

Guideline for Specifying Steel Doors and Frames for Blast Resistance



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1 Introduction

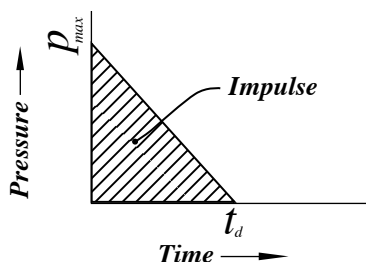
Blast-resistant hardening, or the structural strengthening of buildings, is one measure an owner may employ to minimize the risk to people and equipment from the hazards of accidental or intentional explosions. Many architects are finding it necessary to include blast-resistant products in new and existing construction. These products do not fall under any building code, but are required by a number of government agencies such as the Department of Defense (DoD), Veterans Affairs (VA), Department of State (DOS), and the General Services Administration (GSA). They are backed by analysis or 3rd party test data (from an accredited lab) to show their performance level under blast load conditions. This document will serve as a guide to identify the proper criteria, and to give brief explanations of each criterion. Additional requirements, fire rating, swing, etc. are not covered.

2 Definitions

2.1 Blast Resistant Product: Assembly comprised of a door (or pair of doors) and a frame with hardware, or a glazing system that is rated to resist a specified blast peak pressure and impulse to a required performance level. Higher level doors and frames are typically sold and shipped as one unit in order to be certified by the manufacturer that it will meet the projected blast and performance requirements.

2.2 Blast Pressure: The maximum pressure to be exerted on the assembly by the blast event.

2.3 Positive Phase Impulse: The area under the curve formed by the integral of blast pressure (P_{max}) vs. time (T_d).



Blast Wave (Idealized)

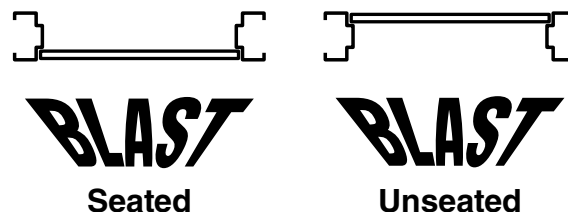
2.4 Charge Weight: The equivalent explosive weight (lbs. or kg) of TNT in the blast event. Different agencies have specific requirements for charge weight to be used. See agency specific criteria for DoD, VA, GSA, and DOS to determine required charge weight and in some cases, the required standoff distance.

2.5 Duration: The amount of time it takes the peak pressure to decay to ambient conditions (or zero).

2.6 Rebound: Load acting in the opposite direction of the initial blast load that may be a result of negative phase pressure loading and system response, and is typically expressed as a percentage of the initial peak blast pressure.

2.7 Stand-off Distance: The distance from the centroid of the explosive device to the specified opening or structure.

2.8 Seated/Unseated: The orientation of the door in the frame, in relation to the blast origin.



2.9 Blast Product Response & Damage Category (Also referred to as **Level of Protection** in the UFC): The amount of structural damage (permanent deformation) present after the blast event. With respect to a door and frame unit, the operability of the door, and whether or not the door and/or frame become detached and present a debris hazard. With respect to a glazing system, whether or not the glazing fractures, and if it presents a flying debris hazard. There are multiple standard test methods written that outline test procedures to follow to show how a blast-resistant unit will react in a blast event.

2.9.1 Paraphrased response and damage categories are given on page 2 to highlight the differences in test methods and design criteria. For the full verbiage, please reference the specified test methods and standards organization.

Blast Product Response & Damage Categories

UFC 4-010-01 – Levels of Protection	
Below AT Standards	Severe damage and/or collapse of structure
Very Low	Heavy structural damage
Low	Moderate damage, unable to be repaired economically
Medium	Minor damage, able to be repaired economically
High	Minimal damage, no permanent deformation

ASTM F2247-11 – Response Categories	
Category I	No permanent deformation to the specimen is present, and the door is fully operable.
Category II	Measurable permanent deformation is present, but the door is operable.
Category III	Non-catastrophic failure, however the unit is inoperable.
Category IV	The unit is severely deformed; however the door will not become a flying debris hazard.

ASTM F2912-11 – Hazard Ratings	
No Break (H1)	No fractures are present in the glazing, and no damage is visible to the unit.
No Hazard (H1)	The glazing has fractured, but no breakage has occurred (no debris).
Minimal Hazard (H2)	The glazing has fractured, and minimal fragments are present on the floor near the interior face of the glazing system (between 0 and 40 inches).
Very Low Hazard (H3)	The glazing has fractured and noticeable fragments are present on the floor near the interior face of the glazing system (between 40 and 120 inches).
Low Hazard (H4)	The glazing has fractured and fragments have fallen up to 120 inches away from the interior face of the glazing system, but lower than 20 inches above the floor.
High Hazard	The glazing has fractured and fragments have fallen up to 120 inches away from the interior face of the glazing system, and higher than 20 inches above the floor.

ASTM F2927-12 – Door Response Damage Categories	
Category I	The door specimen is unchanged and fully operable.
Category II	The unit has acceptable permanent deformation but it still operable.
Category III	The unit has permanent deformation that may cause it to be lodged in the frame, or to swing open in rebound. The door and frame stay together as one unit.
Category IV	The door can become separated from the frame and cause a flying debris hazard, or the door and frame unit may separate from the wall and cause a debris hazard. The flying debris will not go further than 3 meters.
Category V	The door or the door and frame unit together become dislodged and cause a flying debris hazard that will go further than 3 meters.

3 Blast Standard Test Methods and Design Criteria

3.1 ASTM F2247 – *Standard Test Method for Metal Doors Used in Blast Resistant Applications (Equivalent Static Load Method)* – Determines ultimate static capacity. Requires further evaluation to relate to explosive charges or other dynamic loads

3.2 ASTM F2927 – *Standard Test Method for Door Systems Subject to Airblast Loadings* – Used to determine blast capacity for a shock wave created by live explosives or a shock tube.

3.3 ASTM F2912 – *Standard Specification for Glazing and Glazing Systems Subject to Airblast Loadings* – Used to determine blast capacity from a shock wave or explosion

3.4 ASTM F1642 – *Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings* – The data obtained from this test method is used in ASTM F2912 to determine a hazard rating.

3.5 GSA-TS01-2003 – *Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings* – The sole test protocol by which blast resistant windows and related hazard mitigation technology and products shall be evaluated for facilities under the control and responsibility of the US General Services Administration.

3.6 ASCE 2010, 2nd edition – *Design of Blast Resistant Buildings in Petrochemical and Offshore Facilities*

3.7 PIP STC01018 – *Blast Resistant Building Design Criteria for Petrochemical and Offshore Facilities*

3.8 UFC 4-010-01 – *Department of Defense Minimum Antiterrorism Standards for Buildings* – The intent is to minimize mass casualties in buildings or portions of buildings owned, leased, privatized, or otherwise occupied, managed, or controlled by or for DoD in the event of a terrorist attack.

Blast Requirements to be provided (Except DoD Projects)	Sample Criteria (Door)	Sample Criteria (Window)
Product Size (Scheduled Opening)	3'-0" x 7'-0" Door & Frame Assy	4'-0" x 4'-0" Window
Peak Pressure, Duration, & Rebound	4psi, 100ms, 50% Rebound	2psi, 200ms, 50% Rebound
Door Configuration (Seated/Unseated)	Seated in Frame	—
Wall Conditions	Welded to Steel Subframe	Anchored to Wall
Category Response	II	Very Low Hazard (H3) per ASTM F2912-11
Applicable Blast Test Standard	ASTM F2927-12	ASTM F1642-12
Glazing Requirements/Thickness	No Vision Light Required	TBD by Manufacturer

Blast Requirements to be provided (DoD Projects)	Sample Criteria (Door)
Product Size	3'-0" x 7'-0"
Charge Weight	II
Stand-off Distance	250 ft
Level of Protection	Medium
UFC Revision, Revision Date, and Change Date (If Applicable)	UFC 4-010-01, 9 Feb 2012 Change 1, 1 Oct 2013

Sample Blast Quote Request Form

Blast Resistant Door – Request for Quote											
Door					Blast Requirements						
Opening ①		Door Type ②	Fire Rating ③	Seated or Unseated	Load (psi)	Impulse (psi-ms)	Duration (ms)	% Rebound Response	Response Category	Frame ⑤	Hwr ⑥
Qty	Swing	Width	Height	Material						Jamb Width	Wall Thickness
1											
2											
3											
4											
5											
①	<p>Interior – Secure Area Exterior – Public Area (Key side of door) Door Swing</p>				<p>Material: The doors material type (SS-Stainless Steel, CR-Cold Rolled, GV-Galvanized) Hinges: Heavy Duty S.S. Hinges 32D</p>						
②					<p>Glass type will be specified as required to meet the blast requirement <input type="checkbox"/> Glass by Manufacturer <input type="checkbox"/> Glass provided by customer</p>						
③	<p>Fire Rating – Opening is required to withstand a fire for 1/3, 3/4, 1-1/2 or 3-hour rating.</p>				<p>Rebound Response – Represents the expected psi capacity the door will be required to withstand in the opposite direction of the blast in percent form.</p> <p>0% No rebound response required. 50% Rebound response is capable of 50% of the specified blast load (psi) 100% Rebound response capacity is equal to blast load.</p>						
④	<p>Seated or Unseated is whether door will blast towards the door stop or away from the door stop, please choose one.</p> <p>Seated Unseated </p>				<p>Load – Expected loading resistance as generated by a blast psi Duration – Blast duration in msec. Impulse – The amount of psi-msec the door will be exposed to.</p> <p>Category: I No visible damage II Visible damage to the panel, but the door remains operable III Panel is damaged & inoperable, but the door remains as a barrier IV Door panel is severely deformed with openings between the door and frame, but the door remains affixed to the frame.</p>						
⑤	<p>Jamb width – Overall width of the frame section profile</p>				<p>Contact Person: _____ Title: _____ Company: _____ Phone: _____ E-mail: _____ Fax: _____ Date: _____</p>						
⑥	<p>Wall type – Wall condition the frame will be anchored to (Masonry or Challel or Tube steel)</p>				<p>Test Method: _____ Revision: _____ Project Name: _____ Project Location: _____ Project Mgr: _____ Contact Phone: _____</p>						

AVAILABLE PUBLICATIONS

Specifications

- ANSI/SDI A250.6** Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
- ANSI/SDI A250.8** Specifications for Standard Steel Doors and Frames (SDI-100)
- SDI-108** Recommended Selection & Usage Guide for Standard Steel Doors
- SDI-118** Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements
- SDI-128** Guidelines for Acoustical Performance of Standard Steel Doors and Frames
- SDI-129** Hinge and Strike Spacing
- SDI-133** Guideline for Specifying Steel Doors & Frames for Blast Resistance

Test Procedures

- ANSI/SDI A250.3** Test Procedure & Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames
- ANSI/SDI A250.4** Test Procedure & Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
- ANSI/SDI A250.10** Test Procedure & Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
- ANSI/SDI A250.13** Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes (Not applicable for FEMA 320/361 or ICC-500 Shelters)
- SDI-113** Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies
- SDI-131** Accelerated Physical Endurance Test Procedure for Steel Doors

Construction Details

- ANSI/SDI A250.11** Recommended Erection Instructions for Steel Frames
- SDI-110** Standard Steel Doors & Frames for Modular Masonry Construction
- SDI-111** Recommended Details for Standard Details Steel Doors, Frames, Accessories and Related Components
- SDI-122** Installation Troubleshooting Guide for Standard Steel Doors and Frames

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames

AUDIO-VISUAL PROGRAMS ALSO AVAILABLE

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