NTD08 *Guidance on Non-Fragility for Specifiers of In-Plane Rooflights*

NTD09 *Rooflights: Glass, Polycarbonate or GRP?*

NTD13 *Recommendations for Good Practice – Fire Performance of Rooflight Components*

### **National Federation of Roofing Contractors**

NFRC Technical Bulletin 36 *Performance standards for butyl strip sealants in metal clad buildings*

NFRC Technical Bulletin 44 *Profiled metal roof sheeting: Correct method of applying sealant at 4 way lap location*

### **Metal Cladding & Roofing Manufacturers Association**

GD 19 *Effective sealing of end lap details in metal roofing constructions*

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