



GUIDANCE NOTE

Specifying Anti-Shatter Film as Blast Mitigation Measure (Daylight Application)

Introduction

If it is not possible to upgrade and install protective glazing, such as laminated glass, into existing buildings, the use of anti-shatter film (ASF) may be applied as a retrofit measure to mitigate the glazing hazard inside a building as a result of an external blast or impact.

As a mitigation measure, ASF is usually applied in a 'daylight' application, meaning that the film is applied to the inside face of the glass with a 1-3mm gap between the edge of the film and the frame.

This allows the liquid used in the application of the ASF film to the glass surface to be pushed to the edge and wiped away, leaving a daylight area around the perimeter of the film.

The mitigation provided by daylight applied ASF is dependent on the size of the window, the thickness and type of glass, the thickness and tear resistance of the ASF product and the quality of its application. Therefore, it is important to determine the specification of the existing glazing in order to prepare the specification for the daylight applied ASF installation.

This Guidance Note has been produced by NPSA to highlight areas which should be considered when specifying daylight applied ASF for tendering purposes.

For further information and guidance on the effectiveness of ASF as a mitigation measure and alternative protective measures available, please see the following NPSA Guidance Notes:

- Peel Adhesion Testing and Assessment of ASF (NPSA EBP 10/13)
- Glazing Enhancement to Improve Blast Resistance (NPSA EBP 02/13)

If in doubt, further advice on the use, assessment and testing of ASF should be sought from specialist engineers with experience and training in designing and implementing explosion and ballistic mitigation measures. These may be Members of the Register of Security Engineers and Specialists (RSES) www.rses.org.uk or be able to demonstrate that they have similar levels of competence to those required for membership.

Application of ASF material

Anti-shatter film (ASF), also referred to as fragment retention film, is applied as a retrofit measure typically to the inside face of a pane of glass to mitigate the glazing hazard inside a building as a result of an external blast or impact. ASF can be applied to single or double glazed units, although very thin glass <3mm is prone to cracking under the force required to apply the film.

ASF is not recommended for use on laminated, textured, hand-cast or wired (non-safety) glass. Before using ASF, thermal safety checks should be carried out to ensure that the film application will not increase the risk of thermal shock, which can lead to cracking of single glazed or insulated glass units. This is particularly the case when applying combined solar and

safety film installations. In this case, the application of ASF may invalidate any original manufacture warranty on the glass or façade.

The curing time of ASF is dependent on the internal and external temperature and the thickness of the film. Glass coatings such as UV coatings may affect the length of the curing time.

ASF composition

ASF is made up of two key elements: the film and the adhesive which adheres the film to the glass.

The film may be formed of either alternative layers of ultra-clear BOPET (bi-axially oriented polyethylene terephthalate) and adhesive, or a single layer of BOPET. The properties of the film are defined by the tensile strength of the BOPET and the properties of the adhesive interlayers. Therefore, any changes in the BOPET manufacturing process can have a direct impact on the performance of the film.

The film is fixed to the glass by a second type of adhesive which is activated using a wetting solution. If applied correctly and fully cured, the ASF will adhere to the glass and reduce the extent of glass fragmentation in the room from an external explosion.

Availability of ASF

ASF is specified in terms of thickness and can range from 100 to 375 microns, with the thicker films generally being required for glass thickness greater than 8mm, to achieve a greater level of injury mitigation, or for larger panes of glass. Single ply or multi-ply layer films may be used with improved performance generally achieved from multi-ply films.

ASF is available in a variety of roll widths, typically up to a maximum width of approximately 1800mm. It is important to ensure, where possible, that a single piece of film is applied to the window. For daylight applied ASF an edge distance between 1mm and 3mm should be achieved between the film and the frame. A maximum gap of 5mm is acceptable if the frames are irregular. Joints in the ASF should be avoided as they will reduce its mitigation performance.

Manufacturers of ASF

There are a number of major manufacturers of branded ASF available on the market. In addition, some installers may use 'Own brand' products sourced from the main manufacturers which may not come with the original manufacturer's warranties. Performance data is not transferable between similar films from different manufacturers. It is recommended that confirmation of the specification of the film supplied for the project should be provided by the contractor.

Certification of ASF

The mitigation level of daylight applied ASF is usually specified by its impact performance rating¹ with the quality of its application assessed visually and by testing the strength of the

¹ NPSA Guidance Note: Use of ASF and BBNC, NPSA EBP 08/13

adhesive bond. It is recommended that the following certification should be requested to demonstrate compliance:

Impact rating certificate – Daylight applied ASF is tested and rated in accordance with EN12600:2002². The classification of ASF required will depend on the glass thickness, threat level and distance of the window from the ground. See NPSA EBP 8/13 for further guidance.

Peel test certificate - The strength of the adhesive bond can be tested by carrying out a peel adhesion test. The peel adhesion test has been developed to test the effectiveness of newly installed and aged ASF. Details of the test's methodology, testing intervals (based on curing time) and the pass/fail criteria are provided in Guidance Note: Peel adhesion testing and assessment of ASF (NPSA EBP 10/13).

Evidence shows that certification presented for the ASF by some manufacturers can be up to 10 years old. Changes in BOPET manufacturing and the adhesives used, in the meantime, may mean that previous test results cannot always be relied upon. Evidence of current material certification for the film specified and supplied should be reviewed to confirm that the film supplied will provide the level of mitigation expected.

Wetting solutions

The wetting solution is applied to the ASF before being applied to the glass. Once in position, the excess moisture is removed by applying pressure to the film using an outward sweeping motion with a non-scratch plastic application tool. The liquid used in applying the film plays a critical role in the adhesion of the film to the glass and its mitigation performance.

If incorrect, incompatible or homemade wetting solutions are used such as plain water with additives, they may damage the adhesive bond between the film and the glass reducing the film's ability to contain the glass fragments under a blast load, and will not be evident until a peel test is carried out later in the curing period. Homemade solutions containing alcohol, washing-up liquid, or windshield washer are known to damage the adhesive bond and should never be used.

ASF should be installed using the manufacturer's specified wetting solution. Ideally, this should be the same as that used and specified in the supporting test certificate.

Application and visual acceptance

Visual acceptance guidance is defined by the GGF (Glass and Glazing Federation) standard³. This primarily focuses on the quality of the optical and aesthetic appearance of the installation and not the performance of the film as a mitigation measure i.e. how well the film is adhered to the glass. Imperfections such as water or air bubbles and dirt trapped between the film and the glass, lifting of edges and corner of the film, or creases, tears, wrinkles, patchiness and scratches reduce the adhesive contact with the glass and may impact the level of mitigation provided. Trained installers are required in order to mitigate this.

Films with thicknesses of 300 microns and upwards are very inflexible and require well qualified and trained installers to achieve good adhesion.

² EN12600:2002 Glass in building. Pendulum test. Impact test method and classification for flat glass

³ Glass and Glazing Federation Special Applications document 5.18.1 April 2008: SECTION 5 Visual Quality for Adhesive Backed Polymeric Filmed Glass.

Evidence and confirmation of training and a certification programme, to achieve the quality standard stated by the GGF standard, should be provided by the film installers.

Warranty

Warranties from installers should be carefully scrutinised as they will usually be limited to appearance only. They should cover mitigation performance and include full replacement cost i.e. material, labour, removing and installation of ASF, should this not be achieved during the design life.

Design life

Manufacturer's warranty periods range from 10-15 years, depending on the product and environment it is installed in. External applied films tend to offer reduced lifespans, typically between 5-8 years.

Daylight applied ASF - specification check points to consider

Table 1: In general it is recommended that the following check points are considered when specifying and accepting daylight applied ASF:

Measure	Description
Confirm the specification of the existing glass	<p>A site survey should be carried out to determine the types of glass which require blast mitigation measures. The glazing type may vary across the building/area or may have been partially replaced over time so a representative sample of the installation area must be selected.</p> <p>Note any existing film and specialist coatings that have been applied i.e. UV coating as this may affect the suitability of the ASF application.</p> <p>Record where existing ASF is already applied as this will need to be removed and the surface cleaned before reapplying.</p>
Determine the level of Mitigation required	<p>If possible specify the blast loading i.e. reflected pressure and impulse and the level of protection required. Ask the contractor to demonstrate compliance. By doing this, you may determine that the mitigation protection provided by daylight applied ASF is not sufficient.</p>
Request certificates and define acceptance criteria	<p>To provide assurance that the ASF provides the required mitigation level, it is recommended that the following is requested:</p> <ul style="list-style-type: none"> • Impact rating certificate – The test certificate should relate to the specific film product used on the project. Note the date of the test. If greater than 10 years old it is likely that changes to the product have been made which may affect its performance.

	<ul style="list-style-type: none"> • Batch data sheets – Retain the batch data sheets and samples from each individual batch (300x300mm) for testing at a later date if applicable. An individual roll will typically represent a batch.
Installation	<p>Installers of ASF should be trained to achieve the quality standard stated by the GGF standard. The training and certification program followed should also be approved by the original ASF film manufacturer.</p> <p>It is recommended that a test sample is installed to demonstrate the application quality standard before the contract begins. This test sample should be approved by the Client and used as a benchmark for the rest of the project installation.</p> <p>Evidence to demonstrate that the quality of work has been monitored during the installation should be provided together with a marked up drawing recording the date of installation, installer and the film batch number for the applied film.</p>
Post Installation checks	<p>As stated above, a record of product batch numbers should be kept with marked up drawings so that in the event of a peel test failure or product failure, all suspect material can be identified and removed.</p> <p>In conjunction with the visual acceptance test, it is recommended that a random peel test post installation is included as part of the final acceptance criteria, demonstrating that the film has been applied in accordance with the manufacturer’s guidance. The windows should be selected by the Client and carried out in their presence. NPSA Guidance Note EBP 10/13 provides information on the peel test and the recommended testing frequency.</p>
Warranty	<p>The warranty should include the following:</p> <ul style="list-style-type: none"> • Suitability of the product for the application – This refers to two aspects. Firstly, that the film meets the physical mitigation levels required/stated. Secondly, that the film recommended has been assessed to minimise the likelihood of thermal cracking in the existing window. • Installation, curing and final visual quality – All aspects of the ASF product, including optical, physical standards and properties e.g. changes as a result of ageing, and quality of workmanship should be covered. • Costs related to replacement of defective material and installation – If the film is assessed to have not met the original contract quality and performance criteria during the warranty period, full replacement costs e.g. labour, material and shipping should be covered by the warranty at no additional cost to the Client.

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