Guideline for Specifying Steel Doors and Frames for Blast Resistance
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 (Pmax) vs. time (Td).

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

<table>
<thead>
<tr>
<th>Below AT Standards</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below AT Standards</td>
<td>Severe damage and/or collapse of structure</td>
</tr>
<tr>
<td>Very Low</td>
<td>Heavy structural damage</td>
</tr>
<tr>
<td>Low</td>
<td>Moderate damage, unable to be repaired economically</td>
</tr>
<tr>
<td>Medium</td>
<td>Minor damage, able to be repaired economically</td>
</tr>
<tr>
<td>High</td>
<td>Minimal damage, no permanent deformation</td>
</tr>
</tbody>
</table>

## ASTM F2247-11 – Response Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category I</td>
<td>No permanent deformation to the specimen is present, and the door is fully operable.</td>
</tr>
<tr>
<td>Category II</td>
<td>Measurable permanent deformation is present, but the door is operable.</td>
</tr>
<tr>
<td>Category III</td>
<td>Non-catastrophic failure, however the unit is inoperable.</td>
</tr>
<tr>
<td>Category IV</td>
<td>The unit is severely deformed; however the door will not become a flying debris hazard.</td>
</tr>
</tbody>
</table>

## ASTM F2912-11 – Hazard Ratings

<table>
<thead>
<tr>
<th>Hazard Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Break (H1)</td>
<td>No fractures are present in the glazing, and no damage is visible to the unit.</td>
</tr>
<tr>
<td>No Hazard (H1)</td>
<td>The glazing has fractured, but no breakage has occurred (no debris).</td>
</tr>
<tr>
<td>Minimal Hazard (H2)</td>
<td>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).</td>
</tr>
<tr>
<td>Very Low Hazard (H3)</td>
<td>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).</td>
</tr>
<tr>
<td>Low Hazard (H4)</td>
<td>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.</td>
</tr>
<tr>
<td>High Hazard</td>
<td>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.</td>
</tr>
</tbody>
</table>

## ASTM F2927-12 – Door Response Damage Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category I</td>
<td>The door specimen is unchanged and fully operable.</td>
</tr>
<tr>
<td>Category II</td>
<td>The unit has acceptable permanent deformation but it still operable.</td>
</tr>
<tr>
<td>Category III</td>
<td>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.</td>
</tr>
<tr>
<td>Category IV</td>
<td>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.</td>
</tr>
<tr>
<td>Category V</td>
<td>The door or the door and frame unit together become dislodged and cause a flying debris hazard that will go further than 3 meters.</td>
</tr>
</tbody>
</table>
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.


3.7 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.

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

<table>
<thead>
<tr>
<th>Blast Requirements to be provided (DoD Projects)</th>
<th>Sample Criteria (Door)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Size</td>
<td>3´-0¨ x 7´-0¨</td>
</tr>
<tr>
<td>Charge Weight</td>
<td>II</td>
</tr>
<tr>
<td>Stand-off Distance</td>
<td>250 ft</td>
</tr>
<tr>
<td>Level of Protection</td>
<td>Medium</td>
</tr>
<tr>
<td>UFC Revision, Revision Date, and Change Date (If Applicable)</td>
<td>UFC 4-010-01, 9 Feb 2012 Change 1, 1 Oct 2013</td>
</tr>
</tbody>
</table>
### Sample Blast Quote Request Form

#### Blast Resistant Door – Request for Quote

<table>
<thead>
<tr>
<th>Opening</th>
<th>Door Qty</th>
<th>Swing Width</th>
<th>Height</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Door Type**
- **Interior – Secure Area**: RH, LH, RHR, LHR
- **Exterior – Public Area (Key side of door)**: RH, LH, RHR, LHR

**Fire Rating**
- **Seated or Unseated**: seated, unseated

**Blast Requirements**
- **Load (psi)**: expected loading resistance as generated by a blast
- **Impulse (psi-ms)**: amount of psi-msec the door will be exposed to
- **Duration (ms)**: blast duration in msec.
- **% Rebound Response**: represents the expected psi capacity the door will be required to withstand in the opposite direction of the blast
- **Response Category**: I: no visible damage, II: visible damage to the panel but the door remains operable, III: panel is damaged and 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.

**Frame**
- **Jamb Width**
- **Wall Thickness**
- **Lock Type**

**Material**
- The doors material type (SS-Stainless Steel, CR-Cold Rolled, GV-Galvanized)
- **Hinges**: Heavy Duty S.S. Hinges 32D

**Glass Type**
- Will be specified as required to meet the blast requirement
- Glass by Manufacturer
- Glass provided by customer

**Test Method**
- **Project Name**
- **E-mail**
- **Fax**
- **Contact Phone**

**Revision**
- **Project Location**
- **Project Mgr**
- **Contact Person**

**Contact**
- **Title**
- **Company**

**Date**
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

Members of the Steel Door Institute

CECO
AN ASSA ABLOY DOOR GROUP COMPANY
9159 Telecom Drive
Milan, TN 38358-3425
(731) 686-8345
www.cecodoor.com

CURRIES
AN ASSA ABLOY DOOR GROUP COMPANY
1502 12th Street
P.O. Box 1648
Mason City, IA 50402-1648
(641) 423-1334
www.curries.com

DEANSTEEL MANUFACTURING CO.
931 S. Flores Street
San Antonio, TX 78204-1406
(210) 226-8271
www.deansteel.com

DOOR COMPONENTS INC.
7980 Redwood Avenue
Fontana, CA 92336-1638
(909) 770-5700
www.doorcomponents.com

HOLLOW METAL XPRESS
602 S. 65th Avenue
Phoenix, AZ 85043
(623) 936-7000
www.HMXpress.com

MESKER DOOR, LLC
3440 Stanwood Boulevard
Huntsville, AL 35811-9021
(256) 851-6670
www.meskerdoor.com

MPI
319 North Hills Road
Corbin, KY 40701
(606) 523-0173
www.metalproductsinc.com

PIONEER INDUSTRIES, INC.
111 Kero Road
Carlstadt, NJ 07072
(201) 933-1900
www.pioneerindustries.com

REPUBLIC DOORS & FRAMES
155 Republic Drive
McKenzie, TN 38201-0580
(731) 352-3383
www.republicdoor.com

SMP
AN ASSA ABLOY DOOR GROUP COMPANY
5678 Concours Street
Ontario, CA 91764
(909) 593-2100
www.secmet.com

STEELCRAFT
9017 Blue Ash Road
Cincinnati, OH 45242
(513) 745-6400
www.steelcraft.com

Audio-Visual Programs Also Available