GLOBAL HI-TECH FILMS
Middle East Regional Office
Dubai Airport Free Zone (DAFZ), Dubai, U.A.E.
www.GlobalWindowFilms.com

Ref: GHTF/ME/CS/2026/8MIL-01
To: Whom It May Concern

Date: 13 October 2026
Issued by: Global Hi-Tech Films – Middle East

STATEMENT OF COMPLIANCE

GLOBAL 8 MIL CLEAR SAFETY FILM • Safety & Security Window Film for Glass

We, **Global Hi-Tech Films**, hereby confirm that **Global 8 Mil Clear Safety Film**, manufactured by **Garware Hi-Tech Films Limited** (Naigaon, P.O. Waluj, Aurangabad – 431 133, Maharashtra, India), complies with the performance standards listed in this statement, as evidenced by the independent test reports issued by **TÜV Rheinland Nederland B.V.** (Notified Body 0336, ISO/IEC 17025 accredited) and the product Technical Data Sheet. The product is supplied in the Middle East region by Global Hi-Tech Films for glass doors, partitions, windows, façades, mirrors and other vulnerable glazed surfaces in residential, commercial and institutional buildings.

01 PRODUCT IDENTIFICATION

Product name	Global 8 Mil Clear Safety Film
Film construction	High-impact, micro-layered optically clear polyester (PET) safety film with pressure-sensitive adhesive; nominal thickness 8 mil (≈200 micron)
Manufacturer	Garware Hi-Tech Films Limited, Aurangabad, India
Supplier (Middle East)	Global Hi-Tech Films – Middle East Regional Office, DAFZ, Dubai, U.A.E.
Typical applications	Glass doors & partitions, windows and shopfronts, skylights, bathroom mirrors, elevator finishes, automobile windows

02 COMPLIANCE WITH STANDARDS – INDEPENDENT TEST EVIDENCE

Standard	Test / Configuration	Test Report	Classification	Result
EN 12600:2002 Pendulum impact – flat glass	4 mm clear float + 8 mil Safety Film; attack from **glass side**; 876 × 1938 mm; drop height 450 mm	TÜV Rheinland No. 89224672-21 Issued 21-01-2025	**2 (B) 2 Glass side**	**PASS**
EN 12600:2002 Pendulum impact – flat glass	4 mm clear float + 8 mil Safety Film; attack from **film side**; 876 × 1938 mm; drop height 450 mm	TÜV Rheinland No. 89224672-22 Issued 21-01-2025	**2 (B) 2 Film side**	**PASS**
EN 12600:2002 Pendulum impact – flat glass	4 mm clear float + 8 mil **Solar** Safety Film (tinted variant of the 8 mil safety film); glass side; drop height 450 mm	TÜV Rheinland No. 89224672-23 Issued 21-01-2025	**2 (B) 2 Glass side**	**PASS**
EN 356:1999 Security glazing – manual attack (hard body impact)	4 mm clear float + 8 mil **Solar** Safety Film; 900 × 1100 mm; 4.11 kg steel ball from 1500 mm, 3 strikes in a triangle; no penetration on all 3 test pieces	TÜV Rheinland No. 89224672-30 Issued 21-01-2025	**P1A EN 356 P1A**	**PASS**
Blast mitigation ISO arena method / UK PSDB / US GSA (indicative)	6 mm annealed float + 200 micron (8 mil) two-ply safety film with mechanical edge-retention system; 100 kg TNT equivalent at 31 m (measured Pr 58 kPa, impulse ≈327 kPa-ms) – **specimen R3**	ComBlast 2005, Spadeadam UK – GDA Report GDA/71-1701s (18-05-2005)	**Low Hazard (ISO / UK PSDB); GSA 3A equivalent**	**ACHIEVED***
ASHRAE, ASTM, BS EN 410 & AIMCAL Optical / solar & mechanical	Solar-optical and mechanical properties measured and reported per these methods (see Section 03)	Global Hi-Tech Films Technical Data Sheet – 8 Mil Clear Safety Film	**Data as per TDS**	**CONFORMS**

EN 12600 classification 2 (B) 2: *Class 2 impact resistance at 450 mm drop height; breakage mode B – numerous cracks appear but fragments hold together (typical of laminated safety glass).* ***EN 356 P1A:*** *lowest security-glazing resistance category against manual attack (hard body impact).*

** The blast test was a single-specimen range test conducted for the film manufacturer; per the report itself it indicates likely performance and is not a formal certification under ISO/ASTM, which require three identical specimens. Blast performance depends on the edge-retention/anchoring system used.*

Blast test – all specimens in GDA/71-1701s (6 mm annealed float, 1480 × 1080 mm clear glass, Bomb Gard edge retention, 100 kg TNT @ 31 m)

Specimen	Film tested (as stated in report)	Report ref.	Result
L1	175 micron / 7 mil two-ply safety film	§1.1 p.4, §4.1.1 p.18	Low Hazard; GSA 3A
C2	175 micron / 7 mil single-ply safety film	§1.2 p.5, §4.1.2 p.20	Low Hazard; GSA 3B
R3	**200 micron / 8 mil two-ply safety film – basis of this statement**	§1.3 p.6, §4.1.3 p.22	**Low Hazard; GSA 3A**

03 TECHNICAL PERFORMANCE DATA (per TDS)

Mechanical Property	Unit	Nominal Value
Tensile Strength at Break (MD)	kg/cm² | PSI	**3,600 | 51,200**
Break Load (MD)	kg/cm	**38**
Elongation at Break (MD)	%	**260**
Peel Strength (after curing)	g/inch	**5,000**
Abrasion Resistance (100 cycles haze addition)	%	**< 10**

Solar / Optical (on 6 mm clear, single pane)	Value
Visible Light Transmitted	**87 %**
UV Blocking	**> 99 %**
Solar Heat Gain Coefficient	**0.82**
Total Solar Energy Rejected	**18 %**
Visible Light Reflected (int / ext)	**9 % / 9 %**

Solar/optical values per TDS for 1/4" (6 mm) clear single-pane glass with the film applied; values vary with glass type and build-up.

04 CONDITIONS OF COMPLIANCE

- Test results relate to the specimens and configurations tested (glass type and thickness, film, frame and anchoring). Performance on site depends on the existing glass, its condition and the glazing/frame system.
- EN 12600 and EN 356 samples are asymmetrical; classifications apply to the attack side tested. The 8 mil film has been classified 2 (B) 2 from both the glass side and the film side.
- The film must be installed by trained applicators per Global Hi-Tech Films installation guidelines, with full adhesive curing before the stated performance is relied on. Daylight (edge-gap) application unless an anchoring/edge-retention system is specified.
- Full copies of the referenced test reports are available on request and form part of this statement; the reports are to be read in full and not in extracts.

05 DECLARATION

We declare that the information given in this statement is true and correct and is based on the independent test reports and manufacturer's technical data listed above. Global 8 Mil Clear Safety Film supplied by Global Hi-Tech Films is of the same specification as the product tested.

Enclosures

1. TÜV Rheinland Test Report 89224672-21 – EN 12600, 4 mm glass + 8 mil Safety Film (glass side)
2. TÜV Rheinland Test Report 89224672-22 – EN 12600, 4 mm glass + 8 mil Safety Film (film side)
3. TÜV Rheinland Test Report 89224672-23 – EN 12600, 4 mm glass + 8 mil Solar Safety Film
4. TÜV Rheinland Test Report 89224672-30 – EN 356 P1A, 4 mm glass + 8 mil Solar Safety Film
5. ComBlast 2005 Explosion Range Test Report GDA/71-1701s (attached in full after this statement)
6. Technical Data Sheet – Global 8 Mil Clear Safety Film

TEST REPORT

ADVANTICA

Garware Polyester Limited

Explosion Range Testing
ComBlast 2005 Part 1
March 17th 2005



ComBlast2005

GDA & DGA

An Advantica Ltd., Grendon Design Agency Ltd. and David Goode & Associates group project.

Document prepared by: Simon Trundle
Trials Manager
ComBlast 2005-1

Test Report Ref: GDA/71-1701s

Date: 18/05/2005

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1. Introduction

This test report records the results of a range test conducted on glass protection systems supplied by Garware Polyester Limited as part of the ComBlast 2005 Explosion Range Trials.

The Comblast trials were established to allow commercial companies to undertake explosion testing of their products alongside the formal Home Office annual range trails. The commercial trials element of the Comblast tests is managed by a partnership comprising of Advantica Limited [test site provider and shot firing], D. J. Goode & Associates [design of test structures] and Grendon Design Agency [GDA] [Commercial Trials Management].

The Garware Polyester explosion range test was undertaken on the afternoon of the 17th March 2005 at the Advantica Technology test site at Spadeadam, Cumbria, England, under the supervision of Simon Trundle, Managing Director of Grendon Design Agency. A total of three separate test specimens were provided for explosion testing as detailed within this test report.

The individual test specimens were prepared by Anglian Windows Limited on behalf of Garware and installed in the test cubicle by Advantica Technology Limited at the Spadeadam test range in Cumbria, United Kingdom.

Method Of Mounting Glass In Test Frames

The 6mm annealed float glass lite used for all test specimens was mounted into the test frames using compression gaskets. The glass rebate edge cover was approximately 10mm.

Limitation Of Test Performance

Only one sample of each type of product was tested and therefore is not considered a valid certification of performance under the ISO or ASTM standards where a minimum of three identical test specimens must achieve the same result.

These test results also relate only to the materials and the configurations tested and no alterations to the material manufacturer, composition or assembly method can be accepted unless further testing is undertaken.

1.1 Test specimen L1



Test specimen window frame:	1590mm x 1190mm wide.
Style:	Fixed lite non-opening
Clear glass area:	1480mm x 1080m.
Glass:	6mm annealed float held with compression gaskets
Window film manufacturer:	Garware Polyester
Window film type:	175 micron/7mil two-ply safety film.
Window film brand name:	Garsafe, Glassafe, Garware Sun Control and Global Window Film.
Date of test;	17th March 2005
Edge protection system:	A metal film anchoring system was applied to the internal perimeter of the filmed glass to anchor the filmed lite to the aluminium frame. The system was identified as the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada, supplied and fitted by Garware Polyester Limited/Anglian Technical Windows Ltd, UK.
Mounting of test specimen:	Total 10 x M10 mild steel bolts into test cubicle.

1.2 Test specimen C2



Test specimen window frame:	1590mm x 1190mm wide.
Style:	Fixed lite non-opening
Clear glass area:	1480mm x 1080m.
Glass:	6mm annealed float held with compression gaskets
Window film manufacturer:	Garware Polyester
Window film type:	175 micron/7mil single-ply safety film.
Window film brand name:	Garsafe, Glassafe, Garware Sun Control and Global Window Film.
Date of test;	17th March 2005
Edge protection system:	A metal film anchoring system was applied to the internal perimeter of the filmed glass to anchor the filmed lite to the aluminium frame. The system was identified as the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada, supplied and fitted by Garware Polyester Limited/Anglian Technical Windows Ltd, UK.
Mounting of test specimen:	Total 10 x M10 mild steel bolts into test cubicle.

1.3 Test specimen R3



Test specimen window frame:	1590mm x 1190mm wide.
Style:	Fixed lite non-opening
Clear glass area:	1480mm x 1080m.
Glass:	6mm annealed float held with compression gaskets
Window film manufacturer:	Garware Polyester
Window film type:	200 micron/8mil two-ply safety film.
Window film brand name:	Garsafe, Glassafe, Garware Sun Control and Global Window Film.
Date of test;	17th March 2005
Edge protection system:	A metal film anchoring system was applied to the internal perimeter of the filmed glass to anchor the filmed lite to the aluminium frame. The system was identified as the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada, supplied and fitted by Garware Polyester Limited/Anglian Technical Windows Ltd, UK.
Mounting of test specimen:	Total 10 x M10 mild steel bolts into test cubicle.

2. High Explosive Testing

The following text describes in general terms the forces applied to a test specimen in an explosion.

Detonation of a high order explosive produces a shock in air, which takes the form of a rapidly expanding pressure wave in the surrounding atmosphere. The blast wave expands outwards until it meets an object in its path i.e. the test cubicle.

The expanding blast pressure wave is arrested in its travel and in this instance 'reflects' against the front surface of the test cubicle. This expanding pressure wave is referred to as the positive phase or reflected pressure load.

A negative phase effect is experienced immediately following the rapid overpressure load generated by the expanding pressure wave. The negative phase [suction] is created when the detonation of the high explosive and rapid outward movement of the blast wave creates a vacuum at the seat of the explosion, which is rapidly filled by the surrounding atmosphere being drawn back into the evacuated space. This rapid return of air to fill the void created at the centre of the blast causes a reverse flow in the surrounding atmosphere, which causes drag or suction on the face of the test specimen. The negative phase can sometimes coincide with the elastic response of the test specimen and thereby further increase the rebound effect.

2.1 Details Of The Explosive Charges

Tests were conducted using a nitro-methane based explosive liquid contained within a cylindrical container set at a height of 800mm above the surface of the concrete test pad. Pre-testing of the nitro-methane based explosive was undertaken by Advantica to determine the net equivalency to TNT.



The nitro-methane charge size used in these tests was selected as a direct equivalent to 100kg TNT High Explosives. The explosive charge was supported on polystyrene packing to ensure that no fragments would be ejected from the charge support.

P1: Explosive charge

2.2 Blast Pressure And Impulse Loading

The test range of 31 metres from 100kg TNT was chosen on the basis that a daylight application of 200 micron 2-ply anti-shatter window film should have left the window opening and landed inside the structure within the Low Hazard zone. All three test specimens were set in a test cubicle at the same range in order to determine the value of the different film types with common anchoring under the same blast loading.

Table 1 summarises the average values using the Conwep [Conventional Weapons Effects Program] analytical program developed by the US Government and in use with the UK PSDB and Home Office.

Table 1: Blast Pressure And Impulse Loading – Predicted by ConWep

100kg TNT charge Shot number and range	Side-On Pressure		Reflected Impulse		Equivalent Reflected Pressure On face of Test Specimen	
	P_{so} kPa	P_{so} Psi	kPa-msec	Psi-msec	P_r kPa	P_r Psi
Shot No 1 @ 31metres	29	4.26	376	55	57	8.37

The above table shows the predicted pressure and impulse loading calculated using the United States Conventional Weapons Effects Program [CONWEP] after inputting the surface area of the test cubicle and wing walls and calculating the average reflected pressure and impulse. The CONWEP software is know to over predict the impulse values as it does not take account of clearing [pressure wave rapidly rolling over the top of a small target] and therefore blast gauges were mounted within the test arena to record the following side on and reflected pressures and impulses.

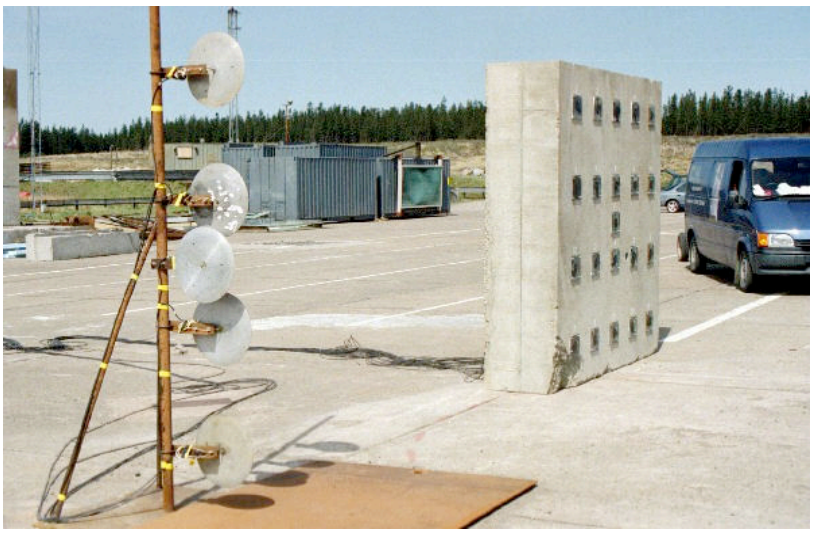
Table 2: Blast Pressure And Impulse Loading – Measured On Range

100kg TNT charge Shot number and range	Measured Side-On Pressure		Reflected Impulse		Equivalent Uniform Reflected Pressure On face of Test Specimen	
	P_{so} kPa	P_{so} Psi	kPa-msec	Psi-msec	P_r kPa	P_r Psi
Shot No 1 @ 31metres	30	4.41	307	45.13	58	8.52

Table two includes the average values measured over four gauges e.g. 2 gauges in the gauge block test wall measuring reflected pressure and impulse and 2 side-on gauges standing in the free field measuring the side on pressure as the blast wave passed by.



P2: Free field gauges



P3: Gauge block

Photos show free field gauges [P1] for measuring side-on incident pressure and the gauge block [P2] used for measuring reflected pressure on face of test specimen.

Summary Of Blast Load

The test specimens received a reflected pressure on the impact face of 58 kPa [8.52 psi] and a reflected impulse loading of 327 kPa-millisecond [48.07 psi-millisecond].

3. Classification Of Performance

The following text and graphic are extracts taken from sections 4 and 7.4 of the new ISO Arena Test Standard draft of October 2003. It is expected that this blast test standard will be adopted internationally in 2006 and is therefore used to classify the results of these tests.

A hazard rating is applied to glazing based on its performance under the blast conditions chosen for the test. The rating is specific to those blast conditions. The hazard rating of the glazing or glazing system shall be according to the rating criteria definitions provided below and further demonstrated in the Figure.

Table 1: ISO Method Of Classification

Hazard Rating	Description	Definition [summary]
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 is fully retained in the facility test frame or glazing system frame with no breach and no material is lost from the interior surface
C	Minimal Hazard	The glazing is observed to fracture and the total length of tears in the glazing plus the total length of pullout from the edge of the frame is less than 20 percent of the glazing sight perimeter. Also, *(. . permissible dust and fragments . .etc)*
D	Very Low Hazard	The glazing is observed to fracture and is located within 1m of the original location. Also, *(. . permissible dust and fragments . .etc)*
E	Low Hazard	The glazing is observed to fracture but glazing fragments fall between 1 m of the interior face of the specimen and 0.5 m or less above the floor of a vertical witness panel located 3 m from the interior face of the specimen. Also, *(. . permissible dust and fragments and indents. .etc)*
F	High Hazard	Glazing is observed to fracture and there are more than 10 perforations in the area of a vertical witness panel located 3 m from the interior face of the specimen and higher than 0.5 m above the floor or there are one or more perforations in the same witness panel area with fragment penetration through the first layer and into the second layer of the witness panel.

The results of the test classification are expressed in the following graphic which is reproduced in larger scale in Annex A.

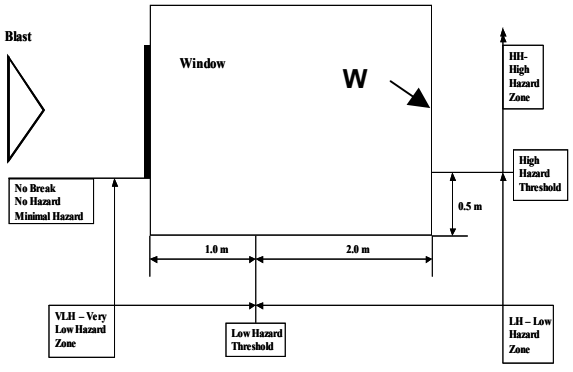


Figure 1: ISO standard hazard zones.

Table 2: GSA Method Of Classification

The following table summarises the performance criteria adopted by the US GSA.

Performance Condition	Description	Glass Fragments		Hazard Level	Protection Level
		Exterior to structure	Interior to structure		
1	Glass not cracked, fully survived and/or fully retained by frame and no glass fragments either inside or outside structure.	None	None	NA	Very High
2	Glass may be cracked but is retained by the frame.	Yes	No significant fragments. Dusting or very small fragments near sill or on floor acceptable.	Very Low	Very High
3a	Glass failed and not fully retained in frame.	Yes	Yes - land on floor no more than 40 inches from window	Low	High
3b	Glass failed and not fully retained in frame.	Yes	Yes - land on floor no more than 10 ft from window.	Low	High
4	Glass failed and not fully retained in frame.	Yes	Yes - Land on floor more than 10 ft from window and impact a vertical surface located not more than 10 ft behind the window no higher than 2 ft above floor level.	Medium	Medium
5	Glass fails catastrophically.	Yes	Yes - land on floor more than 10 ft from window and impact a vertical surface not more than 10 ft behind window above a height of 2 ft.	High	Low

Note: In the USA, Category C facilities require protection from window fragments up to a blast load with a peak pressure of 4psi and an impulse of 28 psi-ms. A performance condition (Damage Level) 4 is permitted for Category C. A graphical depiction of the performance conditions contained in the criteria is shown in Figure 1. A description of the performance conditions and hazard levels are outlined in Table 3.

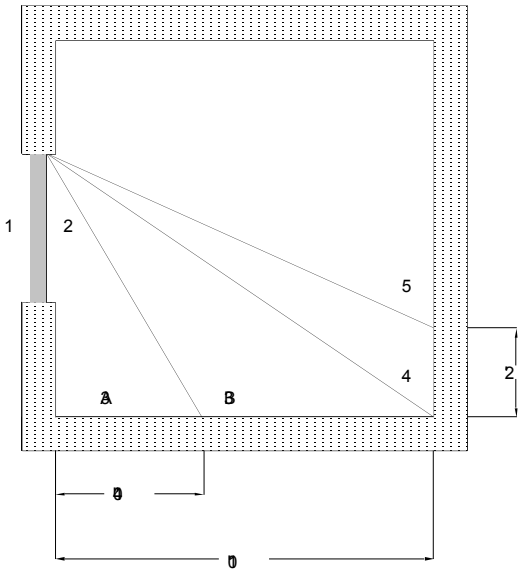


Figure 2: GSA Performance Zones

The United Kingdom Home Office has undertaken explosion testing of glazing materials on an annual basis since 1980 under the EDICTS test program. The EDICTS test program was

undertaken to develop a better understanding of the performance of different glass types, under blast load. The data extracted from the EDICTS research program has lead to it being possible to judge the hazard threshold for unprotected common forms of glass such as annealed float and to identify the benefits that can be gained by retrofitting the annealed glass with window safety film or by replacing the annealed glass with laminated or toughened safety glass.

For the purpose of these current trials we have adopted the EDICTS hazard classification system in the absence of any formal UK or CEN test standards for blast resistance.

The UK EDICTS test criteria relates to the classification of hazard for glazing systems in post break condition and is based on the following performance criteria:

B/S[(1)] 'Break Safely' is where the glass cracks but remains within the window frame. If it is toughened or plain glass [annealed] it may crack and fall outside or into the test cubicle but with no projection of the fragments beyond a 1000mm distance internally. If it is laminated or filmed glass it should remain securely in place. [(1)]B/S has recently being re-designated as 'Minimal Hazard' to overcome the confusion which can arise from a material being designated 'break safe' that evidently has disintegrated under blast load with clear evidence of glass fragments within the test structure.

L **'**Low Hazard' is where fragments or the entire pane of glass falls into the test cubicle to land on the floor without striking the rear wall which is set 3m away from the window opening. This implies that the fragments or pane of glass would be travelling at low velocity and thus proves less injurious to persons within a property affected by blast.

H 'High Hazard' is when the glass fragments/pane or any part of the test specimen strikes the rear wall of a 3metre deep test cubicle at 0.5m above the floor.

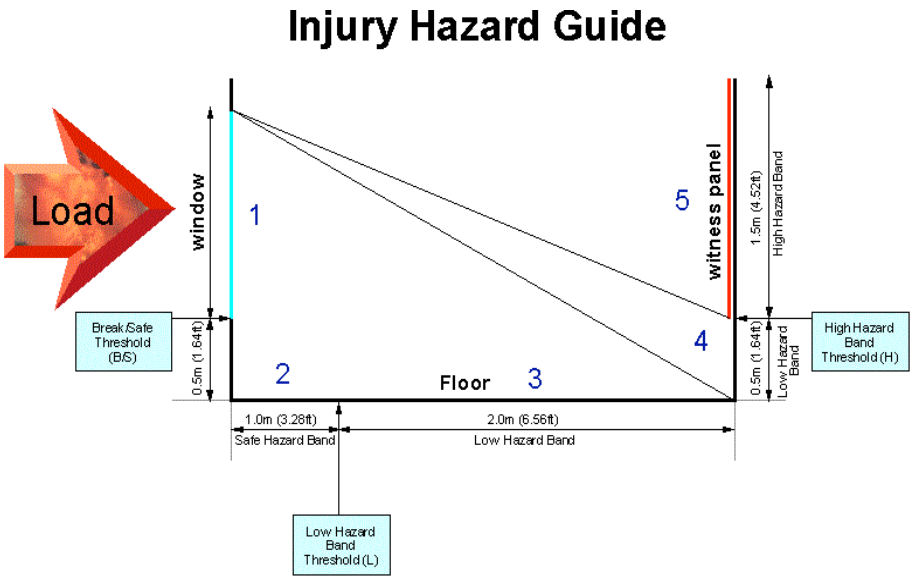


Figure 3: UK PSDB hazard zones.

3.1 Details Of The Test Specimens

Window test specimens were mounted into a steel test structure details of which are included within Annex A.



P4: View of test structure prior to detonation

The individual test specimens are numbered as follows:

L1 [left]: Aluminium framed window containing 6mm annealed float glass with Garware 175 micron two-ply film fitted with the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada, supplied and fitted by Garware Polyester Limited/Anglian Technical Windows Ltd,UK.

C2 [centre]: Aluminium framed window containing 6mm annealed float glass with Garware 175 micron single-ply film fitted with the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada..

R3 [right]: Aluminium framed window containing 6mm annealed float glass with Garware 200 micron two-ply film fitted with the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada.



P5: Typical film anchoring detail

All three test specimens were fitted with the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada. The attachment system comprises a folded aluminium section, indicated as black trim to the interior of the window. The aluminium metal thickness was observed as approximately 1.5mm although details of the system were not disclosed to the testing authority.

Photo shows the M10 mounting bolts used for retaining the window frame into the test cubicle opening.

3.1.1 Security Window Film

The trials were undertaken using window film manufactured by Garware Polyester Limited based in Aurangabad, India.

One sample of each film type was tested as follows:

175 micron/7mil two-ply safety film manufacturer's reference Garsafe, Glassafe, Garware Sun Control and Global Window Film.

175 micron/7mil single-ply safety film manufacturer's reference Garsafe, Glassafe, Garware Sun Control and Global Window Film

200 micron/8mil two-ply safety film manufacturer's reference Garsafe, Glassafe, Garware Sun Control and Global Window Film

3.1.2 Disclaimer

The test results recorded within this report apply only to the items tested and any modification of either the window film material or anchoring systems used in these tests will require a separate test for validation of test performance.

Table 3. GSA Criteria for Test Specimen Performance Conditions

Performance Condition	Description	Glass Fragments		Hazard Level	Protection Level
		Exterior to structure	Interior to structure		
1	Glass not cracked, fully survived and/or fully retained by frame and no glass fragments either inside or outside structure.	None	None	NA	Very High
2	Glass may be cracked but is retained by the frame.	Yes	No significant fragments. Dusting or very small fragments near sill or on floor acceptable.	Very Low	Very High
3a	Glass failed and not fully retained in frame.	Yes	Yes - land on floor no more than 40 inches from window	Low	High
3b	Glass failed and not fully retained in frame.	Yes	Yes - land on floor no more than 10 ft from window.	Low	High
4	Glass failed and not fully retained in frame.	Yes	Yes - Land on floor more than 10 ft from window and impact a vertical surface located not more than 10 ft behind the window no higher than 2 ft above floor level.	Medium	Medium
5	Glass fails catastrophically.	Yes	Yes - land on floor more than 10 ft from window and impact a vertical surface not more than 10 ft behind window above a height of 2 ft.	High	Low

Note: In the USA, Category C facilities require protection from window fragments up to a blast load with a peak pressure of 4psi and an impulse of 28 psi-ms. A performance condition (Damage Level) 4 is permitted for Category C. A graphical depiction of the performance conditions contained in the criteria is shown in Figure 1. A description of the performance conditions and hazard levels are outlined in Table 3.

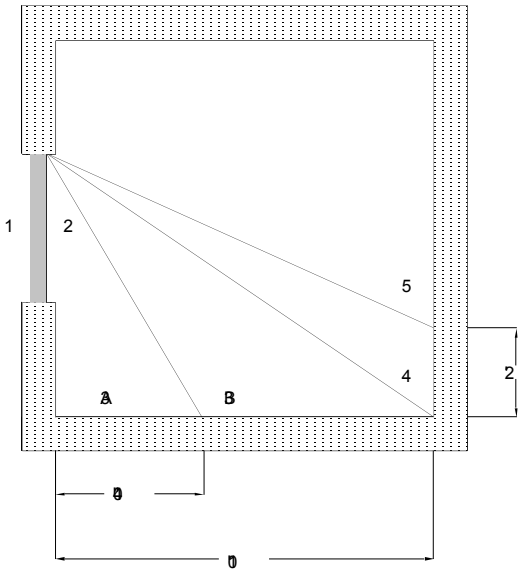


Figure 1. GSA Performance Conditions

3.2 Measurement Of Glass Fragments Ejected From Test Specimen

The ISO, UK PSDB and GSA classification systems recognise the fact that the primary aim of any glass protection system is to limit the travel of the external window glass into the interior of a building where persons might be working and moving about in close proximity to the glass.

The classification of performance of glazing systems in both the US and UK allows for fragments of glass or indeed the entire pane of glass to fall inside the test cubicle [building] so long as the fragments or pane of glass do not travel inwards at sufficient velocity to impact a witness panel mounted 3metres away from the test specimen.

There is evidently a considerable difference in hazard between some loose fragments falling inside the test cubicle compared to an entire sheet of glass entering the room. Falling glass fragments will cause considerably less injury as a rule compared to being impacted by a sheet of glass weighing in excess of 20kg as in the case of these tests. However, both the ISO, US GSA and UK PSDB classification system would appear to classify both loose fragments [even one] and the entire sheet entering the test cubicle as offering similar levels of protection.

In previous trials of window film for the US General Services Administration, GDA in partnership with EQE Limited of San Antonio USA developed a hazard level classification for total glass fragment mass in Zone 3A and 3B. A Low mass level was defined as a total mass less than or equal to 100 g. Medium mass level is a total mass greater than 100 g but less than 501 g. The High mass level is defined as a fragment mass greater than 500 g. These hazard levels, which are not included in the GSA criteria, are used to differentiate between the severity of hazard, risk of injury, and probability of fragment impact within Zone 3 since they are an indication of the number of fragments. Two tests which both produce a Level 3B performance condition may differ greatly in the hazard to personnel depending on the amount of glass fragments in the test cubicle. Comment is therefore provided within the results section of each test as to the overall mass of glass fragments found within the test cubicle and in which section of the cubicle they were found.

4. Results And Photographic Record Of Tests

4.1 Shot No 1: 100kg TNT Equivalent Charge Weight @ 31 Metres



P8: View of test cubicle post detonation of 100kg TNT at 31metres stand off.

L1 [left]:

Aluminium framed window containing 6mm annealed float glass with Garware 175 micron two-ply film fitted with the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada.

C2 [centre]:

Aluminium framed window containing 6mm annealed float glass with Garware 175 micron single-ply film fitted with the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada..

R3 [right]:

Aluminium framed window containing 6mm annealed float glass with Garware 200 micron two-ply film fitted with the Bomb Gard Edge Retention System manufactured by View Plus Window Film Products Inc, Canada.

4.1.1 Results Of Test Specimen L1

View of test specimen L1 post detonation.



P9

- The filmed glass lite was partially retained on one side after failure of the Bomb Gard anchoring system in the blast.
- The Garware 175micron two-ply window film retained approximately 95% of the broken glass fragments.
- Glass fragments, totalling less than 100grammes, were found on the floor of the test structure within GSA hazard zone 3A. Minor glass fragments were noted within zone 3B but of insufficient mass to reduce the 3A performance rating.

Test specimen L1 achieved Low Hazard classification in accordance with UK PSDB and ISO methods of classification. The test specimen also achieved an equivalent 3A performance to the US General Services Administration performance classification although the pressure and impulse loading were considerably above the required GSA level.

Classification of a single test specimen is not permitted under the ASTM or ISO standards where a minimum of 3 identical test specimens must achieve the same performance. Therefore, it should be noted that a single test, while providing an indication of the likely result, does not imply formal classification of a systems performance under blast load.



P10 View of interior of test chamber L1.

Interior photograph shows glass fragment scatter on interior of test chamber within GSA zone 3A and 3B. Total mass of glass fragments less than 100 gram in weight.



P11

View of test specimen from inside cubicle. The Bomb Gard anchoring system delaminated from the film at the cill and was pulled out of the frame at the side and head.

4.1.2 Results Of Test Specimen C2

View of test specimen C2 post detonation.



P12

- The Garware 175 micron single-ply film ripped in the blast and was driven into the test cubicle landing on the floor. The Bomb Gard anchoring system remained attached to the window frame on three sides and portions of the window film was left attached to the anchoring bars as evident in the above photograph.
- The system achieved a Low Hazard classification with the glass landing within GSA zone 3B inside the test cubicle. There was no indication of glass fragments embedded in the witness boards on the rear wall although the entire lite weighing approximately 20kg landed inside the cubicle.
- The test was conducted at a range where 6mm annealed float glass with 200 micron anti-shatter window film at 31 metres range from 100kg TNT was predicted to travel further into the test cubicle. A pre-test using proved that daylight window film landed in the same location as this test specimen.

Test specimen C2 achieved the equivalent of an ISO Low Hazard classification. The test specimen also achieved an equivalent 3B performance to the US General Services Administration performance classification although the pressure and impulse loading were considerably above the required GSA level.

Classification of a single test specimen is not permitted under the ASTM or ISO standards where a minimum of 3 identical test specimens must achieve the same performance. Therefore, it should be noted that a single test, while providing an indication of the likely result, does not imply formal classification of a systems performance under blast load



P13

View of interior of test chamber showing the filmed lite within zone 3B and extensive glass fragment scattered throughout the entire cubicle.

The Bomb Gard anchoring bar struck the left hand wall and buckled, tearing from the file and landing separate as indicated in the above photograph.

4.1.3 Results Of Test Specimen R3

View of test specimen R3 post detonation.



P14

- The filmed glass lite was ejected from the frame to land within 0,50m of the front face of the cubicle. The filmed lite had one side of the Bomb Gard anchoring system still attached with the remaining three sides of the anchoring system still fixed to the window frame.
- The Garware 200 micron two-ply window film retained approximately 70% of the broken glass fragments.
- Glass fragments, totalling less than 100grammes, were found on the floor of the test structure within GSA hazard zone 3A. Minor glass fragments were noted within zone 3B but of insufficient mass to reduce the 3A performance rating.

Test specimen R3 achieved Low Hazard classification in accordance with UK PSDB and ISO methods of classification. The test specimen also achieved an equivalent 3A performance to the US General Services Administration performance classification although the pressure and impulse loading were considerably above the required GSA level.

Classification of a single test specimen is not permitted under the ASTM or ISO standards where a minimum of 3 identical test specimens must achieve the same performance. Therefore, it should be noted that a single test, while providing an indication of the likely result, does not imply formal classification of a systems performance under blast load



P15

Test specimen R3: View of cill and floor of test chamber. The Bomb Gard anchoring system possessed insufficient strength or adhesion to retain the filmed lite in the opening.

Fragments of window film remained attached to the anchoring in the window opening implying delamination between layers of the 200 miron two-ply film.

Glass fragments were identified inside zone 3B [in accordance with GSA classification].



P16

200 micron two-ply film showing large area of clear film on bottom left corner where the glass has become detached in the explosion.

5. Observations

The selection of the 31 metre range proved correct in that it is the base line comparison where the daylight filmed 6mm annealed float glass is typically ejected from the frame to land inside the test cubicle.

While all three test specimens gained the same Low Hazard classification there was a clear difference in the performance of the multi-ply films over the single ply 175 micron film which landed inside the test chamber.

The more flexible multi-ply films appeared to stretch under blast load and absorb sufficient energy to last until the negative suction phase pulled the film out of the window opening, completely in the case of the 200 micron two-ply film and partially [on three sides] with the 175 micron two-ply film.

The Bomb Gard anchoring system did not stand up to the forces transmitted through the film and failed either through lack of adhesion either to the window film or to the window frame.

Only one sample of each type of product was tested and therefore is not considered a valid certification of performance under internationally recognised ASTM or ISO standards which require a minimum of three identical test specimens to achieve the same result.

These test results also relate only to the materials and the configurations tested and no alterations to the material manufacturer, composition or assembly method can be accepted unless further testing is undertaken.

Report concludes:

Author:



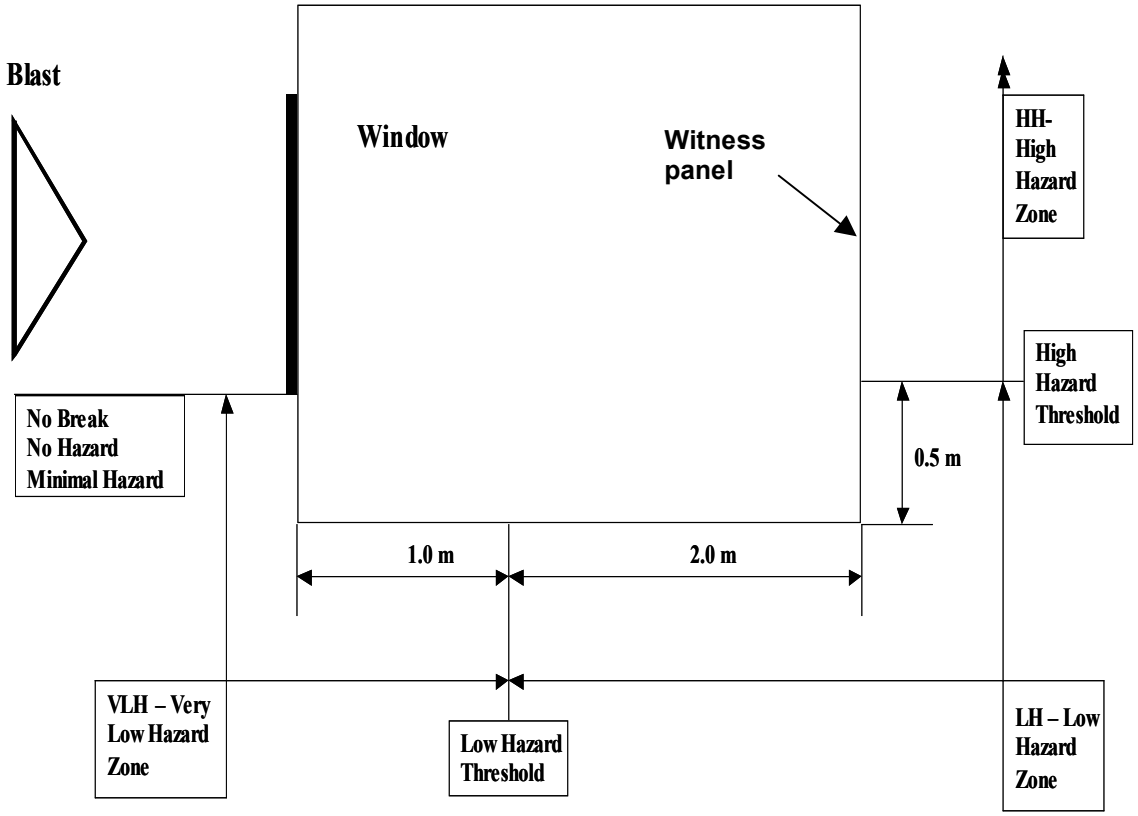
Simon Trundle:

Commercial Trials manager

ComBlast 2005-1

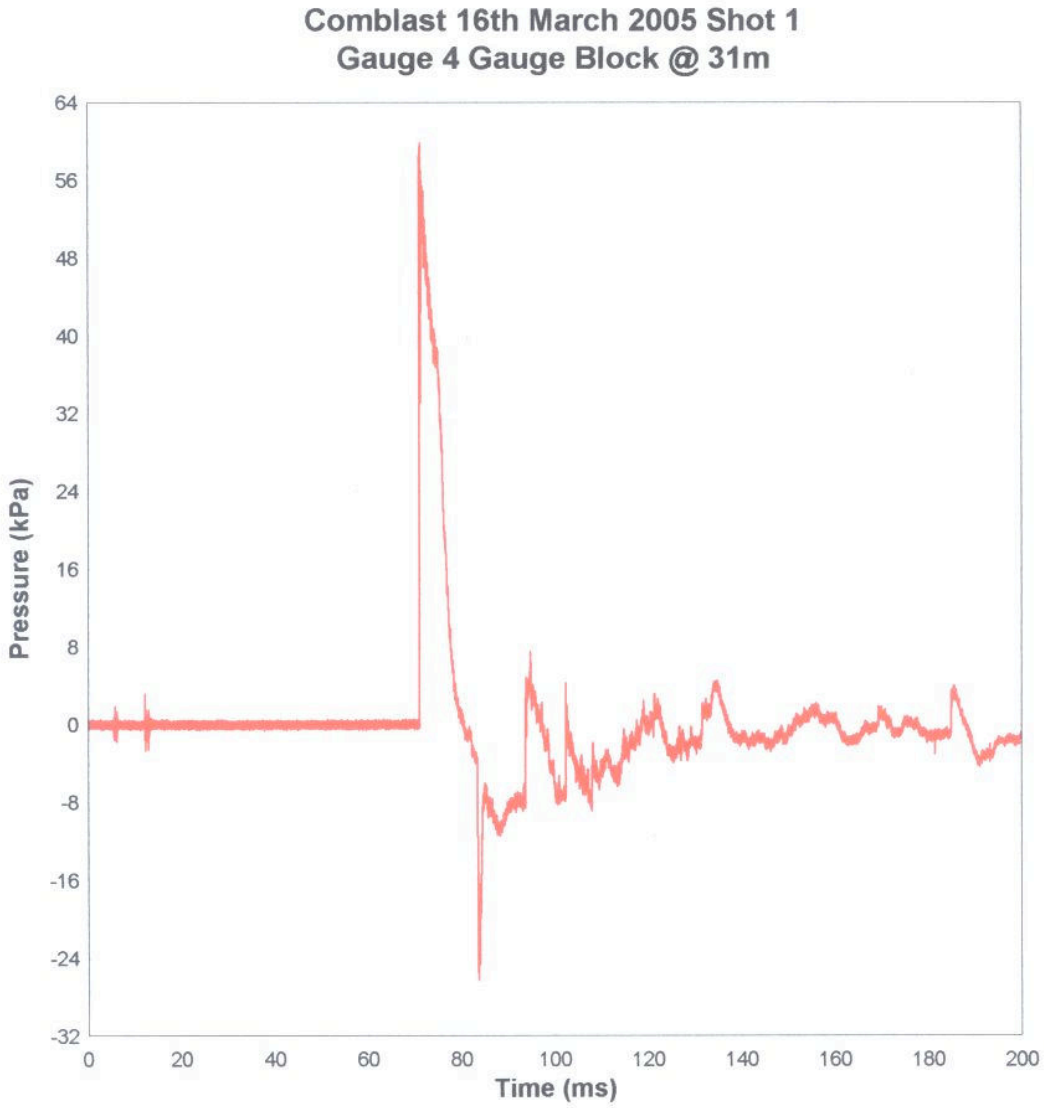
Date: 24/04/2005

Annex A: ISO Hazard Classification Diagram

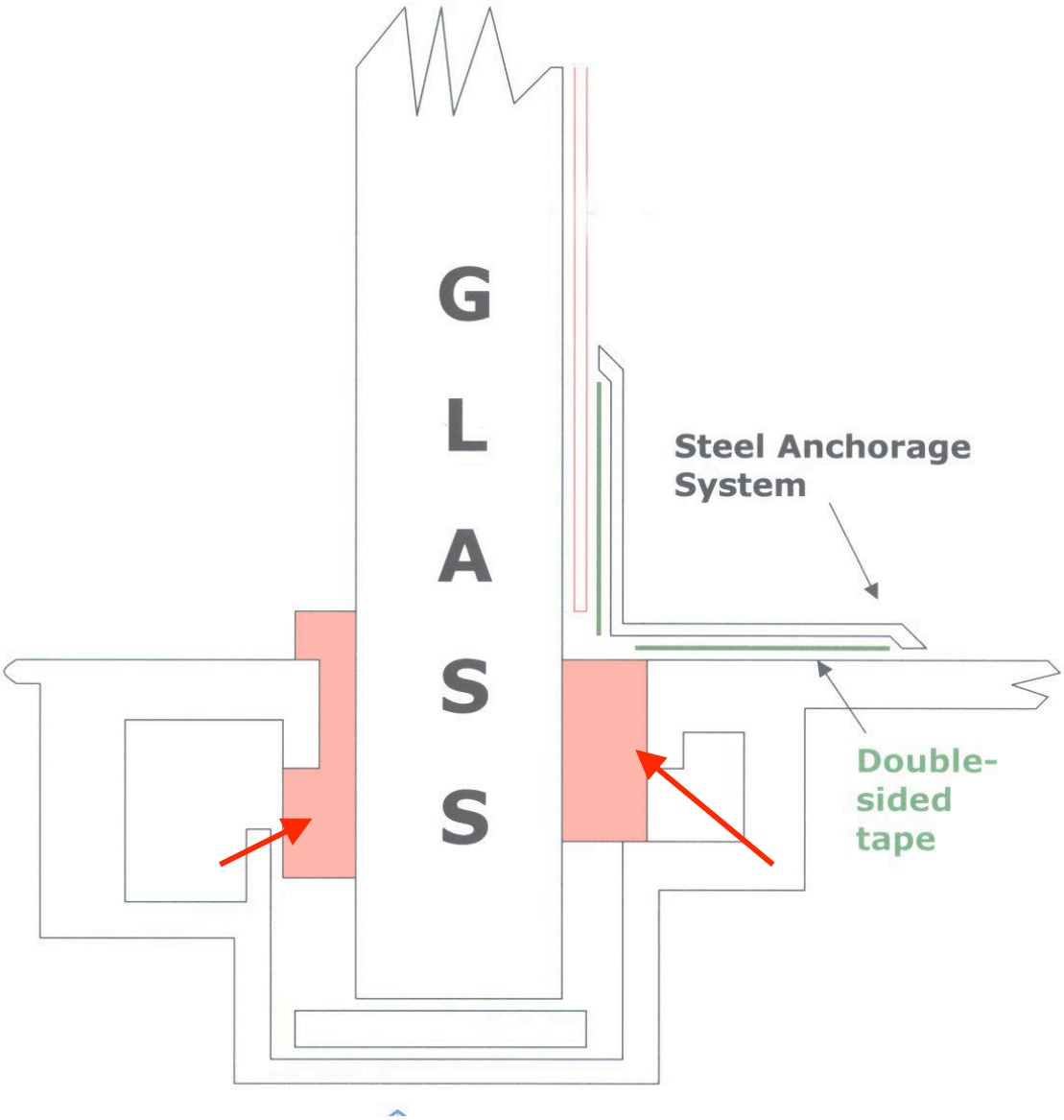


Cross-section through Witness Area

Annex B: Blast Plot


Comblast 16th March 2005 Shot 1
Gauge 4 Gauge Block @ 31m
Pressure (kPa)
64
56
48
40
32
24
16
8
0
-8
-16
-24
-32
0
20
40
60
80
100
120
140
160
180
200
Time (ms)

Annex C: Drawings Of Test Specimen



The above sketch is illustrative only of the arrangement of the window film and the Bomb Gard anchoring system. The glass was retained by compression type wedge gaskets at the locations indicated by the red arrows and not by an adhesive tape as implied by the shape of the gasket in the above sketch. The compression gaskets were approximately 8mm in height.