Hambleside Danelaw
Rooflights

TECHNICAL MANUAL
Non-Fragility

ZENON

LOW CARBON DAYLIGHT SOLUTIONS

ISSUE 2

Non-fragility

The introduction of natural light into a building is important in many ways, from providing a good and healthy working environment, increasing productivity, and in reducing a building's CO_2 emissions by reducing the demand for artificial lighting.

Rooflights are the most effective way to bring daylight into a building where there are internal wall partitions or where the distance into the building is more than 6m away from a wall window. As most rooflights are fitted to flat or low pitched roofs, there is a high probability that the roof will receive some degree of foot traffic and therefore the roof and rooflights should all be designed and classified as non-fragile to minimise the risk of death and injuries due to people falling through roofs.

Defining non-fragility

Until the publication of the first edition of ACR[M]001 by the Advisory Committee for Roofsafety (ACR) in 2000, there was no clear guidance of how manufacturers or installers of systems could demonstrate that the requirements for non-fragility of roofs were being met. Now ACR[M]001:2014 Test for Non-Fragility of Large Element Roofing Assemblies [fifth edition], often referred to as the 'Red Book',

prescribes how a representative roof assembly should be tested to demonstrate the ability to resist the impact of a person falling onto it, and then supporting their weight.

From the testing and guidance contained in the ACR document, the roof assembly can be defined in terms 'fragile' and 'non-fragile'. It should be noted that the test is not of any single component or product, but all of the elements including all of the fixings and fasteners that are required to be representative of the finished installation on, or of a roof.

This test for non-fragility is very specifically defined to simulate the impact created by a person falling onto a roof assembly, and concentrates a destructive impact load over a relatively small area that should be representative of occurring on the most critical, worst case scenario locations of that assembly.

The application of this test and classification for in-plane rooflights is further described and defined in the National Association of Rooflight Manufacturers (NARM) Technical Document NTD03, Application of ACR[M]001 'Test for Non-Fragility of Large Element Roofing Assemblies' to GRP Profiled Rooflight Sheeting'.

The test procedure

The test should be carried out by a competent person with sufficient technical knowledge, experience and authority as defined within the ACR[M]001 document. It involves an 'impactor' comprising a 300mm diameter cotton weave sandbag filled with 45kg of soft sand, being dropped from a height of 1.2 metres onto the roofing assembly. The test sample is built on a standard roof rig representing a typical metal roof structure one metre high from the ground, also clearly defined within the ACR[M]001 document.

The impactor should be dropped in specific worst case scenario zones, depending upon the assembly, which are generally:-

- Within 150mm of the centre of the sample.
- Within 300mm of a support point.
- Within 150mm of the assembly edge adjacent to the underlap with the next sheet.
- Where ever the competent person deems the worst case scenario to be.

To better define the 'non-fragility' classification of an assembly, the impact may be repeated in the same location, and from 1200mm above the height of where the bag was retained after the first drop.

Classification of Results

If the assembly fails to survive the impact, and the impactor passes through, then the assembly is classed as **fragile**.

If the impactor is retained by the assembly after the first drop for a minimum of five minutes, it can be classified as **non-fragile** and may be used for, or within roof construction.

If, after the second impact at the same location, the impactor is retained for a further five minutes, the assembly can then be rated as **Class B non-fragile**. If the impactor is not retained for at least five minutes then the assembly is rated as **Class C non-fragile**.

Impactor falling towards rooflight sample under test

Impactor at rest on rooflight sheet after drop test

Class A non-fragile is only achieved where no part or component of the assembly suffers any damage or detriment after the second impact that might affect the long term strength or weatherability of the assembly. Such is the destructive nature of the test, no known self-supporting metal roof assembly can achieve an 'A' rating irrespective of the performance of the rooflight. Most metal cladding system manufacturers design their systems to achieve Class B non-fragile.

It should be noted that where any part of a roofing assembly is unfixed or partially fixed, it should always be treated as fragile.

When testing rooflight products to ensure non-fragile performance, Hambleside Danelaw carry out testing for all worst case scenarios, with minimum end lap criteria of 50mm to allow for site tolerances, and without the use of side or end lap sealants; these cannot be relied upon to make any significant contribution to the non-fragile classifications after age hardening over extended periods of time.

The whole of the Zenon rooflight range has been subjected to this rigorous test programme and delivers non-fragile performance in accordance with both the aforementioned ACR[M]001 document and NARM Technical Document NTD03.

For extended periods of non-fragility, the rooflight industry, fastener manufacturers, trade associations and technical committees all recommend that all rooflights should be fixed using stainless steel and expanding metal grommet type fasteners where required.

Achieving non-fragility

Zenon Pro glass reinforced polyester (GRP) rooflights, when correctly installed in accordance with Hambleside Danelaw's recommendations into a roof construction that has already been demonstrated to achieve at least the same rating, will achieve non-fragile classifications in accordance with the following table. This is providing that all other elements of the roof assembly are correctly installed in accordance with the relevant manufacturers recommendations, and that all these components meet the same performance criteria and retain their integrity for the same period.

Minimum classifications for non-fragility using Zenon Pro rooflights

Application (rooflight type)	Non-fragile classification	Min specification for non-fragility for up to 20 years	Min specification for non-fragility for up to 25 years
Single skin Rigid trapezoidal profiles for single skin metal sheeting	Class B	Zenon Pro 30	Zenon Pro 36
Rigid sinusoidal profiles for fibre cement sheeting	Class C	Zenon Pro 24	Zenon Pro 30
Double or triple skin with flexible steel liners (0.4mm typical) Liner panel assembly	Class C	Outer: n/a Liner: Zenon Pro 24	Outer: n/a Liner: Zenon Pro 24
Complete rooflight assembly *(Class C liner required when lining out)*	Class B	Outer: Zenon Pro 18 Liner: Zenon Pro 24	Outer: Zenon Pro 24 Liner: Zenon Pro 24
Complete rooflight assembly	Class B	Outer: Zenon Pro 24 Liner: Zenon Pro 18	Outer: Zenon Pro 30 Liner: Zenon Pro 18
Double or triple skin with rigid steel liners (0.7mm typical) Liner panel assembly	Class B	Outer: n/a Liner: Zenon Pro 30	Outer: n/a Liner: Zenon Pro 30
Complete rooflight assembly	Class B	Outer: Zenon Pro 18 Liner: Zenon Pro 30	Outer: Zenon Pro 18 Liner: Zenon Pro 30
Factory assembled double or triple skin Medium/low flexibility outer profile, continuous rooflight box	Class B	Outer: Zenon Pro 24 Liner: Zenon Pro 15	Outer: Zenon Pro 30 Liner: Zenon Pro 15
Medium/low flexibility outer profile, separate rooflight boxes between purlins	Class B	Outer: Zenon Pro 30 Liner: Zenon Pro 15	Outer: Zenon Pro 36 Liner: Zenon Pro 15

The classifications shown in the table are for rooflight spans from 1.35m to 2.0m. Exceptional cases outside this range should be subject to specific testing for the application.

For rooflights fitted to curved roofs, in continuous runs and at hips, or to anything other than cold rolled steel purlins may require testing for the specific application. Alternatively a single incremental increase in sheet weight above that shown would usually suffice.

The classification for fibre cement sheeting applies to current products manufactured and tested to achieve at least the same rating. Asbestos cement and obsolete fibre cement profiles should always be considered to be fragile.

A number of factors will impact on the period of non-fragility which will be achieved by a roofing assembly including the quality and durability of the other roof materials, and the quality of installation of the whole roof.

Manufacturers can only indicate the expected period of non-fragility from extensive testing carried out and cannot offer performance guarantees out of their direct control. Further guidance is available from NARM and The Metal Cladding and Roofing Manufacturers Association (MCRMA).

Imported rooflights claiming the same or similar specifications and not manufactured to BS EN1013, and the UK Annex to this Standard, cannot be assumed to achieve the same non-fragility ratings, or for the same periods of use.

Zenon Evolution rooflights

Due to the nature of the continuous glass filament reinforcements used in Zenon Evolution rooflight production, the tensile strength and tear resistance of the product is far greater than with traditionally reinforced GRP materials. Zenon Evolution significantly outperforms traditional GRP rooflights, resisting impact after impact. This gives great confidence, when specifying the Evolution product, that the non-fragile rating of the material will be retained for periods in excess of 30 years subject to all other parts of the roof retaining their integrity for the same period.

Minimum Classifications for Non-Fragility using Zenon Evolution Rooflights

Application (rooflight type)	Non-fragile classification	Min specification for non-fragility for up to 30 years	Min specification for non-fragility for 30 years +
Single skin Rigid trapezoidal profiles for single skin metal sheeting	Class B	Zenon Evolution LC1	Zenon Evolution LC2
Rigid sinusoidal profiles for fibre cement sheeting	Class C	Zenon Evolution LC1	n/a
Double or triple skin with flexible steel liners (0.4mm typical) Liner panel assembly	Class C	Outer: n/a Liner: Zenon Evolution LC1	Outer: n/a Liner: Zenon Evolution LC1
Complete rooflight assembly *(Class C liner required when lining out)*	Class B	Outer: Zenon Pro 18 Liner: Zenon Evolution LC1	Outer: Zenon Pro 24 Liner: Zenon Evolution LC1
Complete rooflight assembly	Class B	Outer: Zenon Evolution LC1 Liner: Zenon Pro 18	Outer: Zenon Evolution LC2 Liner: Zenon Pro 18
Double or triple skin with rigid steel liners (0.7mm typical) Liner panel assembly	Class B	Outer: n/a Liner: Zenon Evolution LC1	Outer: n/a Liner: Zenon Evolution LC1
Complete rooflight assembly	Class B	Outer: Zenon Pro 18 Liner: Zenon Evolution LC1	Outer: Zenon Pro 24 Liner: Zenon Evolution LC1
Factory assembled double or triple skin Medium/low flexibility outer profile, continuous rooflight box	Class B	Outer: Zenon Evolution LC1 Liner: Zenon Pro 15	Outer: Zenon Evolution LC2 Liner: Zenon Pro 15
Medium/low flexibility outer profile, separate rooflight boxes between purlins	Class B	Outer: Zenon Evolution LC1 Liner: Zenon Pro 15	Outer: Zenon Evolution LC2 Liner: Zenon Pro 15

The classification for fibre cement sheeting applies to current products manufactured and tested to achieve at least the same rating. Asbestos cement and obsolete fibre cement profiles should always be considered to be fragile.

HSG33 Health and Safety in Roofwork (2012)

The following three extracts are considerations for designers that have been reproduced from the Health and Safety Executive HSG publication that will influence safety during construction, maintenance and demolition phases of profile sheet roofs:

Non-fragility: most industrial-grade profiled sheets, including roof lights, are now available to achieve a non-fragile status when installed. Designers should make sure that such specifications are followed during procurement and construction. A reduction in the thickness of the profiled sheeting, to save on cost, may result in a non-fragile specification becoming a fragile construction;

Longevity: whatever roofing assembly has been specified, all non-fragile roofs will deteriorate with time, and at some point the assembly will become fragile. Designers should therefore determine the design life of the roof and specify the roofing materials that will provide non-fragility for this period. Such information must be included in the health and safety file for the building. Environmental issues may also affect longevity;

Material weight: with an increasing need to provide better-insulated and more airtight buildings there is a growing need for thicker, longer and therefore heavier roof panels. Designers must consider the safety issues with handling the materials that they specify.

'Walkable' and 'Walk-On' Rooflights

Glass rooflight used for foot traffic
Source: Glazing Vision

Some site-assembled or built-up cladding systems incorporate a liner sheet in 0.7mm thick steel, and in a profile depth usually exceeding 30mm. This liner assembly should have been tested to achieve non-fragility classification as a single skin only, allowing the construction operative to traverse it while installing the full cladding system. This kind of construction is often referred to within the industry as a 'walkable liner'.

It should be noted, however, that profiled rooflight sheets in such an assembly that have been tested to achieve the required non-fragility rating, are still not 'walkable' and must never be subjected to foot traffic, regardless of specification.

Rooflights should never be walked on unless they are specifically designed for this purpose. Irrespective of the strength of a rooflight and the non-fragility classification, any foot traffic could damage the integrity of the rooflight structure or surface protection and consequently impact upon the long term performance of the product.

Rooflights designed to be walked on, and for use where they will be deliberately walked on, need to be designed for much greater loads. The only suitable material for this application is glass, subject to very specific specifications for each application. Polycarbonate and GRP glazing can never be considered suitable materials for 'walkable' applications.

Zenon, a comprehensive range of low carbon rooflights for the metal building envelope from Hambleside Danelaw

Hambleside Danelaw Rooflights

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