# GGF Data Sheet: Recommendations for Blast Mitigation: Adhesive Backed Polymeric Film Applied to Glass

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**Contents**



## Introduction

This standard has been developed by the GGF Window Film Group, in association with all major film manufacturers, to clarify recommendations concerning the use of safety film applied to glass for blast mitigation purposes.

## 1. Scope

This standard gives recommendations for the use of adhesive backed polymeric safety film ("safety film") applied to glass for reducing the risk of injury from glass shattered in an explosion. It does not give guidance concerning peel testing of aged safety film (see GGF Data Sheet 5.18.7 Standard for On-Site Peel Adhesion Testing of Aged Adhesive Backed Polymeric Film Applied to Vertical Flat Glass).

## 2. Definitions and Description

**2.1** See GGF Data Sheet 5.18.3 Recommendations for Adhesive backed polymeric Film Applied to Glass: Definitions, Descriptions and Components.

**2.2** Blast mitigation reduction of injuries, property damage and business disruption resulting from glass breakage under explosive pressure.

## 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, and are being incorporated into international standards such as ISO/DIS 16933.

**3.2** Figure 1 shows the Hazard Rating system from draft standard ISO 16933. ISO 16933 uses a range test with 3 m deep test cubicles. Areas defined within the cubicle classify different hazard levels.

### 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.

Low Threat is for buildings where there is a significant risk of a nearby explosion of approximately a satchel bomb size.

High Threat is for buildings where there is a significant risk of a nearby explosion of approximately a van sized bomb.

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

**3.5** Recommendations for the use of safety film at these threat levels are given in Section 5.

## 4. Risk Reduction with Safety Film

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

(Figure 1 and Section 6)

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### 4.2 Risk Assessment

**4.2.1** A professional Risk Assessment is required to establish the risks for man 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 for man 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 safety film, building owners and managers very often select the appropriate safety films 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'. In addition, the cost penalty for the increased protection of higher performing is relatively small.

### 5. Recommended Safety 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** Safety 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 safety 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 | Typical cure times/days |
|---|---|
| All floors | Safety film ≥ 100 microns and meeting BSEN 12600 Class 2B2 |

**Table 1:** Low Threat: Safety film recommendations for all pane sizes and thicknesses

### 5.5 Recommendations for buildings at High Threat

**5.5.1** The recommendations for use of safety film for a High Threat for man explosion and where pane size ≤ 3 m² and pane thickness ≤ 6 mm are given in Table 2.

| Floor level | Recommendation |
|---|---|
| Ground – 11th | Safety film ≥ 150 microns and meeting BS EN 12600 Class 1B1 |
| 12th and over | Safety film ≥ 100 microns and meeting BS EN 12600 Class 2B2 |

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

**5.5.2** The recommendations for use of safety film for a High Threat for man explosion and where pane size > 3 m² and/or pane thickness > 6 mm are given in Table 3.

| Floor level | Recommendation |
|---|---|
| Ground – 1st | Safety film ≥ 275 microns and meeting BS EN 12600 Class 1B1 |
| 2nd – 11th | Safety film ≥ 150 microns and meeting BS EN 12600 Class1B1 |
| 12th and over | Safety film ≥ 100 microns and meeting BS EN 12600 Class 2B2 |

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

### 5.6 Recommendations for internal glass partitions

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

| Floor level | Recommendation |
|---|---|
| All floors | Safety film ≥ 100 microns and meeting BSEN 12600 Class 2B2 |

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

### 5.7 Recommendations for secondary glazing

The recommendations for use of safety 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.

| Glazing | Recommendation |
|---|---|
| Primary | As in Sections 5.4 to 5.5 |
| Secondary | Safety film 100 microns and meeting BSEN 12600 Class 2B2 |

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

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

- The specific safety film has been independently tested as a safety film + float glass composite and meets the stated BS EN 12600 classification.
- Glass thickness is the same as that to be treated.
- The exception to the above is that occasionally glass > 6 mm may require protection, but independent testing to BS 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 150 microns thickness is recommended. However, the client must decide whether further testing is needed to demonstrate BS 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 safety film, e.g.marking of safety glazing required in BS 6262-4.

## 6. Containment Systems

A containment system is designed to attach the safety 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.

See GGF Data Sheets 5.18.4 Recommendations for Adhesive Backed Polymeric Film Applied to Glass in the Overhead Position for Containment of Glass in the Event of Failure: Types of Systems and Precautions in Use, and 5.18.5 Recommendations for Adhesive Backed Polymeric Film Applied to Glass in the Overhead Position for Containment of Glass in the Event of Failure: Test Method.

## 7. Additional Notes

**7.1** Independent testing has shown the efficacy of safety films for protection in an explosion. As with all safety products, correct installation is essential. It is therefore very important to use a professional installation company with an appropriately trained and experienced work force.

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

**7.3** Peel adhesion testing is recommended for both newly installed and cured safety film and for aged safety film.

See GGF Data Sheet 5.18.7 Standard for On-Site Peel Adhesion Testing of Adhesive Backed Polymeric Film Applied to Vertical Flat Glass.

## 8. References

### 8.1 Standards

#### European Standard

**EN 12600** Glass in building – Pendulum test – Impact classification for flat glass

#### International Standard

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

### 8.2 GGF Data Sheets

Current GGF Data Sheets for adhesive backed polymeric film are:

**GGF Data Sheet 5.18.1** Visual Quality for Adhesive Backed Polymeric Filmed Glass

**GGF Data Sheet 5.18.2** Installation Quality Standard for Applying Adhesive Backed Polymeric Film to Glass

**GGF Data Sheet 5.18.3** Recommendations for Adhesive Backed Polymeric Film Applied to Glass: Definitions, Descriptions and Components

**GGF Data Sheet 5.18.4** Recommendations for Adhesive Backed Polymeric Film Applied to Glass in the Overhead Position for Containment of Glass in the Event of Failure: Types of Systems and Precautions in Use

**GGF Data Sheet 5.18.5** Recommendations for Adhesive Backed Polymeric Film Applied to Glass in the Overhead Position for Containment of Glass in the Event of Failure: Test Method

**GGF Data Sheet 5.18.6** Recommendations for Blast Mitigation: Adhesive Backed Polymeric Film Applied to Glass

**GGF Data Sheet 5.18.7** Standard for On-Site Peel Adhesion Testing of Aged Adhesive Backed Polymeric Film Applied to Vertical Flat Glass

**GGF Data Sheet 5.18.8** Adhesive backed Polymeric Film-Guidelines for Installation on Existing Glazing

## 9. Acknowledgement

The Home Office Scientific Development Branch (HOSDB) has provided valuable assistance and advice in preparation of these recommendations.

**Figure 1:**
Hazard Ratings in relation to a typical test cubicle; refer to the (draft) standard ISO/DIS 16933 for a fuller description.