GGF Datasheet: Recommendations for Adhesive Backed Polymeric Film Applied to Glass - Blast Mitigation

5.18.4 April 2020

Contents

Introduction

This GGF Datasheet gives advice on one of the major roles for adhesive backed polymeric film applied to glass.

1. Scope

This GGF Datasheet gives recommendations for the use of adhesive backed polymeric film applied to glass for reducing the risk of injury from glass shattered in an explosion.

2. Definitions and Description

The definitions contained within GGF Datasheet 5.18.1 together with the following apply

2.1 Blast Mitigation

Reduction of injuries, property damage and business disruption resulting from glass breakage under explosive pressure.

2.2 Threat levels

Threat levels for buildings are defined with respect to proximity to the building and the use of improvised explosive devices

2.3 Low threat level

For buildings where there is a significant risk of a nearby explosion of approximately a satchel bomb size.

2.4 High threat level

For buildings where there is a significant risk of a nearby explosion of approximately a van sized bomb.

3. Hazard Rating/Threat Levels

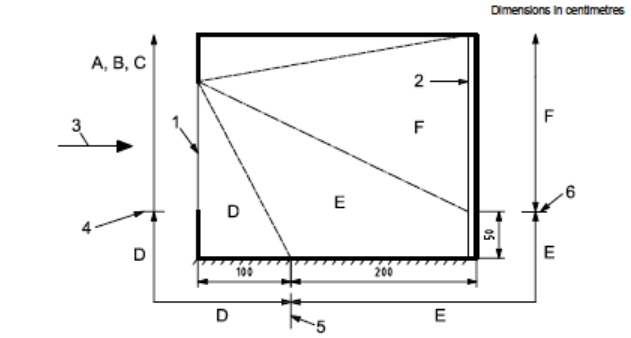
3.1 Systems of Hazard Rating of the risks from shattered glass in an explosion have been developed by the UK Government and other organisations based upon decades of explosion testing. This work has been incorporated into an international standard, i.e. ISO 16933: 2007: Glass in building - *Explosion-resistant security glazing -- Test and classification for arena air-blast loading*

3.2 Table 1 shows the Hazard Rating system from the standard.

Table 1 — Hazard-rating criteria for arena tests

Hazard rating	Hazard-rating description	Definition
A	No break	The glazing is observed not to fracture and there is no visible damage to the glazing system.
B	No hazard	The glazing is observed to fracture but the inner, rear face leaf is fully retained in the facility test frame or glazing system frame with no breach and no material is lost from the interior surface. Outer leaves from the attack face may be sacrificed and may fall or be projected out.
C	Minimal hazard	The glazing is observed to fracture. Outer leaves from the attack face may be sacrificed and may fall or be projected out. The inner, rear face leaf shall be substantially retained, with the total length of tears plus the total length of pullout from the edge of the frame less than 50 % of the glazing sight perimeter. Also, there are no more than three rateable perforations or indents anywhere in the witness panel and any fragments on the floor between 1 m and 3 m from the interior face of the specimen have a sum total united dimension of 250 mm or less. Glazing dust and slivers are not accounted for in the hazard rating. If by design intent there is more than 50 % pullout but the glazing remains firmly anchored by purpose-designed fittings, a rating of C (minimal hazard) may be awarded, provided that the other fragment limitations are met. The survival condition and anchoring provisions shall be described in the test report.
D	Very low hazard	The glazing is observed to fracture and significant parts are located no further than 1 m behind the original location of the rear face. Parts be projected any distance from the attack face towards the blast source. Also, there are no more than three rateable perforations or indents anywhere in the witness panel, and any fragments on the floor between 1 m and 3 m from the interior face of the specimen have a sum total united dimension of 250 mm or less. Glazing dust and slivers are not accounted for in the rating.
E	Low hazard	The glazing is observed to fracture, and glazing fragments or the whole of the glazing fall between 1 m and 3 m behind the interior face of the specimen and not more than 0,5 m above the floor at the vertical witness panel. Also, there are 10 or fewer rateable perforations in the area of the vertical witness panel higher than 0,5 m above the floor and none of the perforations penetrate more than 12 mm.
F	High hazard	Glazing is observed to fracture and there are more than 10 rateable perforations in the area of the vertical witness panel higher than 0,5 m above the floor, or there are one or more perforations in the same witness panel area with fragment penetration more than 12 mm.

Glass and Glazing Federation
40 Rushworth Street, London SE1 0RB
Tel: 020 7939 9100 Fax: 0870 042 4266
www.ggf.org.uk



Key

1	window	A to F	hazard ratings:
2	witness panel	A	no break
3	blast	B	no hazard
4	very low hazard threshold	C	minimum hazard
5	low-hazard threshold	D	very low hazard
6	high-hazard threshold	E	low hazard
		F	high hazard

Figure 1 — Cross-section through witness area for arena test

ISO 16933 uses a range test with 3m deep test cubicles. Illustrated in Figure 1. Areas defined within the cubicle classify different hazard level

3.3 Explosion properties

It can be difficult if not impossible to define exactly the specific properties and effects an explosion may have on particular buildings and structures around them. However, extensive research has developed substantial practical and theoretical understanding of explosions, allowing protective measures to be taken in order to reduce the effects of explosions to be made with confidence

3.4 Threat levels

Two levels of the potential threat of an explosion have been established: Low Threat and High Threat.

Although these threat levels are given in terms of improvised explosive devices, corresponding definitions can be extrapolated for explosion threats from other sources, e.g. oil refinery plant.

NOTE: Details of the improvised devices can be found in ISO16933

3.5 Recommendations for the use of adhesive backed polymeric film at these threat levels are given in Section 5.

4. Risk Reduction with Adhesive Backed Polymeric Security Film

4.1 Security films on annealed glass are intended to reduce High Hazard to Low Hazard or Very Low Hazard. Security film on annealed glass with specifically designed containment systems can further improve the performance to Minimal Hazard or No Hazard.

(See Table 1 and Section 6)

4.2 Risk Assessment

4.2.1 A professional Risk Assessment is required to establish the risks from an explosion for a particular building. This will be dependent upon criteria including the glazing and glass types, size and thickness, the assessed threat, the building location, the building environment, and the usage of the building. The Risk Assessment will also identify the measures required for reducing the risks from an explosion. Installation of safety film is only a part of the overall strategy for protecting people and property in an explosion.

4.2.2 For specification of security film, building owners and managers very often select the appropriate adhesive backed polymeric film based upon a High Threat (see Section 3.4), principally because many at risk buildings are in major cities and are close to potential 'targets'.

NOTE: In addition, the cost penalty for the increased protection of a higher performing adhesive backed film is relatively small.

5. Recommended Security Films for Blast Mitigation

5.1 The recommendations given below are the minimum levels of protection to be employed against both threat levels (Section 3.4). They are based upon the current Home Office Scientific Development Branch (HOSDB) recommendations and publications and the current understanding of the effects of an explosion on glass.

5.2 Security films for blast mitigation are recommended based upon their performance. This generally means that as film thickness increases, so does film performance, although the expectation is that technology improvements may result in higher performing products without always an increase in thickness.

5.3 These recommendations are not intended to substitute for a professional Risk Assessment but can be used to quickly decide the minimum specification of adhesive backed polymeric security film required for the threat level (Section 3.4).

5.4 Recommendations for buildings at Low Threat

The recommendations for use of safety film for a Low Threat from an explosion are given in Table 1.

Floor Level	Recommendations
All floors	Security film ≥ 100µ (micron) and meeting EN 12600 Class 1B1

Table 1: Low Threat: Security film recommendations for all pane sizes and thicknesses.

5.5 Recommendations for buildings at High Threat

5.5.1 The recommendations for use of adhesive backed polymeric security film for a High Threat from an explosion and where pane size ≤ 3m2 and pane thickness ≤ 6mm are given in Table 2

Floor Level	Recommendations
Ground - 11th	Security film ≥ 150µ (microns) and meeting EN 12600 Class 1B1
12th and over	Security film ≥ 100µ (micron) and meeting EN 12600 Class 2B2

Table 2: High Threat: Security film recommendations for panes ≤ 3m2 & ≤ 6mm

5.5.2 The recommendations for use of adhesive backed polymeric security film for a High Threat from an explosion and where pane size > 3m2 and/or pane thickness > 6mm are given in Table 3

Floor Level	Recommendations
Ground - 1st	Security film ≥ 275µ (microns) and meeting EN 12600 Class 1B1
2nd - 11th	Security film ≥ 150µ (microns) and meeting EN 12600 Class 1B1
12th and over	Security film ≥ 100µ (microns) and meeting EN 12600 Class 2B2

Table 3: High Threat: Security film recommendations: panes > 3m2 and/or > 6mm

5.6 Recommendations for internal glass partitions

The recommendations for use of security film for internal glass partitions are given in Table 4. For internal insulating glass units, it may be necessary to treat both sides with security film

Floor Level	Recommendations
All Floors	Security film ≥ 100µ (microns) and meeting EN 12600 Class 2B2

Table 4: Internal glass partitions:: Security film recommendations for all pane sizes and thicknesses

5.7 Recommendations for secondary glazing

The recommendations for use of security films where the window consists of two separate frames and where both frames can be accessed independently (e.g. as in secondary glazing) are given in Table 5.

Floor Level	Recommendations
Primary	See Sections 5.4 to 5.5
Secondary	Security film ≥ 100µ (microns) and meeting EN 12600 Class 2B2

Table 5: Secondary and similar glazing: Security film recommendations for all pane sizes and thicknesses

5.8 It is possible to obtain a different classification for a adhesive backed security film on one thickness of float glass than for the same film on a different thickness of float glass. Therefore, classification to EN 12600 for security film means that: -

- The specific security film has been independently tested as a security film + float glass composite and meets the stated EN 12600 classification.
- Glass thickness is the same as that to be treated.
- The exception to the above is that occasionally glass > 6mm may require protection, but independent testing to EN 12600 may not have been carried out for the specified film on the thicker glass. In these cases, it is normal to accept that testing on thinner glasses is sufficient evidence to demonstrate adequate performance. A film of at least 150µ (microns) thickness is recommended.

However, the client must decide whether further testing is needed to demonstrate EN 12600 performance for the particular film + glass thickness composite.

5.9 These recommendations are generally for monolithic glass. Laminated glass may be treated with safety film for blast mitigation and to reduce spalling.

5.10 It is important to check whether there are any other requirements when installing security film, e.g. marking of safety glazing required in BS 6262-4.

6. Containment Systems

A containment system is designed to attach the adhesive backed polymeric security film to the glazing bar, glazing system or frame. The use of a containment system with safety film can further reduce the risks from glass shattered in an explosion.

For further information on containment systems see:

GGF Datasheet 5.18.5: Recommendations for Adhesive Backed Polymeric Film Applied to Glass*: Containment of Glass in the Overhead Position in the Event of Failure: Types of Systems and Precautions in Use*

GGF Datasheet 5.18.6: Recommendations for Adhesive Backed Polymeric Film Applied to Glass: *Containment of Glass in the Overhead Position in the Event of Failure – Test Method*

NOTE 1: Independent testing has shown the efficacy of adhesive backed polymeric security films for protection in an explosion. As with all security products, correct installation is essential. It is therefore very important to use a professional installation company with an appropriately trained and experienced work force.

NOTE 2: The cure time should not be confused with time to achieve a level of performance. For example, with good installation, performance against impact to EN 12600 may be achieved within one or two days of installation for many safety films.

NOTE 3: Peel adhesion testing is recommended for both newly installed and cured safety film and for aged safety film.

NOTE 4: See GGF Datasheet 5.18.7: Recommendations for Adhesive Backed Polymeric Film Applied to Glass On-Site Peel Adhesion Testing: - Aged Adhesive Backed Polymeric Film Applied to Vertical Flat Glass

Bibliography

European Standards – Product

EN 15752-1: Glass in Building: *Adhesive Backed Polymeric Film-Part1: Definitions and Requirements*

EN 15755-1: Glass in Building: *Adhesive Backed Polymeric Filmed Glass-Part1. Definitions and Requirements*

NOTE: Other standards for adhesive backed polymeric film will also be developed e.g. Evaluation of Conformity.

European Standards – Test methods

EN 356: Glass in building: *Security glazing - Testing and classification of resistance against manual attack.*

EN 1063: Glass in Building: *Security glazing - Testing and classification of resistance against bullet attack.*

EN 12600: Glass in building: *Pendulum test - Impact test method and classification for flat glass.*

International Standards

ISO 16933: Glass in building: *Explosion resistant security glazing - Test and classification for arena air-blast loading*

ISO 16934: Glass in building: *Explosion resistant security glazing - Test and classification by shock-tube loading*

GGF Datasheets

For information on all of the 5.18 series see Datasheet 5.18.