

# GUIDANCE NOTE: MEASURES TO IMPROVE THE BLAST RESISTANCE OF GLAZING

CPNI EBP 01/14: April 2014

## Disclaimer:

Reference to any specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favouring by CPNI. The views and opinions of authors expressed within this document shall not be used for advertising or product endorsement purposes.

To the fullest extent permitted by law, CPNI accepts no liability for any loss or damage (whether direct, indirect or consequential and including, but not limited to, loss of profits or anticipated profits, loss of data, business or goodwill) incurred by any person and howsoever caused arising from or connected with any error or omission in this document or from any person acting, omitting to act or refraining from acting upon, or otherwise using, the information contained in this document or its references. You should make your own judgement as regards use of this document and seek independent professional advice on your particular circumstances.

## Introduction

This Guidance Note replaces CPNI EBP 02/13: June 2013 - Guidance Note: Glazing Enhancement to Improve Blast Resistance. It has been issued to provide updated guidance on the use of glazing to reduce potential hazards from flying glass in the event of an explosion, and to provide guidance on the specification of more specialised glazing systems such as fixed point glazing which are frequently used in new commercial developments.

The measures contained in the Guidance Note should be considered as the minimum requirements for blast resistance. Other requirements such as Health and Safety and wind loading may be more stringent and result in thicker panes of glass or larger fixings being required. Where window systems require a level of blast resistance they should be specified by designers competent in the field of blast design.

NOTE 1: Suitable engineers should be members of the Register of Security Engineers and Specialists (RSES) ([www.rses.org.uk](http://www.rses.org.uk)) or be able to demonstrate that they have the training and experience to meet the appropriate RSES competences.

## Measures covered

The measures covered by this guidance note can be broken down into two broad categories; mitigation measures and protection measures.

Mitigation measures – are used where the potential for flying glass must be reduced but it is not practical to use other protection measures because: it is not possible to replace the windows because the building is listed or leased; the building is not considered a likely target but the potential for flying glass caused by the

blast from an explosion at some distance needs to be reduced. In such situations the installation of the following measures can be considered:

- Anti-Shatter Film (ASF) (sometimes referred to as Anti-Fragmentation Film) and Bomb Blast Net Curtains (BBNC)
- Laminated Glass in normal window frames.

Protection measures – are used where a specified level of protection is required and where it is possible to replace the existing windows, incorporate secondary window systems or influence new construction design. In these cases the building owner will need to agree the threat (charge mass and range or pressure and impulse) and the acceptable hazard level with the glazing designer.

In such situations the following measures are recommended:

- Blast Resistant Glazing in Blast Enhanced Frames
- Secondary Windows
- Blast Resistant Fixed Point Glazing

In addition to the measures identified above, combinations of laminated and toughened glass are frequently used in large window panes in areas classified as ‘crowded spaces’, such as shopping centres and transport related buildings, where a level of blast resistance may be required. In these situations the driving factor for determining the appropriate pane thickness will often be compliance with the Building Regulations or wind loading and not the minimum thicknesses specified in this guidance note. In such situations the assistance of designers competent in the field of blast design should be sought (see Note 1 above).

## Anti-Shatter Film (ASF) and Bomb Blast Net Curtains (BBNC)

- These should be used in normal window frames as a retrofit for existing annealed glass only where the windows cannot be replaced.
- This option approximately halves the stand-off range at which a Hazard would occur from flying annealed glass shards. ASF holds the broken glass together and BBNC will stop the glass and ASF being projected further into the building.
- More details can be found in CPNI EBP 08/13: December 2013 – Guidance Note: The Use of ASF and BBNC.

## Laminated glass in normal window frames

- This option provides better blast-mitigation than ASF and BBNC, subject to suitable frame fixings into the adjacent structure.
- Required in lieu of ASF and BBNC for 1) new builds; or 2) window replacements in some Government buildings.
- As a general principle laminated glass should be specified for all new works as it provides a significant improvement in blast resistance for a minimal increase in cost. Compliance with Building Regulations for heat loss generally dictates the use of double glazed units which are able to accommodate the increase in thickness required for laminated glass. For government buildings any deviation from this must be approved by the Departmental Security Officer. Further guidance for Government Departments can be found in the Security Policy Framework, Security Policy 4 - Physical Security and Counter-Terrorism.
- For single glazing not less than 6.8mm laminated glass should be used. In double glazed units (DGU) the inner pane should not be less than 6.8mm laminated glass and the outer pane should be a minimum of 6mm toughened or 6.8mm laminated glass. These dimensions relate to panes with maximum dimensions of approximately 1.5m x 1.2m. Where the pane dimensions are greater than this the

guidance of an engineer with experience in designing glazing systems to withstand blast loads should be sought (see Note 1). This is applicable for external facing windows where there is no likelihood of impact by people. If used in internal locations where the glass may be impacted by people, then the glass should also be designed in accordance with BS6262: Glazing in buildings - Part 4:2005 Safety related to human impact which may require toughened laminated glass to be used for both panes.

- For laminated glass further slight improvements in safety may be achieved by selective strengthening of the glazing assembly e.g. by adding fixing screws to beading and/or the frame.

## **Blast Resistant Glazing with Blast Enhanced Frames – where a greater level of blast resistance is required**

- These should be designed in accordance with the agreed threat and acceptable hazard level.
- For example for windows with maximum pane dimensions of approximately 1.5m by 1.2m minimum pane thicknesses for DGUs are: the inner pane should not be less than 7.5mm laminated glass and the outer pane should be a minimum of 6mm toughened or 6.8mm laminated glass. Where the pane dimensions are greater than this the guidance of an engineer with experience in designing glazing systems to withstand blast loads should be sought (see Note 1).
- The glass should be well held in suitable gaskets in 35mm rebates or be in at least 30mm rebates if held in well bedded clamped gaskets or, preferably, bonded with silicon or polysulphide sealant. The latter will reduce the hazard range to about a quarter of that for plain annealed glass.
- Other designed combinations of toughened and/or laminated glass or polycarbonate can be specified with appropriately designed and tested frames and fixings.
- In all cases the surrounding structure and fixings must be capable of withstanding the increased loads expected.

## **Secondary glazing**

- In situations where a greater level of blast resistance is required, and it is not practical to replace the window with laminated glass in enhanced frames, secondary glazing units may be considered.
- These window systems are designed to prevent the external glazing from entering the building and are either fixed within the window reveal or, where there is a reduced wall thickness, to the inner face of the wall.
- Such window systems are designed to be openable to provide access to the inside of the external glazing for cleaning and maintenance.

## **Glazed Façades**

- In certain situations where a large glazed façade is required the designer may recommend a façade using mullion and transom sections to form a glazing support structure, or where clear glazing lines are required, glass bonded to an internal frame or utilising a fixed point glazing system.
- These are specialist systems which are beyond the scope of this guidance note (though see note on fixed point glazing below). If blast resistance is required the façade and support system must be appropriately designed and must be checked by façade designers competent in the field of blast design (see note on page 1).

## **Blast Resistant Fixed point glazing**

- Fixed point, or planar glazing, is increasingly used for commercial buildings where architects want to reduce the visual impact of any support system. The design and specification of such window systems should only be undertaken by appropriately qualified façade designers.

- Where a degree of blast enhancement is required the fixings must be considered in conjunction with a correctly designed façade and support system which must be checked by façade designers competent in the field of blast design (see note on page 1).
- Details of suitable fixings for blast situations can be found in CPNI EBP 01/13 - Fixed-Point Glass: Specification for Blast Enhanced Fixings.

## Other considerations

For window systems designed to resist blast using laminated glass the bonds between the supporting structure and the edge of the glass and between the glass and the interlayer are crucial to ensure that the laminated glass is retained in position. Material defects such as edge delamination will reduce this bond and reduce the blast-resistance of the laminated glass. Further guidance is available in CPNI EBP 04/13: July 2013 – Guidance Note: Influence of Delamination of Laminated Glass on its Blast Performance.