

# blast mitigation design manual



# DEFENDER

## BLAST MITIGATION PRODUCTS



**National Guard Readiness Center**  
Spokane, WA

# introduction

In the blink of an eye, the contemporary concept of facility security was forever changed on the morning of April 19, 1995. The attack on the Murrah Federal Building in Oklahoma City, and the implications of the complex physical interactions caused by an event of that magnitude compelled architects, engineers, and the Federal Government to reexamine the design process and expectations for government facilities. A blast event of that nature turns conventional glass into a multitude of tiny shards propelled at over 200 feet per second into a structure. Studies estimate that over 60% of the casualties in the Murrah Building were glass related. Reports of shattered glass were received from up to 14 blocks away from the Murrah Building, demonstrating the vulnerability that structures near a possible target site face for collateral damage.

United States Aluminum has designed and tested a host of Blast Mitigation Glazing Systems, manufactured to the highest standard, to provide protection for GSA, DoD, and private sector facilities. These systems cover the range of glazing requirements, including Storefront, Entrance, Curtain Wall, and Window Systems designed to meet a variety of protection levels. While our dedicated Blast Mitigation Project Management Team and Application Engineers will provide assistance in selecting the appropriate system for a project, it is strongly recommended that each project design team work with an experienced blast consultant to ensure compliance.

## **INTRODUCTION**

Blast Mitigation .....	1
------------------------	---

## **BLAST MITIGATION**

Design Considerations and Standards .....	2
---	---

## **LEED® STANDARDS**

Green Building Considerations .....	8
-------------------------------------	---

## **BLAST ENTRANCE**

Blast Resistant Entrance System.....	10
--------------------------------------	----

## **BT601**

1 psi Blast Resistant Storefront System .....	12
---	----

## **BR604**

4 psi Blast Resistant Storefront System .....	14
---	----

## **BR606**

6 psi Blast Resistant Storefront System .....	16
---	----

## **BW3250**

Blast Resistant Curtain Wall System .....	18
---	----

## **BW7500**

Blast Resistant Vent Window System.....	20
---	----

## **BW8000**

Blast Resistant Single Hung Window System .....	22
---	----

## **BW8200**

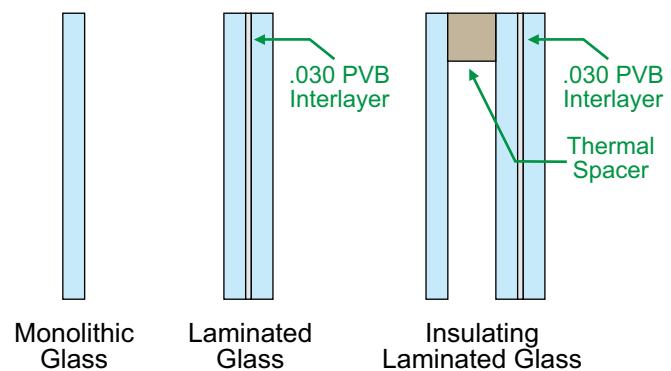
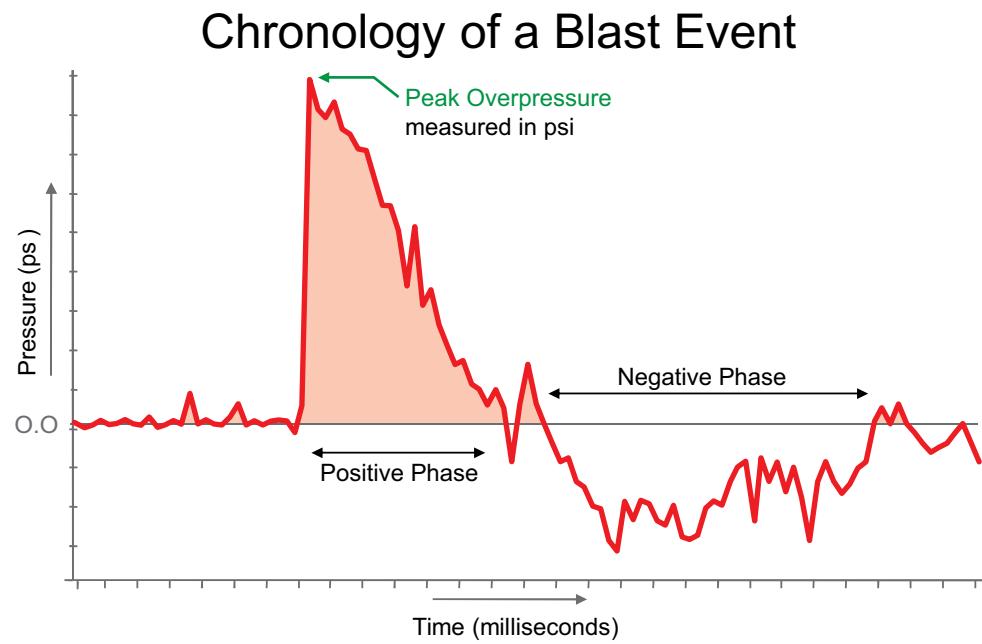
Blast Resistant Horizontal Sliding Window System .....	23
--	----

# design considerations

An emerging trend of the green building movement is the emphasis placed on daylighting in buildings. Daylighting is the design practice of placing windows, and sometimes reflective surfaces, so that during the day natural light provides effective internal lighting. Design consideration must be given to glazing used in buildings assessed to be at risk of explosions, both accidental and intentional. Buildings considered at risk include GSA and DoD buildings, office buildings, research facilities, and buildings in proximity to possible target buildings.

As shown in this illustration, a blast wave is an extreme energy release manifested in four forms; light, sound, heat, and a shock wave. The chronology of a blast wave consists of a instantaneous positive pressure wave that quickly reaches the peak overpressure point, measured in psi, exerting positive pressure on a glazing assembly, which decreases exponentially in milliseconds to the zero pressure point, followed by a negative pressure phase where air rushes into the void behind the blast wave, pulling the glazing assembly and debris outward.

Blast mitigation glazing assemblies have three critical stress points; anchor, frame, and laminated glass. Both laminated and insulating blast mitigation glass units typically include a thin interlayer material, usually polyvinyl butyral (PVB), to bond annealed, heat strengthened or tempered layers of monolithic glass together. The glazed assembly must have a secure anchoring system to keep the framing in place, the framing system must keep the laminated glass unit in place, and though the laminated glass unit may fracture, the glass must remain adhered to the PVB layer according to the Performance Condition of the project. The design purpose for these blast resistant glazed units is to absorb energy and debris from a blast event by deforming in its framing, instead of being rigid in an attempt to deflect the energy.

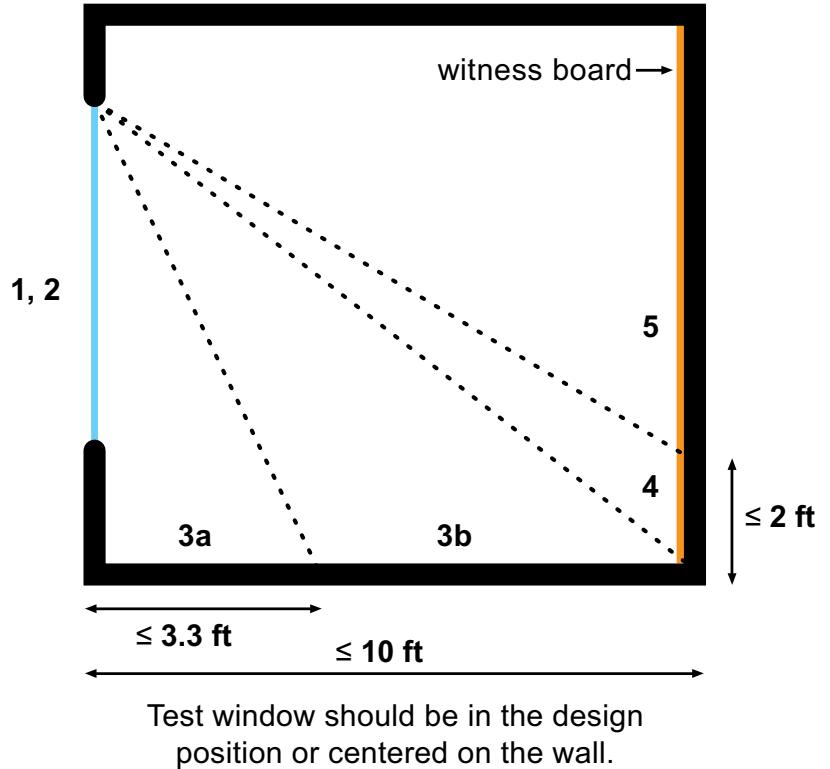


# ISC/GSA standards

A host of government and non-government agencies have addressed the issue of blast mitigation for facilities. The United States Federal Interagency Security Committee (ISC) developed a blast-resistance standard outlining criteria for design. The General Services Administration (GSA) implemented the **ISC Security Design Criteria** as its design standard. The GSA is responsible for nearly 60 agencies, the U.S. Courts and Congress; encompassing over 340 million square feet of space in office buildings, courthouses, border stations, and warehouses. The GSA guideline for glazing system performance, GSA-TS01-2003, outlines approved methods for shock tube testing, arena testing, and test modeling with software.

This illustration shows a cross section of a test structure defining the protection levels correlated in **Table 1: ISC Security Design Criteria Blast Protection Levels for Windows**. Table 1 describes the six defined ISC Protection Levels and the associated glazing response expectations.

The GSA and the Department of Homeland Security use a standard called the Federal Security Risk Management (FSRM) as a threat/vulnerability assessment, and risk analysis to determine the protection level required for a facility.



**Table 1: ISC Security Design Criteria Blast Protection Levels for Windows**

Performance Condition	Protection Level	Hazard Level	Description of Window Glazing Response
1	Safe	None	Glazing does not break. No visible damage to glazing or frame.
2	Very High	None	Glazing cracks but is retained by the frame. Dusting or very small fragments near sill or on floor acceptable.
3a	High	Very Low	Glazing cracks. Fragments enter space and land on floor no further than 3.3 ft. from the window.
3b	High	Low	Glazing cracks. Fragments enter space and land on floor no further than 10 ft. from the window.
4	Medium	Medium	Glazing cracks. Fragments enter space and land on floor and impact a vertical witness panel at a distance of no more than 10 ft. from the window at a height no greater than 2 ft. above the floor.
5	Low	High	Glazing cracks and window system fails catastrophically. Fragments enter space and land on floor and impact a vertical witness panel at a distance of no more than 10 ft. from the window at a height greater than 2 ft. above the floor.

# DoD/UFC standards

The Department of Defense (DoD) developed a blast mitigation standard for use in designing DoD facilities, the **Unified Facilities Criteria (UFC) – DoD Minimum Antiterrorism Standards for Buildings**.

Table 2-1 Levels of Protection (New and Existing Buildings) and Table 2-2 Levels of Protection (Expeditionary and Temporary Structures) detail the varying levels of protection, the potential structural damage and potential injuries. **Section B-3.1 Standard 10 Windows and Skylights** of the DoD's **UFC 4-010-01** establishes design expectations for blast mitigation glazing systems in response to the designated Levels of Protection.

**Table 2-1 Levels of Protection – New and Existing Buildings**

Level of Protection	Potential Building Damage / Performance <sup>2</sup>	Potential Door and Glazing Hazards <sup>3</sup>	Potential Injury
<b>Below AT Standards<sup>1</sup></b>	Severe damage. Progressive collapse likely. Space in and around damaged area will be unusable.	Doors and windows will fail catastrophically and result in lethal hazards. (High hazard rating).	Majority of personnel in collapse region suffer fatalities. Potential fatalities in areas outside of collapsed area likely.
<b>Very Low</b>	Heavy damage - Onset of structural collapse, but progressive collapse is unlikely. Space in and around damaged area will be unusable.	Glazing will fracture, come out of the frame, and is likely to be propelled into the building, with the potential to cause serious injuries. (Low hazard rating). Doors may be propelled into rooms, presenting serious hazards.	Majority of personnel in damaged area suffer serious injuries with a potential for fatalities. Personnel in areas outside damaged area will experience minor to moderate injuries.
<b>Low</b>	Moderate damage – Building damage will not be economically repairable. Progressive collapse will not occur. Space in and around damaged area will be unusable.	Glazing will fracture, potentially come out of the frame, but at a reduced velocity, does not present a significant injury hazard. (Very low hazard rating). Doors may fail, but they will rebound out of their frames, presenting minimal hazards.	Majority of personnel in damaged area suffer minor to moderate injuries with the potential for a few serious injuries, but fatalities are unlikely. Personnel in areas outside damaged areas will potentially experience minor to moderate injuries.
<b>Medium</b>	Minor damage – Building damage will be economically repairable. Space in and around damaged area can be used and will be fully functional after cleanup and repairs.	Glazing will fracture, remain in the frame and results in a minimal hazard consisting of glass dust and slivers. (Minimal hazard rating). Doors will stay in frames, but will not be reusable.	Personnel in damaged area potentially suffer minor to moderate injuries, but fatalities are unlikely. Personnel in areas outside damaged areas will potentially experience superficial injuries.
<b>High</b>	Minimal damage. No permanent deformations. The facility will be immediately operable.	Glazing will not break. (No hazard rating). Doors will be reusable.	Only superficial injuries are likely.
<b>Notes:</b>			
1. This is not a level of protection, and should never be a design goal. It only defines a realm of more severe structural response, and may provide useful information in some cases.			
2. For damage / performance descriptions for primary, secondary, and non-structural members, refer to UFC 4-020-02, DoD Security Engineering Facilities Design Manual.			
3. Glazing hazard levels are from ASTM F 1642.			

# DoD/UFC standards

**Table 2-2 Levels of Protection – Expeditionary and Temporary Structures**

Level of Protection	Potential Structural Damage	Potential Injury
<b>Below AT Standards <sup>1</sup></b>	Severe damage. Frame collapse/massive destruction. Little left standing.	Majority of personnel in collapse region suffer fatalities. Potential fatalities in areas outside of collapsed area likely.
<b>Very Low</b>	Heavy damage. Major portions of the structure will collapse (over 50%). A significant percentage of secondary structural members will collapse (over 50%).	Majority of personnel in damaged area suffer serious injuries with a potential for fatalities. Personnel in areas outside damaged area will experience minor to moderate injuries.
<b>Low</b>	Moderate damage. Damage will be unrepairable. Some sections of the structure may collapse or lose structural capacity (10 to 20% of structure).	Majority of personnel in damaged area suffer minor to moderate injuries, with the potential for a few serious injuries, but fatalities are unlikely. Personnel in areas outside damaged areas will potentially experience minor to moderate injuries.
<b>Medium</b>	Minor damage. Damage will be repairable. Minor to major deformations of both structural members and non-structural elements. Some secondary debris will be likely, but the structure remains intact with collapse unlikely.	Personnel in damaged area potentially suffer minor to moderate injuries, but fatalities are unlikely. Personnel in areas outside damaged areas will potentially experience superficial injuries.
<b>High</b>	Minimal damage. No permanent deformation of primary and secondary structural members or non-structural elements.	Only superficial injuries are likely.
Note 1: This is not a level of protection, and should never be a design goal. It only defines a realm of more severe structural response, and may provide useful information in some cases.		

# DoD/UFC standards

UFC 4-010-01 establishes a minimum standoff distance of 82 ft. from roadways and parking lots with certain exemptions like post exchanges that may require different blast mitigation performances due to the proximity of vehicular access.

**Section B-3.1** of the UFC specifies that hardware, connectors, glazing stops and anchors be calculated to a load of 10.8 psi for glazed units of 10.8 square feet or less, and 4.4 psi for glazed units of more than 10.8 square feet but less than 32 square feet.

**Section 3.1.1.1** sets minimum glazing requirements as two  $\frac{1}{8}$ " (3 mm) annealed glass panes bonded together with a minimum of a .030" polyvinyl-butyl interlayer, as shown in Table B-2 and Table B-3. For insulating glass units a minimum  $\frac{1}{4}$ " (6 mm) laminated glass is required for the inboard pane. These standards are based on application of the **ASTM F 2248 Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass** and the **ASTM E 1300 Standard Practice for Determining Load Resistance of Glass in Buildings**.

**Table B-1 Minimum Standoff Distances  
for New and Existing Buildings**

Location	Building Category	Standoff Distance or Separation Requirements			
		Applicable Level of Protection	Conventional Construction Standoff Distance	Effective Standoff Distance <sup>(1)</sup>	Applicable Explosive Weight <sup>(2)</sup>
Controlled Perimeter or Parking and Roadways without a Controlled Perimeter	Billeting	Low	45 m <sup>(3)</sup> (148 ft.)	25 m <sup>(3)</sup> (82 ft.)	I
	Primary Gathering Building	Low	45 m <sup>(3) (4)</sup> (148 ft.)	25 m <sup>(3) (4)</sup> (82 ft.)	I
	Inhabited Building	Very Low	25 m <sup>(3)</sup> (82 ft.)	10 m <sup>(3)</sup> (33 ft.)	I
Parking and Roadways Building within a Controlled Perimeter	Billeting	Low	25 m <sup>(3)</sup> (82 ft.)	10 m <sup>(3)</sup> (33 ft.)	II
	Primary Gathering Building	Low	25 m <sup>(3) (4)</sup> (82 ft.)	10 m <sup>(3) (4)</sup> (33 ft.)	II
	Inhabited Building	Very Low	10 m <sup>(3)</sup> (33 ft.)	10 m <sup>(3)</sup> (33 ft.)	II
Trash Containers	Billeting	Low	25 m (82 ft.)	10 m (33 ft.)	II
	Primary Gathering Building	Low	25 m (82 ft.)	10 m (33 ft.)	II
	Inhabited Building	Very Low	10 m (33 ft.)	10 m (33 ft.)	II

(1) Even with analysis, standoff distances less than those in this column are not allowed for new buildings, but are allowed for existing buildings if constructed/retrofitted to provide the required level of protection at the reduced standoff distance.

(2) See UFC 4-010-02, for the specific explosive weights (kg/pounds of TNT) associated with designations -I and II. UFC 4-010-02 is For Official Use Only (FOUO)

(3) For existing buildings, see paragraph B-1.1.2.2 for additional options.

(4) For existing family housing, see paragraph B-1.1.2.3 for additional options .

# DoD/UFC standards

**Table B-2. Laminated Glass Thickness Selection for Single Pane Windows**

Applicable Level of Protection	Applicable Explosive Weight	Nominal Laminated Glass and PVB Interlayer Thickness Requirements <sup>(1)</sup>			
		At Conventional Construction Standoff Distance <sup>(2)</sup>		Between Conventional Construction and Minimum Standoff Distances <sup>(2)</sup>	
		Nominal Glass Thickness	Minimum Interlayer Thickness	Nominal Glass Thickness	Minimum Interlayer Thickness
Low	I	6 mm (1/4")	0.75 mm (0.030")	F2248/E1300 – 3 mm (1/8") <sup>(3)(4)</sup>	1.50 mm (0.060")
	II			F2248/E1300 <sup>(3)</sup>	1.50 mm (0.060")
Very Low	I	F2248 <sub>45</sub> /E1300 <sup>(5)</sup>	1.50 mm <sup>(7)</sup> (0.060")	Refer to DoD Security Engineering Facilities Design Manual	
	II	F2248 <sub>10</sub> /E1300 <sup>(6)</sup>	1.50 mm <sup>(7)</sup> (0.060")	Not Applicable <sup>(8)</sup>	

(1) Nominal thickness will be achieved by laminating two thinner glass panes of the same thickness to achieve the nominal thickness.

(2) Refer to Table B 1 for applicable standoff distances.

(3) Enter ASTM F 2248 with the applicable explosive weight and the actual standoff distance achieved to determine the equivalent 3 second duration design loading.

(4) Calculate the required laminated glass thickness for this pane by subtracting 3mm (1/8") from the thickness determined by ASTM E 1300.

(5) For this window, enter ASTM F 2248 with explosive weight I at a standoff distance of 45m (148') to determine the equivalent 3 second duration design loading. The laminated glass thickness selected for this design loading may then be used at the 25m (82') conventional construction standoff distance.

(6) For this window, enter ASTM F 2248 with explosive weight II at the 10m (33') conventional construction standoff distance to determine the equivalent 3 second duration design loading.

(7) For standoff distances greater than the conventional construction standoff distance, lesser interlayer thicknesses may be allowable based on analysis, but they shall not be less than 0.75 mm (0.030")

(8) Conventional construction standoff distance = minimum standoff distance.

**Table B-3. Laminated Glass Thickness Selection for Insulating Glass Unit (IGU) Windows**

Applicable Level of Protection	Applicable Explosive Weight	Nominal Laminated Glass Thickness w/ PVB Interlayer Requirements <sup>(1)</sup>				
		At Conventional Construction Standoff Distance <sup>(2)</sup>		Between Conventional Construction and Minimum Standoff Distances <sup>(2)</sup>		
		Glass Thickness <sup>(3)</sup>	Minimum Interlayer Thickness <sup>(4)</sup>	Glass Thickness <sup>(3)</sup>	Interlayer Thickness <sup>(4)</sup>	
Low	I	6 mm (1/4")	0.75 mm (0.030")	6 mm (1/4")	1.50 mm (0.060")	
	II					
Very Low	I	F2248 <sub>45</sub> /E1300 <sup>(5)</sup>	0.75 mm (0.030")	Refer to DoD Security Engineering Facilities Design Manual		
	II	6 mm (1/4")	0.75 mm (0.030")	Not Applicable <sup>(6)</sup>		

(1) Nominal thickness will be achieved by laminating two thinner glass panes of the same thickness to achieve the nominal thickness.

(2) Refer to Table B 1 for applicable standoff distances.

(3) Glass thickness is the same or interior and exterior panes.

(4) Interlayer is within the insulating pane only as a minimum.

(5) For this window, enter ASTM F 2248 with explosive weight I at a standoff distance of 45m (148') to determine the equivalent 3 second duration design loading. The glass thickness selected for both panes of the IGU for this design loading may then be used at the 25m (82') conventional construction standoff distance.

(6) Conventional construction standoff distance = minimum standoff distance.

The United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED®) program sets a definitive standard for what constitutes a 'Green Building'. The program is based on nationally accepted energy and environmental standards and principles that strike a balance between known effective practices and emerging technologies. The U.S. Green Building Council is the governing body for LEED® and is the nation's foremost coalition of leaders from across the building industry working to promote buildings that are socially and environmentally responsible, profitable, and healthy places to live and work.

The United States Aluminum product line can help new commercial construction and major renovation projects (LEED-NC), existing building operations (LEED-EB), commercial interiors projects (LEED-CI) and core and shell projects (LEED-CS) attain points towards one of the four levels of LEED certification: basic, silver, gold, and platinum. The level achieved is based on the total number out of 100 possible points across six categories.

As the green building movement has grown in the United States, so to has it grown in a host of other countries including Canada, Mexico, and the United Kingdom. The Canadian Green Building Council's (CaGBC) version of the LEED program, is a close derivative of USGBC's version.

One LEED credit commonly sought is MR Credit 5: Regional Materials. The intent of this credit is to increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation. Due to the geographic diversity of bauxite sources, Australia, Brazil, Jamaica, Russia, and the United States, and the stream of recycled aluminum content in billet, it is difficult to determine a specific regional source to qualify for this credit.



This section shows the LEED® credits that are influenced by architectural aluminum glazed products. Each credit is labeled as active or passive; active credits are those that involve product specific performance requirements (i.e. recycled content of product or VOC performance), and passive credits are dependant upon design specific conditions (i.e. designer adding glazing for daylighting).

**EA Credit 1 – Optimize Energy Performance (passive)**

United States Aluminum offers many thermally insulated systems that provide excellent energy performance.

**MR Credit 3 – Materials Reuse (active)**

Doors, frames, and a variety of the products we manufacture can be salvaged for reuse in future projects.

**MR Credit 4 – Recycled Content (active)**

United States Aluminum can provide extrusions manufactured using billet composed of more than 20% post-industrial recycled aluminum.

**MR Credit 5 – Regional Materials (passive)**

United States Aluminum has Manufacturing Facilities across North America, making much of the continent within a 500 mile radius of regional manufacturing.

**IEQ Credit 2 – Increased Ventilation (passive)**

Our products can be used as part of a comprehensive plan to provide additional outdoor air ventilation to improve indoor air quality for improved occupant comfort, well-being, and productivity.

**IEQ Credit 4.2 – Low Emitting Materials, Paints and Coatings (active)**

United States Aluminum uses paints and coatings that meet or exceed AAMA 2005.

**IEQ Credit 6.1 – Controllability of Systems, Lighting (passive)****IEQ Credit 6.2 – Controllability of Systems, Thermal Comfort (passive)**

United States Aluminum provides systems that offer a greater level of thermal, ventilation, and lighting control with features like operable windows that meet the requirements of ASHRAE 62.1-2004 paragraph 5.1 Natural Ventilation.

**IEQ Credit 7.1 – Thermal Comfort, Design (passive)**

United States Aluminum produces building envelope systems that meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy.

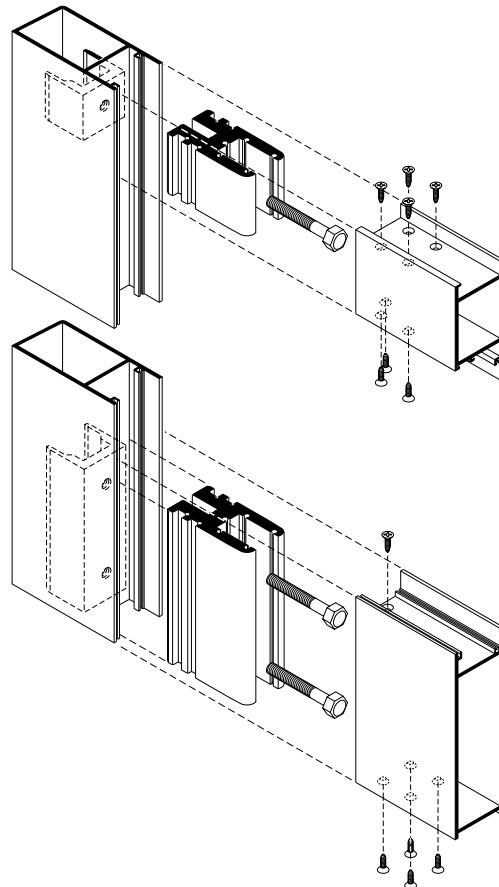
**IEQ Credit 8.1 – Daylight and Views, Daylight (passive)****IEQ Credit 8.2 – Daylight and Views, View (passive)**

United States Aluminum manufactures systems that can be configured to allow an amount of Daylight and View that exceeds LEED requirements.

# blast entrance



- 2-½" x 5" (63.5 x 127 mm) Frame Dimension
- Compatible With BT601, BR604, BR606, and BW3250 Systems
- Finishes Range From Custom Matched Painted Coatings to a Wide Selection of Clear, Bronze or Black Anodic Finishes

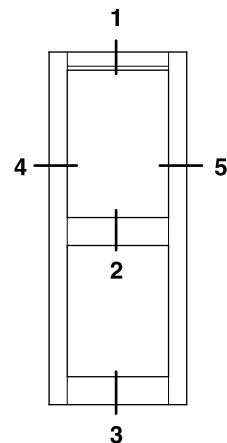
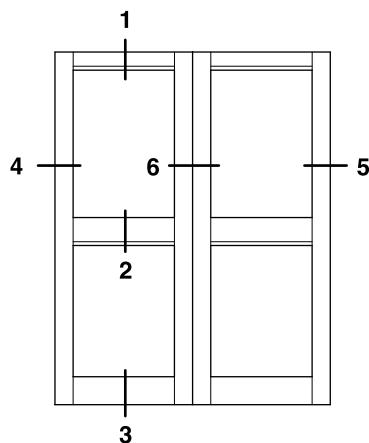


Tested in compliance with:  
UFC 4-010-01, Oct 03 and Jan 07  
ASTM F-1642  
ASTM E 283-91  
ASTM E 331-93  
ASTM A 164  
AAMA 605.2-92

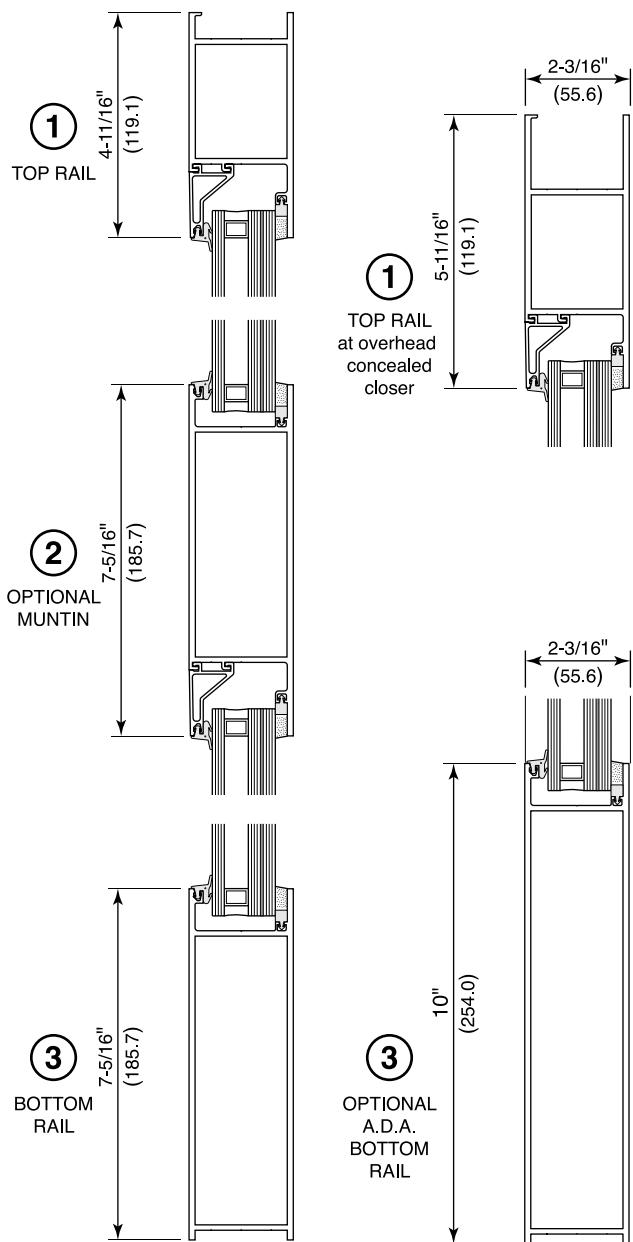
Patent No. 6,829,868

The Blast Entrance and Framing System has been tested for use with our BT601, BR604, BR606 Storefronts, and our BW3250 Curtain Wall. The Blast Entrance Doors are 2-¾" (55.6 mm) thick, with a ¼" (3.2 mm) wall thickness, and feature a two glass stop glazing system for clean sightlines. Standard corner construction includes heavy-duty blocks and welding for maximum corner strength.

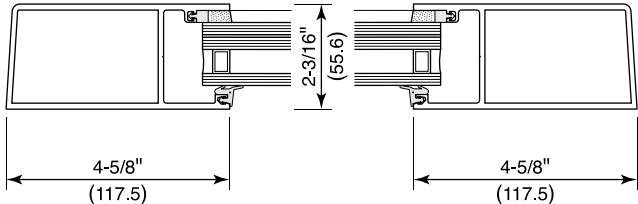
# blast entrance typical details



**Door Size Maximum:**  
Single Door - 44" X 96"  
(1117.6 mm X 2438.4 mm)  
Double Door - 88" X 96"  
(2235.2 mm X 2438.4 mm)



For complete details and installation instructions visit [usalum.com](http://usalum.com)

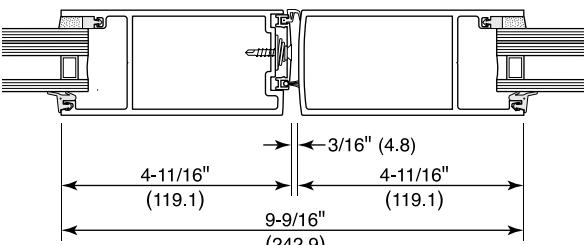


④

JAMB  
STILE

⑤

JAMB  
STILE



⑥

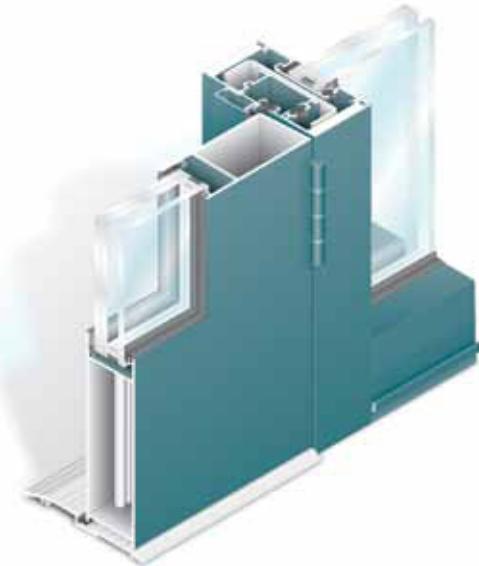
MEETING  
STILES

# BT601 storefront



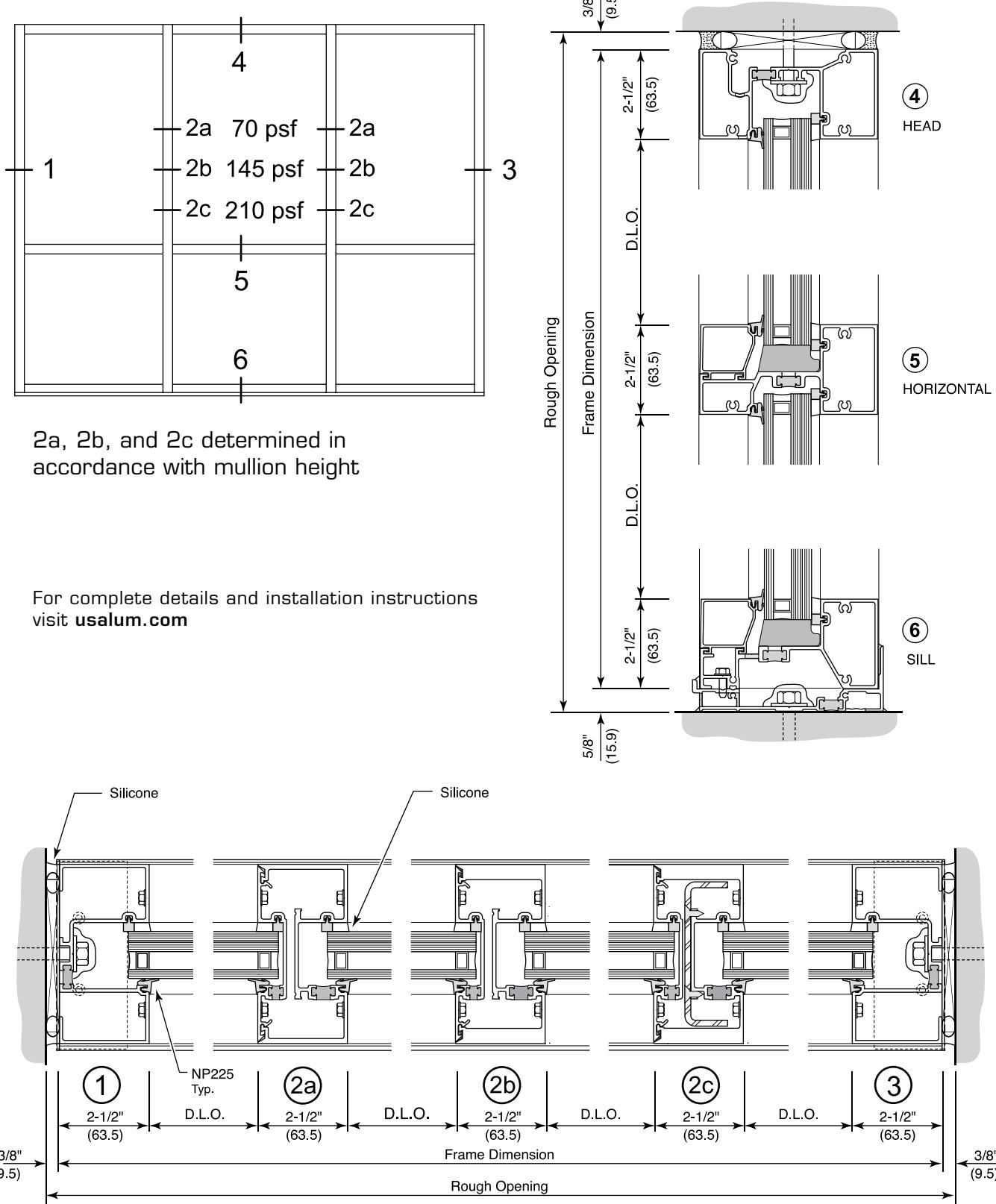
- 2-½" x 5" (63.5 x 127 mm) Frame Dimension
- Tested to 1 psi
- DoD Response - High and Medium
- GSA Response - Condition 1 and 2
- ASTM Response - No Hazard and Minimal Hazard
- Tested With 1- $\frac{5}{16}$ " Insulating Laminated Glass with .030 Butacite by DuPont® Interlayer
- Thermally Isolated
- High Performance Subsill
- Finishes Range From Custom Matched Painted Coatings to a Wide Selection of Clear, Bronze or Black Anodic Finishes

Tested in compliance with:  
UFC 4-010-01, Oct 03 and Jan 07  
ASTM E 283-91  
ASTM E 331-93  
ASTM A 164  
AAMA 605.2-92



The Defender Series BT601 is a Thermal Blast Mitigation Storefront System engineered and successfully tested to withstand explosions with pressure levels of 1 pound per square inch. This protective storefront system features our Storm Front™ Entrance as well as; screw spline assembly for panel type erection, insulated and laminated glass siliconed in place, high performance subsill and steel reinforced mullions. The BT601 is a good product solution for DoD, GSA, and private sector conditions requiring a blast mitigation storefront system up to 1 psi and enhanced thermal performance.

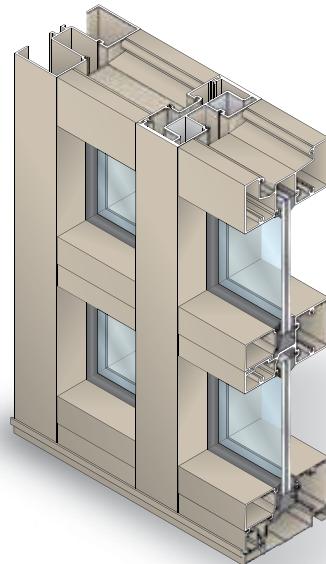
# BT601 typical details



# BR604 storefront



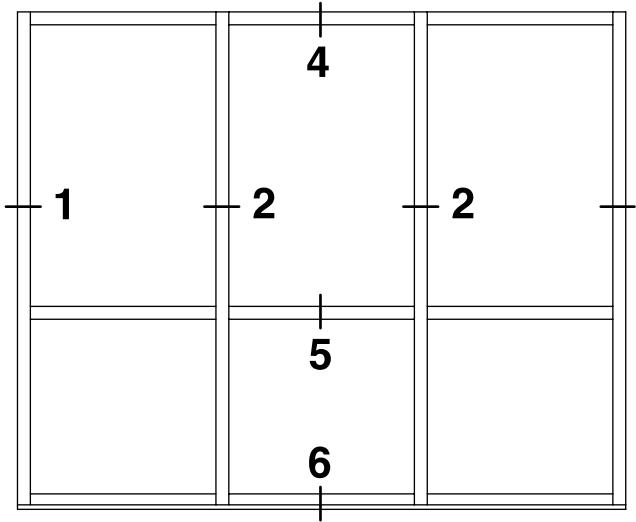
- 2-½" x 5" (63.5 x 127 mm) Frame Dimension
- Tested to 4.4 psi, With 19 MSEC Duration 32 psi Pulse
- DoD Response - High and Medium
- GSA Performance Condition 1 and 2
- ASTM Hazard Rating No Hazard and Minimal Hazard
- Tested With 1-5/16" (33 mm) Insulating Laminated Glass With .030 Butacite by DuPont® Interlayer
- Screw Spline Assembly
- High Performance Subsill
- Finishes Range From Custom Matched Painted Coatings to a Wide Selection of Clear, Bronze or Black Anodic Finishes



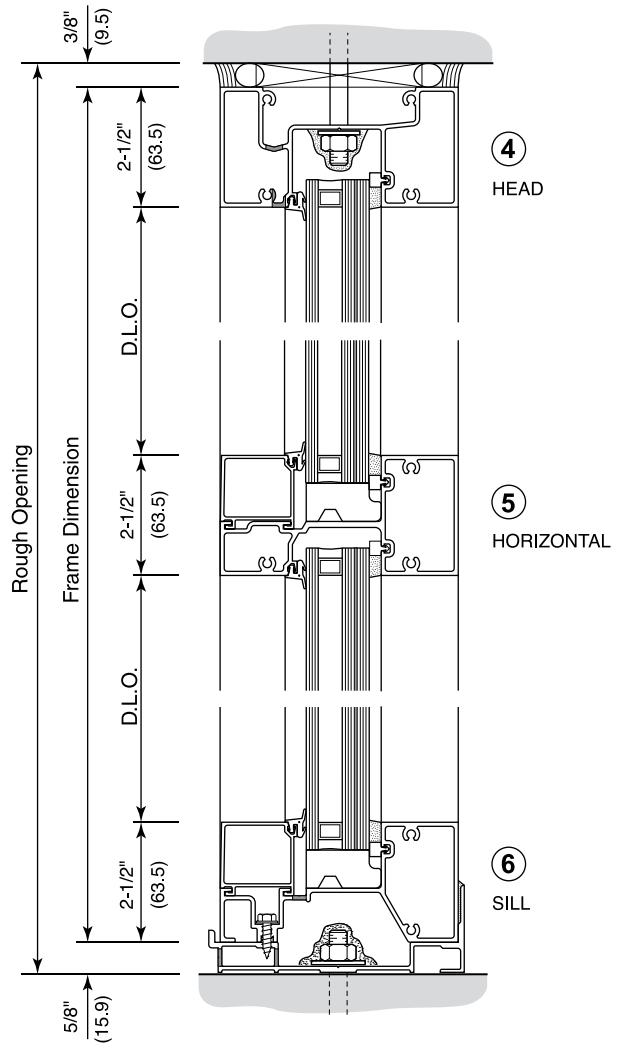
Tested in compliance with:  
UFC 4-010-01, Oct 03 and Jan 07  
ASTM F-1642  
ASTM E 283-91  
ASTM E 331-93  
ASTM A 164  
AAMA 605.2-92

The Defender Series BR604 is a Blast Mitigation Storefront System engineered and successfully tested to withstand explosions with pressure levels of 4.4 pounds per square inch. This protective storefront system features our Storm Front™ Entrance as well as; screw spline assembly for panel type erection, insulated and laminated glass siliconed in place, high performance subsill and steel reinforced mullions. The BR604 is a good product solution for DoD, GSA, and private sector conditions requiring a blast mitigation storefront system up to 4.4 psi.

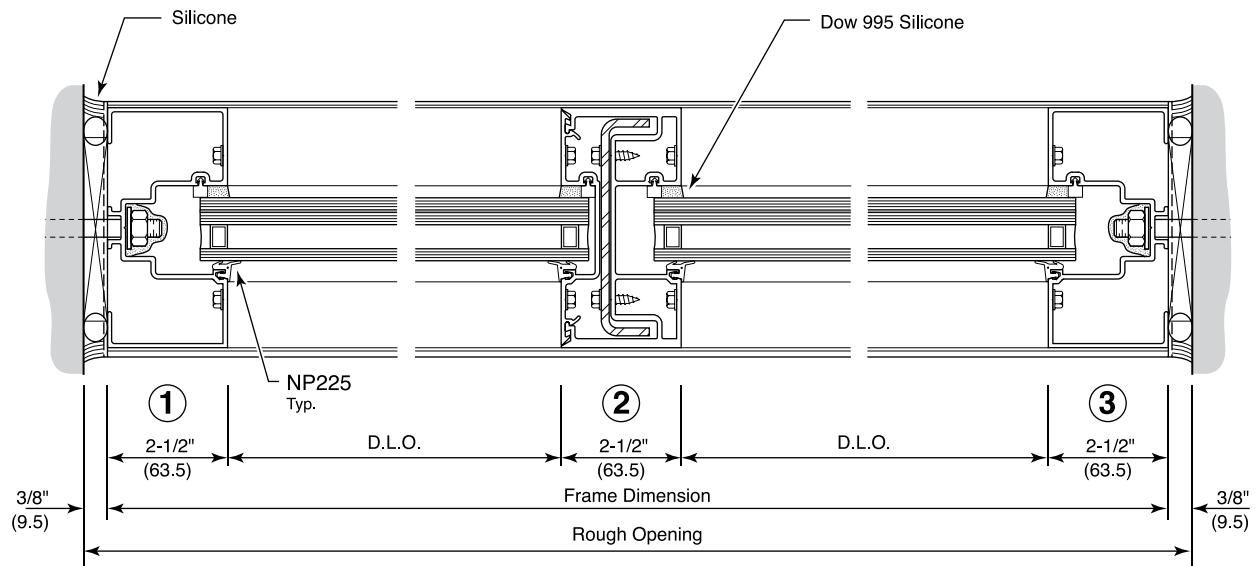
# BR604 typical details



TYPICAL ELEVATION



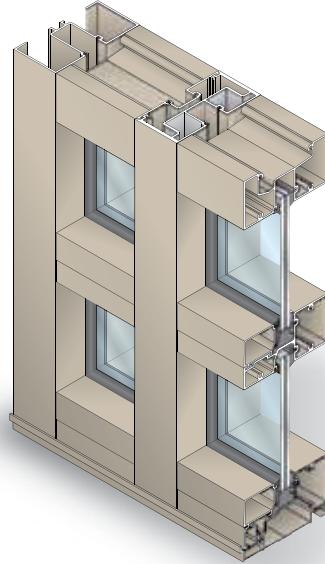
For complete details and installation instructions  
visit [usalum.com](http://usalum.com)



# BR606 storefront



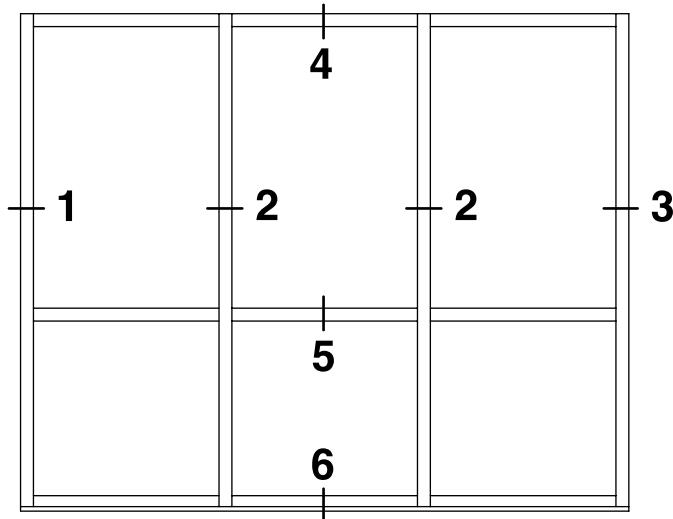
- 2-½" x 5" (63.5 x 127 mm) Frame Dimension
- Tested to 6 psi, With 19 MSEC Duration 45 psi Pulse
- DoD Response - Medium and Very Low
- GSA Response - Condition 2 and 4
- ASTM Response - Minimal Hazard and High Hazard
- Tested With 1-5/16" (33 mm) Insulating Laminated Glass With .060 Butacite by DuPont® Interlayer
- Screw Spline Assembly
- High Performance Subsill
- Finishes Range From Custom Matched Painted Coatings to a Wide Selection of Clear, Bronze or Black Anodic Finishes



Tested in compliance with:  
UFC 4-010-01, Oct 03 and Jan 07  
ASTM F-1642  
ASTM E 283-91  
ASTM E 331-93  
ASTM A 164  
AAMA 605.2-92

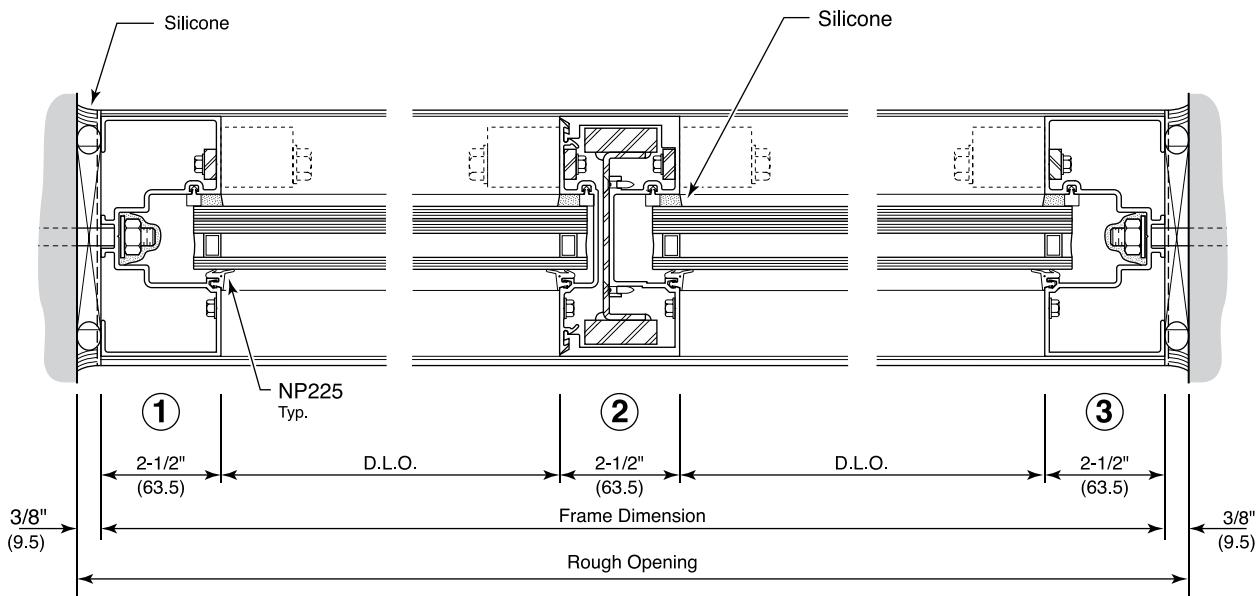
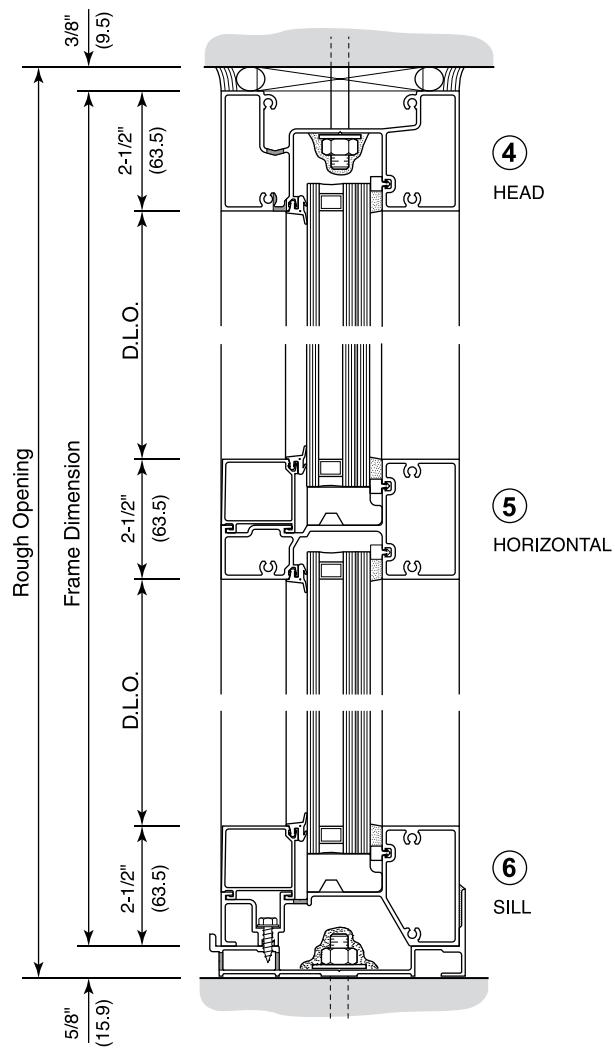
The Defender Series BR606 is a Blast Mitigation Storefront System engineered and successfully tested to withstand explosions with pressure levels of 6 pounds per square inch. This protective storefront system features our Storm Front™ Entrance as well as; screw spline assembly for panel type erection, insulated and laminated glass siliconed in place, high performance subsill and steel reinforced mullions. The BR606 is a good product solution for DoD, GSA, and private sector conditions requiring a blast mitigation storefront system up to 6 psi.

# BR606 typical details



TYPICAL ELEVATION

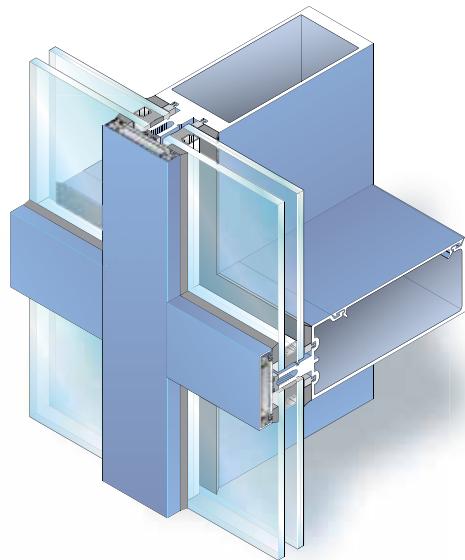
For complete details and installation instructions  
visit [usalum.com](http://usalum.com)



# BW3250 curtain wall



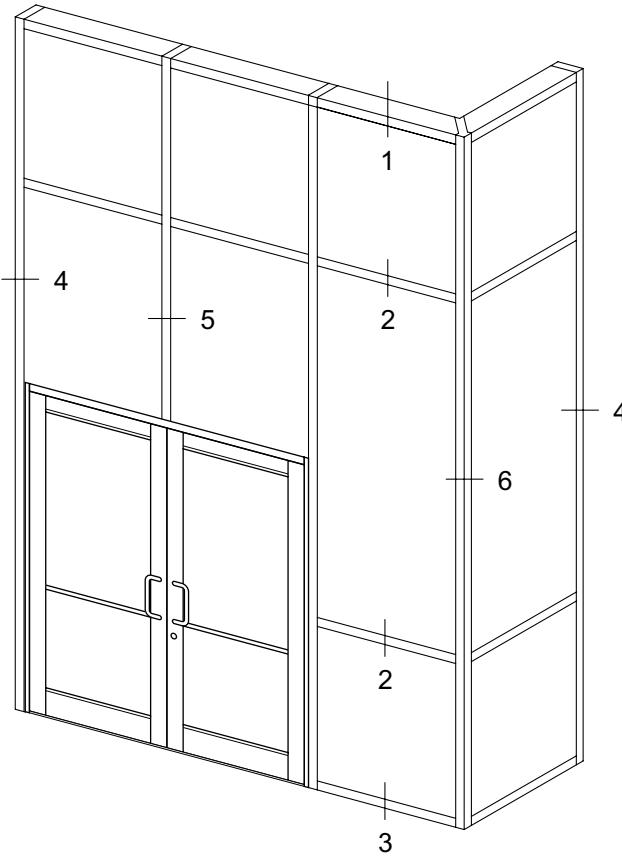
- 2-½" x 8" (63.5 x 203.2 mm) Frame Dimension
- Tested With 1" (25 mm) Insulating Laminated Glass With .030 Butacite by DuPont® Interlayer
- GSA Performance Condition 2 and 4
- ASTM Hazard Rating - Low Hazard and Very Low Hazard
- Exterior Glazed
- Thermally Improved
- Silicone Glazed
- Available in 2.91 psi, 4.4 psi, and 10.8 psi Pressure Loads
- Available in a Two-Tone Finish That Range From Custom Matched Painted Coatings to a Wide Selection of Clear, Bronze or Black Anodic Finishes



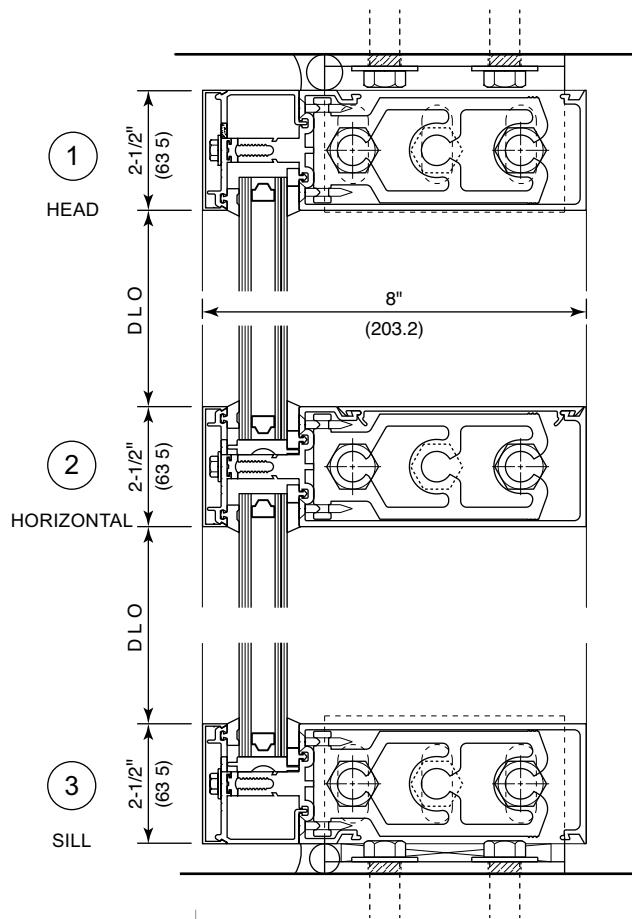
Tested in compliance with:  
UFC 4-010-01, Oct 03 and Jan 07  
ASTM A 164  
ASTM E 283-91  
ASTM E 330  
ASTM E 331-93  
AAMA 1503.1-88  
AAMA 605.2-92

Strength, versatility, and thermal performance make Series BW3250 Blast Mitigation Curtain Wall a perfect fit for low to mid-rise applications where blast protection is required. Based on our top-selling Series 3250 Curtain Wall System, the blast wall offers the blast mitigation protection specified by government agencies like the GSA and DoD, as well as private sector projects. Series BW3250 is thermally improved by a continuous thermal spacer interlocked with the horizontal and vertical pressure plates. Dual or two-tone colors can be achieved by specifying different finishes for the exterior face covers and interior mullions. Two-piece horizontals and extruded shear blocks allow for a concealed horizontal to vertical joint.

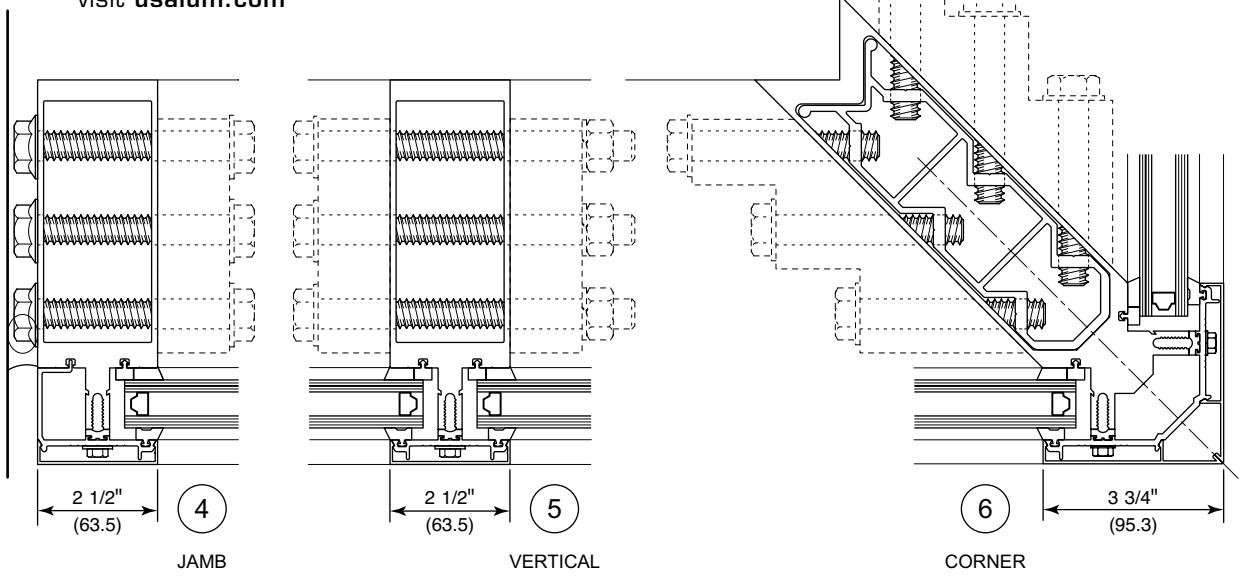
# BW3250 typical details



TYPICAL ELEVATION



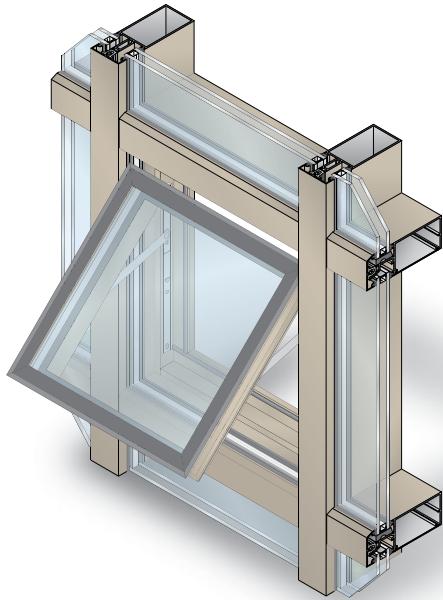
For complete details and installation instructions  
visit [usalum.com](http://usalum.com)



# BR7500 vent window



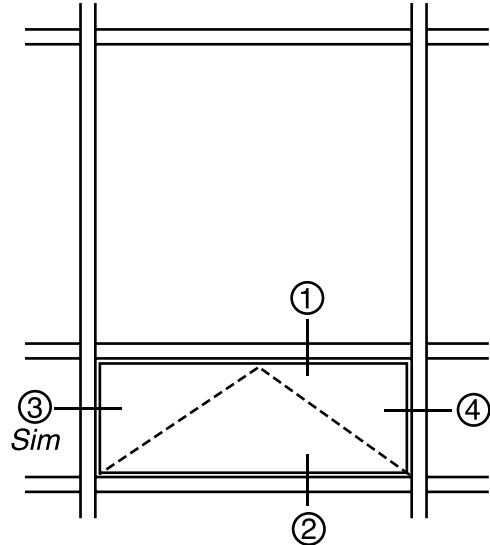
- C-75 Rated Project Out Window
- Minimal Sightline
- Structural Silicone Glazed
- 1" (25 mm) Laminated Glazing
- Reinforced Corner Construction
- Use With BR604, BR606 and BT601 Storefront or BW3250 Curtain Wall
- Thermally Improved Design
- Finishes Range From Custom Matched Painted Coatings to a Wide Selection of Clear, Bronze or Black Anodic Finishes



Tested in compliance with:  
UFC 4-010-01, Oct 03 and Jan 07

The Series BR7500 Blast Mitigation Concealed Vent is a minimal sightline window perfect for use in blast mitigation storefront and curtain wall openings. Standard hardware includes stainless steel four bar hinges and cam locking handles. As with all of our operable windows, vent construction starts with tubular vent components that are mitered, reinforced with corner keys, and crimped at all corners. When closed, the vent is sealed to the frame with bulb gaskets ensuring an airtight seal.

# BR7500 typical details

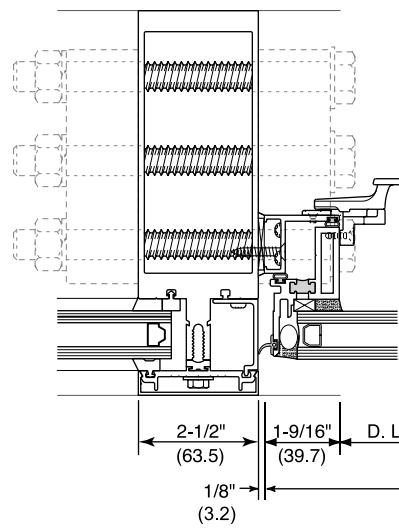
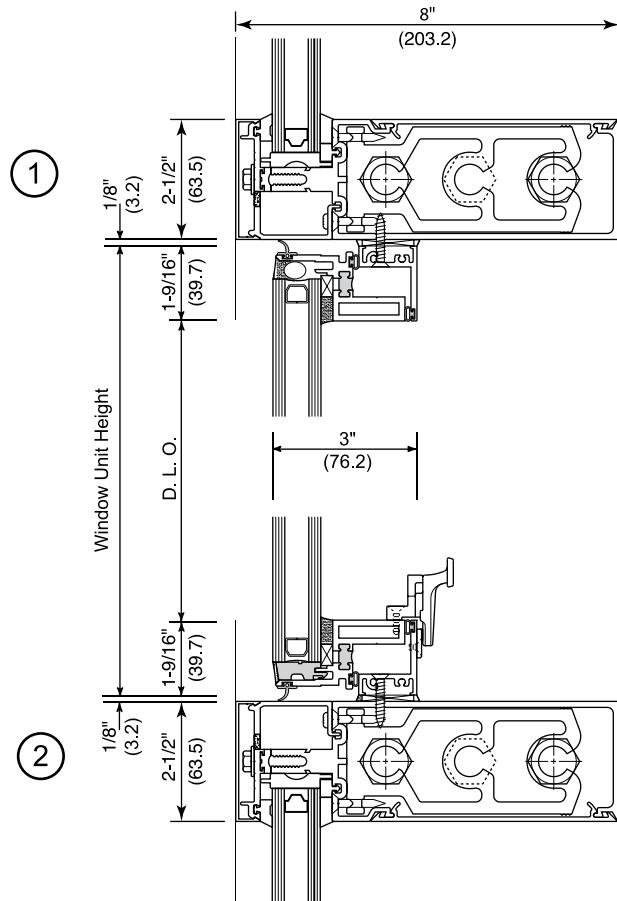


TYPICAL ELEVATION

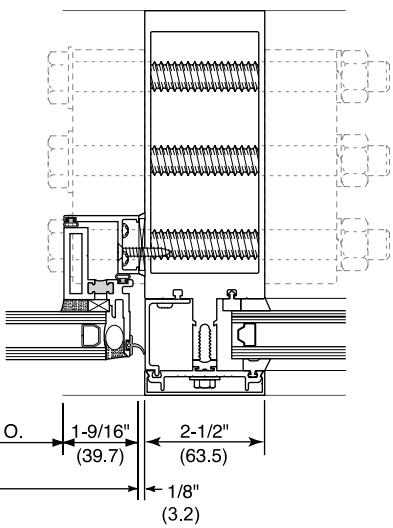
Maximum size is 60"w x 32"h (1524 mm x 813 mm).

Shown with BW3250 2-1/2" x 8"  
(63.5 mm x 203.2 mm) Framing System.

For complete details and installation instructions  
visit [usalum.com](http://usalum.com)



3



4

# BW8000 single hung window



- 1- $\frac{1}{32}$ " (26 mm) Glazing
- DoD Blast Rated for 1 psi
- Tested to AAMA CW60
- Thermally Insulated-NFRC Certified
- 4- $\frac{1}{2}$ " (114 mm) Deep Frame
- Choice of Block or Fin Frame
- Class 5 Balance for Ease of Operation
- Accessories Such as Screens, Mulling Bars, Subsills, Head and Jamb Channels are Available
- Available in an Array of Architectural Coatings and Anodized Finishes
- Made in the USA



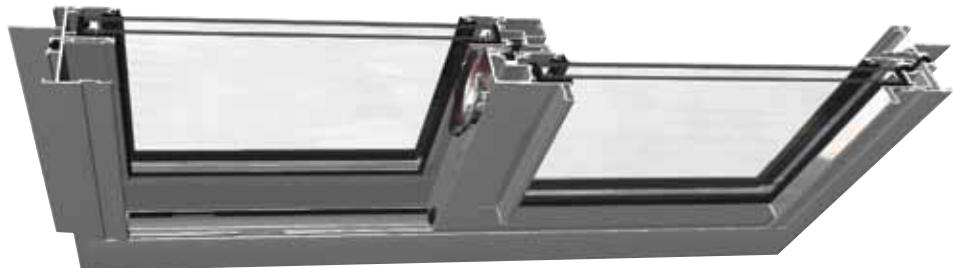
As part of the 8000 Series of heavy commercial windows, the BW8000 Blast Mitigation Single Hung Window offers a DoD 1 psi blast resistance capability to the product line. The 4-1/2" (114 mm) deep frame is designed to match typical building conditions, including our entrances and storefronts. An efficient thermally insulated frame accepts 1- $\frac{1}{32}$ " (26 mm) glazing infills, with extruded pulls at the interlock and bottom rail. The window features a self-locking latch and Class 5 Balances for ease of operation. Accessories such as Mulling Bars, Subsills, and Head and Jamb Channels are available. The high performance BW8000 Window is both AAMA CW60 Rated and NFRC Certified.

For complete details and installation instructions visit [usalum.com](http://usalum.com)

# BW8200 horizontal sliding window



- 1- $\frac{1}{32}$ " (26 mm) Glazing
- DoD Blast Rated for 1 psi
- Tested to AAMA CW60
- Thermally Insulated-NFRC Certified
- U-Factors as Low as 0.34
- 4-1/2" (114 mm) Deep Frame
- Choice of Block or Fin Frame
- Even Sightlines
- Self-Locking Latch and Adjustable Tandem Rollers for Ease of Operation
- Accessories Such as Screens, Mulling Bars, Subsills, Head and Jamb Channels are Available
- Available in an Array of Architectural Coatings and Anodized Finishes
- Made in the USA

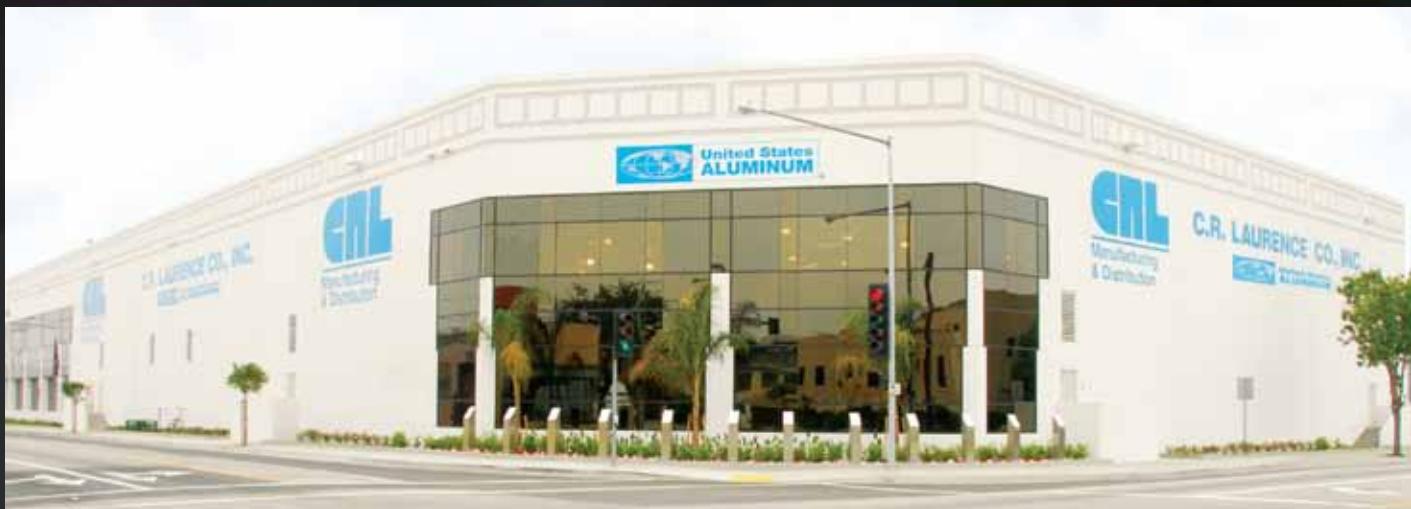


The BW8200 Horizontal Sliding Window offers that rare combination of smooth operation, durability, and toughness to meet blast mitigation requirements. The Defender Series of Blast Mitigation products are designed to provide protection for DoD and private sector facilities. Other Defender Series products include Storefront, Curtain Wall, Projected, Fixed, and Single Hung Windows.





**United States Courthouse**  
Coeur D'Alene, ID



The New U.S. Aluminum Facility in Los Angeles, California

## U.S. Aluminum is a Manufacturer and Supplier of:

- Entrances and Storefronts
- Windows and Curtain Walls
- Hurricane Resistant Building Fronts
- Sun Control Systems
- Blast Mitigation Systems
- Ribbon Wall Systems
- Custom Extrusions

National Toll Free Phone  
**(800) 262-5151**

National Toll Free Fax  
**(866) 262-3299**

Online  
[usalum.com](http://usalum.com)  
[crlaurence.com](http://crlaurence.com)

### U.S. Aluminum Serves You From 11 Locations in North America

#### **Los Angeles, CA**

2450 E. Vernon Ave.  
Los Angeles, CA 90058-1802  
Toll Free Phone: (800) 262-5151  
Phone: (323) 268-4230  
Fax: (866) 262-3299

#### **Langley, BC (Vancouver Area)**

5377 272nd St.  
Langley, BC V4W 1P1 Canada  
Phone: (604) 857-7766  
Fax: (604) 857-1377

#### **Atlanta, GA**

5530 Westpark Drive SW  
Atlanta, GA 30336-2645  
Phone: (404) 344-3468  
Fax: (404) 344-3412

#### **Rock Hill, SC (Charlotte, NC Area)**

720 Celriver Rd.  
Rock Hill, SC 29730-8937  
Phone: (803) 366-8326  
Fax: (803) 366-5776

#### **Davenport, FL (Orlando Area)**

45150 US Highway 27 North, Suite D  
Davenport, FL 33897-4512  
Phone: (863) 424-4700  
Fax: (863) 424-4646

#### **Miami, FL (Formerly Delta Doors)**

7500 N.W. 69th Ave.  
Miami, FL 33166-2543  
Phone: (305) 888-0077  
Fax: (305) 884-3111

#### **Chicago, IL**

6969 W. 73rd St.  
Chicago, IL 60638-6092  
Phone: (708) 458-9070  
Fax: (708) 458-7364

#### **St. Louis, MO**

11621 Fairgrove Industrial Bl.  
Maryland Heights, MO 63043-3437  
Phone: (314) 997-5112  
Fax: (314) 997-7504

**United States ALUMINUM**   
USALUM.COM

MEMBER  
**NGA**  
NATIONAL GLASS ASSOCIATION

on the cover  
**United States Courthouse**  
Coeur D'Alene, ID

AVDB4080