
USACE / NAVFAC / AFCEA UFGS-08390 (November 2003)

Preparing Activity: USACE Superseding
UFGS-08390 (April 2001)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 23 June 2005

Latest change indicated by CHG tags

SECTION TABLE OF CONTENTS

DIVISION 08 - DOORS AND WINDOWS

SECTION 08390

BLAST RESISTANT DOORS

11/03

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DOOR DESCRIPTION
 - 1.3.1 Design Requirements
 - 1.3.1.1 Static Material Strength
 - 1.3.1.2 Dynamic Material Strength
 - 1.3.1.3 Structural Member Design
 - 1.3.1.4 Dynamic Analysis and Deformation
 - 1.3.1.5 Rebound Resistance
 - 1.3.2 Blast Effects
 - 1.3.2.1 Overpressure
 - 1.3.2.2 Overpressure Direction
 - 1.3.2.3 Fragment Resistance
 - 1.3.3 Blast Door Operation
- 1.4 QUALIFICATIONS
- 1.5 DELIVERY AND STORAGE
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Concrete and Concrete Reinforcement
 - 2.1.2 Structural Tubing
 - 2.1.3 Structural Steel
 - 2.1.4 Steel Sheet and Strip
 - 2.1.5 Fasteners
- 2.2 HARDWARE
 - 2.2.1 Hinges
 - 2.2.1.1 General Requirements
 - 2.2.1.2 Hinge Description
 - 2.2.2 Latching System
 - 2.2.2.1 Latching Points

- 2.2.2.2 Latching System Operation
- 2.2.2.3 Latching Mechanism
- 2.2.2.4 Safety Cover
- 2.2.2.5 Cover Plate
- 2.2.2.6 Latches
- 2.2.2.7 Handle
- 2.2.3 Mortise Lock and Latch Set
- 2.2.4 Keying
- 2.2.5 Exit Device
- 2.2.6 Straight Steel Bar Door Pull
- 2.2.7 Padlock
- 2.2.8 Shrouded Padlock
- 2.2.9 Hasp
- 2.2.10 High Security Hasp
- 2.2.11 Shrouded Hasp
- 2.2.12 Door Stop
- 2.2.13 Surface Door Closer
- 2.2.14 Overhead Door Holder
- 2.2.15 Gasket Seal
- 2.2.16 Door Silencer
- 2.2.17 Optical Device
- 2.3 ACCESSORIES
 - 2.3.1 Subframe
 - 2.3.2 Nameplate
 - 2.3.3 Removable Threshold
 - 2.3.4 Ramp
 - 2.3.5 Self-Rescue Kit
- 2.4 FABRICATION
 - 2.4.1 Shop Assembly
 - 2.4.2 Mullion
 - 2.4.3 Thermal Insulation
 - 2.4.4 Shop Finishing
 - 2.4.5 Clearance
- 2.5 BLAST DOOR ASSEMBLIES
 - 2.5.1 Door [____]; Steel
 - 2.5.1.1 Type
 - 2.5.1.2 Overpressure
 - 2.5.1.3 Fragment
 - 2.5.1.4 Rebound
 - 2.5.1.5 Deformation Limits
 - 2.5.1.6 Hardware
 - 2.5.1.7 Operating Forces
 - 2.5.1.8 Accessories
 - 2.5.2 Door [____]; Concrete
 - 2.5.2.1 Type
 - 2.5.2.2 Overpressure
 - 2.5.2.3 Fragment
 - 2.5.2.4 Rebound
 - 2.5.2.5 Deformation Limits
 - 2.5.2.6 Hardware
 - 2.5.2.7 Operating Forces
 - 2.5.2.8 Accessories
 - 2.5.3 Door [____]; Metal
 - 2.5.3.1 Type
 - 2.5.3.2 Overpressure
 - 2.5.3.3 Rebound
 - 2.5.3.4 Hardware
 - 2.5.3.5 Operating Forces
 - 2.5.3.6 Accessories

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

- 2.6.1 Prototype Static Test
- 2.6.2 Prototype Blast Test
- 2.6.3 Shop Operating Test
- 2.6.4 Air Leakage Test
- 2.6.5 Sound Rating Test
- 2.6.6 Fire Rating Test and Inspection

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 TESTS
- 3.3 MANUFACTURER'S FIELD SERVICE

-- End of Section Table of Contents --

USACE / NAVFAC / AFCEA UFGS-08390 (November 2003)

Preparing Activity: USACE Superseding
UFGS-08390 (April 2001)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 23 June 2005

Latest change indicated by CHG tags

SECTION 08390

BLAST RESISTANT DOORS 11/03

NOTE: This guide specification covers the requirements for manually operated swinging structural steel, reinforced concrete, and hollow metal blast resistant doors.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

- ACI 318/318R (2002) Building Code Requirements for Structural Concrete and Commentary
- ACI 318M/318RM (2002) Metric Building Code Requirements for Structural Concrete and Commentary

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

- ABMA 11 (1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
- ABMA 9 (1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

- AISC 316 (1989) ASD Manual of Steel Construction
- AISC 325 (2001) LRFD Manual of Steel Construction
- AISC 335 (1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

- AISI SG-971-Spec (1996) Specification and Commentary for the Design of Cold-Formed Steel Structural Members and Commentary; includes SG-2000-1 Supp 1 to 1996 Spec, dated 2000

AMERICAN WELDING SOCIETY (AWS)

- AWS A2.4 (1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
- AWS A5.4 (1992; R 2000) Stainless Steel Electrodes for Shielded Metal Arc Welding
- AWS D1.1/D1.1M (2004) Structural Welding Code - Steel
- AWS D1.3 (1998) Structural Welding Code - Sheet Steel
- AWS D1.4 (1998) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

- ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A 153/A 153M (2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A 242/A 242M (2004) High-Strength Low-Alloy Structural Steel

ASTM A 307	(2004) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2004b) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2004b) Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 354	(2004) Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A 36/A 36M	(2004) Carbon Structural Steel
ASTM A 449	(2004a) Quenched and Tempered Steel Bolts and Studs
ASTM A 490	(2004a) Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 490M	(2004a) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(2003a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2001) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(2000a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(2004) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 534	(2004) Carburizing Steels for Anti-Friction Bearings
ASTM A 563	(2004a) Carbon and Alloy Steel Nuts
ASTM A 563M	(2004) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(2004) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 574	(2004) Alloy Steel Socket-Head Cap Screws
ASTM A 574M	(2004) Alloy Steel Socket-Head Cap Screws (Metric)
ASTM A 588/A 588M	(2004) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield

	Point to 4 in. (100 mm) Thick
ASTM A 606	(2004) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 615/A 615M	(2004b) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 618	(2004) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 653/A 653M	(2004a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 706/A 706M	(2004b) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 792/A 792M	(2003) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 90	(2004) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM F 436	(2004) Hardened Steel Washers
ASTM F 436M	(2004) Hardened Steel Washers (Metric)
ASTM F 568M	(2004) Carbon and Alloy Steel Externally Threaded Metric Fasteners
ASTM F 835	(2004) Alloy Steel Socket Button and Flat Countersunk Head Cap Screws
ASTM F 835M	(2004) Alloy Steel Socket Button and Flat Countersunk Head Cap Screws (Metric)
ASTM F 883	(2004) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.13	(2002) Mortise Locks & Latches, Series 1000
BHMA A156.20	(2001) Strap and Tee Hinges and Hasps
BHMA A156.3	(2001) Exit Devices
BHMA A156.4	(2000) Door Controls - Closers

BHMA A156.8 (2000) Door Controls - Overhead Holders
and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2003) Life Safety Code

NFPA 252 (2003) Fire Tests of Door Assemblies

NFPA 80 (1999) Fire Doors and Fire Windows

NFPA 80A (2001) Protection of Buildings from
Exterior Fire Exposures

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-29181 (Rev C, Am 1, Notice 1) Hasp, High
Security, Shrouded, for High and Medium
Security Padlock

MIL-DTL-43607 (Rev H; Notice 1) Padlock, Key Operated,
High Security, Shrouded Shackle

1.2 SUBMITTALS

NOTE: Submittals must be limited to those necessary
for adequate quality control. The importance of an
item in the project should be one of the primary
factors in determining if a submittal for the item
should be required.

A "G" following a submittal item indicates that the
submittal requires Government approval. Some
submittals are already marked with a "G". Only
delete an existing "G" if the submittal item is not
complex and can be reviewed through the Contractor's
Quality Control system. Only add a "G" if the
submittal is sufficiently important or complex in
context of the project.

For submittals requiring Government approval on Army
projects, a code of up to three characters within
the submittal tags may be used following the "G"
designation to indicate the approving authority.
Codes for Army projects using the Resident
Management System (RMS) are: "AE" for
Architect-Engineer; "DO" for District Office
(Engineering Division or other organization in the
District Office); "AO" for Area Office; "RO" for
Resident Office; and "PO" for Project Office. Codes
following the "G" typically are not used for Navy
projects.

Submittal items not designated with a "G" are
considered as being for information only for Army
projects and for Contractor Quality Control approval
for Navy projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation[; G][; G, [____]]

For special doors or standard doors with appreciable modifications, detailed fabrication and assembly drawings indicating the door location and showing dimensions, materials, fabrication methods, hardware, and accessories in sufficient detail to enable the Contracting Officer to check compliance with contract documents. Weld symbols used shall conform to AWS A2.4. These drawings need not be submitted for standard doors for which manufacturer's catalog data is submitted.

SD-03 Product Data

Door Description[; G][; G, [____]]

Data on standard blast doors consisting of catalog cuts, brochures, circulars, specifications, and product data that show complete dimensions and completely describe overpressure ratings, rebound ratings, doors, frames, anchors, hardware, and accessories.

Design Requirements[; G][; G, [____]]

Detailed structural analysis and design calculations demonstrating resistance to blast when blast resistance is not demonstrated by prototype tests. Design calculations shall demonstrate adequacy under the blast effects specified or indicated. Design calculations shall include a sketch of the overpressure waveform; dimensioned sketches of blast resisting elements such as door members, frame members, latches, and hinges; section properties for blast resisting members including built-up sections; the standard under which steel is produced; static and dynamic material strength properties; the resistance, stiffness, mass, elastic natural period, and elastic deflection for flexural members; and the peak deflection, peak support rotation, and time to peak deflection for door members in flexure. Design calculations shall cover initial response, rebound, and all secondary items such as shear, welds, local buckling, web crippling, hinges, and latches.

Door Description

Manufacturer's instructions for installation and field testing.

Manufacturer's Field Service

Information describing training to be provided, training aids to be used, and background data on the personnel conducting the training.

SD-06 Test Reports

Tests[; G][; G, [____]]
Tests, Inspections, and Verifications

Shop and field operating test reports that include values for opening and closing forces and times, forces required to operate latches, and a description of all operating tests performed.

Fire Rating Test and Inspection[; G][; G, [____]]

In lieu of a UL listing for fire door assemblies, a letter may be submitted by the testing laboratory which identifies the submitted product by manufacturer and type or model and certifies that it has tested a sample assembly and issued a current listing.

Prototype Static Test[; G][; G, [____]]
Prototype Blast Test[; G][; G, [____]]

Certified test reports demonstrating blast resistance. Test reports shall include the name and location of the testing agency or laboratory, a description of the testing apparatus, the date of the tests, a description of the door specimen tested, descriptions of loadings, and the value of measured peak door deflection and peak permanent set. Test reports shall include analysis and interpretation of test results.

SD-07 Certificates

Materials[; G][; G, [____]]

Steel mill reports covering the number, chemical composition, and tension properties for structural quality steels. When blast resistance is demonstrated by calculations, a certificate stating that the door assembly provided was manufactured using the same materials, dimensions, and tolerances shown in the calculations. When blast resistance is demonstrated by prototype testing, a certificate stating that door and frame provided was manufactured using the same materials, dimensions, and tolerances as the tested prototype and listing the hardware and frame anchors required to achieve blast resistance. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturer and shall identify the door assembly and date of shipment or delivery to which the certificate applies.

Fire-Rated Door Assemblies[; G][; G, [____]]

Certificate of inspection conforming to NFPA 80, NFPA 80A, and NFPA 101 for fire doors exceeding the size for which label service is available.

Thermal Insulation[; G][; G, [____]]
Sound Rating Test[; G][; G, [____]]

Certification or test report for [thermal insulated] [sound rated] doors listing the type of hardware used to achieve the rating.

SD-10 Operation and Maintenance Data

Door Description

Information bound in manual form consisting of manufacturer's safety precautions, preventative maintenance and schedules, troubleshooting procedures, special tools, parts list, and spare parts data. All material shall be cross referenced to the door designations shown on the drawings.

1.3 DOOR DESCRIPTION

NOTE: Unlike most other doors, a blast door is provided by one manufacturer as a complete assembly including the door, frame, hardware, and accessories. This must be done because items such as the door, frame, latches, and hinges are of special manufacture and are interdependent parts of blast resistance. To facilitate the specification of individual door assemblies, the door type, blast effects, rebound, deformation limits, operating forces, hardware, and accessories for each door are brought together under a blast door assembly specification in Part 2 where assembly specification paragraphs for the various door types are provided.

The designer will become familiar with these assembly paragraphs prior to specification editing. Coordinate with paragraph BLAST DOOR ASSEMBLIES.

[Structural steel doors shall be [flush mounted in frames] [or] [surface mounted] [as indicated].] [Reinforced concrete doors shall be surface mounted.] [Hollow metal doors shall be flush mounted in frames.] Doors shall be the manually operated, side hinged, swinging type. Each door assembly shall include the door, frame, anchors, hardware, and accessories and shall be provided by a single manufacturer. Frames and anchors shall be capable of transferring blast and rebound reactions to the adjacent supporting structure. Resistance to blast shall be demonstrated either by design calculations or tests on prototype door assemblies.

1.3.1 Design Requirements

1.3.1.1 Static Material Strength

The static values for minimum yield strength (or yield point) and (ultimate) tensile strength for steel shall be obtained from the applicable material specification. For tensile strength specified in terms of a tensile strength range, the lowest tensile strength specified shall be selected for design. Structural steel having a minimum static yield strength (or yield point) less than 345 MPa 50 ksi [and Grade 60 reinforcing bars] shall be designed using an average yield strength computed as 1.1 times the minimum static yield strength or yield point. If the minimum static yield for structural steel exceeds 345 MPa 50 ksi, the expected yield strength used for design shall be equal to the minimum specified static yield strength or yield point without increase. [The in-place compressive strength of concrete used for design shall be computed by multiplying the specified compressive strength by 1.1 to reach the

expected compressed strength and then multiplying by not more than 1.15 to account for a one year age effect.] [The expected yield stress for steel sheet and strip used in design shall be computed as 1.21 times the specified static yield point.]

1.3.1.2 Dynamic Material Strength

The dynamic material strength shall be computed by applying a dynamic increase factor that accounts for the increase in material strength due to strain rate effects. The dynamic increase factor for structural steel in flexure shall be applied to the average yield strength and shall be [1.29] [____], [1.19] [____], and [1.09] [____] for structural steel having a minimum yield strength (or yield point) of 248 MPa, 345 MPa, and 689 MPa, 36, 50, and 100 ksi, respectively. The dynamic increase factor for structural steel having a minimum yield strength (or yield point) between these values shall be obtained by interpolation. Optionally, for structural steel in these yield ranges, the dynamic increase factor shall be determined by a detailed analysis that accounts for the time to yield. The dynamic increase factor for structural steel having a minimum yield exceeding 689 MPa 100 ksi shall be 1.0. [The dynamic increase factor for Grade 60 flexural reinforcing bars shall be [1.17] [____] applied to the average yield strength. The dynamic increase factor for concrete used in flexure shall be [1.19] [____] applied to the in-place compressive strength. Optionally, the dynamic increase factor applied to flexural reinforcing bar yield and concrete compressive strength shall be determined by a detailed analysis that accounts for the time to steel yield and time to ultimate concrete strength.] [The dynamic increase factor for steel sheet and strip used in flexure shall be 1.1 applied to the average yield stress.]

1.3.1.3 Structural Member Design

[Structural steel section properties for rolled shapes shall be obtained from AISC 325, AISC 316, or steel manufacturers' catalogs. The plastic moment capacity for single plate sections and sections built up from plates and shapes shall be computed as the average of the elastic and plastic section modulus multiplied by the dynamic yield strength, unless otherwise approved. Shear, welds, local buckling, and web crippling of structural steel shall be designed in accordance with AISC 325, the plastic design provisions of AISC 335, or by other approved methods except that for blast design, the load factors and resistance factors shall be equal to 1.0 and the dynamic yield strength shall be substituted for the static yield stress.] [Nominal reinforcing bar designations, weights, and dimensions shall be obtained from ACI 318M/318RM ACI 318/318R or the reinforcing bar specification. The moment of inertia of the reinforced concrete cross section used to determine the elastic deflection shall be the average of the moment of inertia of the gross section and the moment of inertia of the cracked section. The resistance of the reinforced concrete section shall be computed in accordance with ACI 318M/318RM ACI 318/318R or other approved methods except that for blast design, the load and resistance factors shall be equal to 1.0 and the dynamic reinforcing bar yield strength and dynamic ultimate concrete strength shall be substituted for the static strength values.] [Hollow metal doors shall be designed in accordance with AISI SG-971-Spec except that for blast design, the dynamic yield strength shall be substituted for the static yield point.]

1.3.1.4 Dynamic Analysis and Deformation

The door shall be designed using an equivalent single degree of freedom or

other approved dynamic analysis method. The maximum door deformation shall be selected by the door manufacturer except that the maximum deformation in flexure shall not exceed the deformation limits specified or indicated. The deformation of structural steel members having a minimum yield strength or yield point greater than 448 MPa 65 ksi shall not exceed the elastic deflection. [Increased resistance due to strain hardening of structural steel in flexure can be used when the ductility ratio exceeds 10 or when otherwise approved.] [The ductility ratio for flexural members in hollow metal doors shall not exceed 1.0.]

1.3.1.5 Rebound Resistance

NOTE: For structural steel and hollow metal doors, specify 100 percent rebound resistance in the extreme case when the blast overpressure duration is much shorter than the expected period of the door and when rebound resistance must be guaranteed. Specify less than 50 percent rebound resistance in the extreme case when the blast overpressure duration is much longer than the expected period of the door. Specify zero rebound in the extreme case in which the door need not remain in place after the blast. Otherwise, specify 50 percent rebound resistance as recommended in TM 5-1300, Chapter 5. The most prevalent rebound resistance for reinforced concrete doors is 20 and 100 percent.

Rebound for each door will be specified in paragraph
BLAST DOOR ASSEMBLIES.

Rebound resistance shall be the specified or indicated percentage of the door resistance at initial peak response.

1.3.2 Blast Effects

NOTE: Specifying doors in terms of overpressure without duration is recommended only when the overpressure is low and the overpressure duration is greater than about 10 times the expected period of the door. Overpressure without duration is often specified for hollow metal doors because they have low overpressure resistance. Hollow metal doors are available to resist overpressures in the range from 6 to 173 kPa (1 to 25 psi), but a structural steel door option should be considered when the overpressure exceeds 83 kPa (12 psi).

Specifying time dependent overpressure is required for other than low and long duration overpressures and is recommended for reinforced concrete doors. When the waveform is other than a zero rise time triangle, show the waveform on the drawings.

1.3.2.1 Overpressure

The spatial distribution of overpressure shall be uniform unless otherwise specified or indicated. [For overpressure specified or indicated without duration, the overpressure waveform shall have a zero rise time and infinite duration.] [For overpressure specified or indicated with duration only, the waveform shall be a triangle with a zero rise time.] [Special waveforms are indicated.]

1.3.2.2 Overpressure Direction

[For overpressure identified as seating and for overpressure directions not otherwise specified or indicated, the positive phase overpressure shall be in the direction that causes the door to seat toward the frame.] [For overpressure identified as unseating, the positive phase overpressure shall be in the direction that causes the door to unseat away from the frame.]

1.3.2.3 Fragment Resistance

NOTE: Fragment design parameters will be determined in accordance with TM 5-1300, chapter 2 and TM 5-855-1 as applicable. Exposing blast doors to primary fragments is not recommended because of the resulting severe damage to hardware, because molten fragments can weld the door to the frame preventing post-blast opening, and because it is difficult to prevent perforation at the door edges. Also, while latches and latch mechanisms can be protected, it is usually not practical to protect the hinges.

Worst-case fragment perforation of the door can be prevented for structural steel and reinforced concrete doors by specifying fragment characteristics or a minimum plate or concrete thickness in the door assembly paragraph.

The 100 and 200 mm (4 and 8 inch) reinforced concrete nominal thickness shown are typically available.

Hollow metal doors cannot prevent perforation by primary fragments and will not be used for this purpose.

Fragment parameters or door thickness will be specified in paragraph BLAST DOOR ASSEMBLIES.

For doors specified or indicated to resist fragments, the door and the door and frame interface shall be designed to prevent fragment perforation and the latches and latching mechanism shall be shielded from fragment damage. The fragment impact point shall be anywhere on the door and frame face exposed to overpressure.

1.3.3 Blast Door Operation

NOTE: Specify swing forces of 90 and 70 N (20 and

15 pounds) for hollow metal doors, 135 and 90 N (30 and 20 pounds) for structural steel doors, and 180 and 90 N (40 and 20 pounds) for 200 mm (8 inch) thick reinforced concrete doors and heavy structural steel doors. Use the lower values for structural and hollow metal doors when rolling bearing hinges are specified.

For latch engagement and release, specify 90 to 135 N (20 to 30 pounds) for structural steel doors without gasket seals and for reinforced concrete doors. Specify 135 to 180 N (30 to 40 pounds) for structural steel doors with gasket seals is recommended to accommodate the extra force required to compress the gasket during latching.

For means of egress, specify NFPA 101 operating forces. In this case, Type I (rolling bearing) hinges are recommended.

Operating requirements will be specified in paragraph BLAST DOOR ASSEMBLIES.

The force required to set the door in motion shall be measured from the 90-degree open position, and the force required to engage and release the latches shall be measured at the latch handle with the door in the normal closed position.

1.4 QUALIFICATIONS

NOTE: Delete AWS D1.3 requirement when hollow metal doors are not specified. Delete AWS D1.4 requirement when reinforced concrete doors are not specified.

Welders, welding operators, and weld inspectors shall be qualified in accordance with AWS D1.1/D1.1M [except that] [welders performing arc welding of steel sheet and strip shall be qualified in accordance with AWS D1.3] [and] [welders and weld operators performing welding of reinforcing bars shall be qualified in accordance with AWS D1.4].

1.5 DELIVERY AND STORAGE

Door assemblies delivered and placed in storage shall be stored with protection from weather and dirt, dust, and contaminants.

1.6 WARRANTY

Manufacturer's written warranty covering the blast door assembly for 2 years after acceptance by the Government shall be furnished. Warranty shall provide for repair and replacement of the blast door assembly and individual hardware and accessory items in the event of malfunction due to defects in design, materials, and workmanship except that the warranty need not cover finishes provided by others.

PART 2 PRODUCTS

2.1 MATERIALS

Only structural quality steel materials for which tension properties have been obtained shall be used to resist blast except that commercial quality steel sheet and strip shall be permitted for prototype tested hollow metal doors. Steel used in the door, door frame, and door frame anchors and non stainless steel fasteners that resist blast shall be selected from the materials specified.

2.1.1 Concrete and Concrete Reinforcement

**NOTE: Retain this paragraph when reinforced
concrete doors are specified.**

Concrete is specified in Section [03300A CAST-IN-PLACE STRUCTURAL CONCRETE] [03300N CAST-IN-PLACE CONCRETE]. Concrete reinforcement shall conform to ASTM A 615/A 615M or ASTM A 706/A 706M, Grade 60.

2.1.2 Structural Tubing

**NOTE: Retain this paragraph when structural steel
or hollow metal doors are specified.**

Structural tubing shall conform to ASTM A 500, ASTM A 501, or ASTM A 618.

2.1.3 Structural Steel

**NOTE: For reinforced concrete and hollow metal
doors, specify only ASTM A 36/A 36M.**

Structural steel bars, plates, and shapes shall conform to ASTM A 36/A 36M, ASTM A 242/A 242M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M. Quenched and tempered steel plate shall conform to ASTM A 514/A 514M.

2.1.4 Steel Sheet and Strip

**NOTE: Retain this paragraph when hollow metal doors
are specified.**

Steel sheet and strip shall conform to ASTM A 653/A 653M, Grades A, B, C, D, and F; ASTM A 653/A 653M; ASTM A 606; or ASTM A 792/A 792M, Grades 33, 37, 40, and 50.

2.1.5 Fasteners

Steel studs and bolts shall conform to ASTM A 307, ASTM A 325M, ASTM A 325, ASTM A 354, ASTM A 449, or ASTM A 490M, ASTM A 490 as applicable. Steel nuts shall conform to ASTM A 563M, ASTM A 563. Hardened circular, beveled, and clipped washers shall conform to ASTM F 436M, ASTM F 436. Steel hex cap

screws shall conform to ASTM F 568M. Steel socket-headed cap screws shall conform to ASTM A 574MASTM A 574. Steel button and flat-headed countersunk cap screws shall conform to ASTM F 835M ASTM F 835.

2.2 HARDWARE

2.2.1 Hinges

NOTE: Retain rolling bearing and operating cycle description under General Requirements when hinge Type 1 is specified.

Blast door hinges are normally full surface. Mortise hinges can be specified for hollow metal doors, but availability must be verified with door manufacturers.

Hinge Type 1 is intended for cases where high usage with smooth operation is the main requirement and is generally appropriate for facilities designed to resist the effects of improvised explosive devices.

Hinge Type 2 is intended for cases where in-structure shock could damage rolling thrust bearings and is recommended for facilities designed to resist the effects of conventional weapons.

Hinge Type 3 is recommended for low use applications such as infrequently used access doors.

2.2.1.1 General Requirements

Hinges shall be specially manufactured to support the door and to resist blast induced loading. The number of hinges shall be determined by the blast door manufacturer. Welds used in hinges shall be continuous. Hinges shall be attached to the door and frame using mechanical fasteners except that full surface hinges for doors with locks shall be attached to the door and frame by welding or approved tamper-resistant mechanical fasteners and hinges for doors with locks shall have approved nonremovable pins. Load ratings and fatigue life for ball and roller bearings shall be determined in accordance with ABMA 9 and ABMA 11 as applicable and, unless otherwise approved, the bearing steel shall conform to ASTM A 534. Hinges shall be capable of operating for the minimum number of cycles specified without failure or excessive wear under the door service loads where one cycle consists of swinging the door back and forth between the normal closed position and the 90-degree open position, where failure or excessive wear means that the latches do not seat properly or the door does not swing smoothly due to hinge failure or wear, and where door service loads consist of the door weight plus any loads produced by hardware. Rolling bearings shall be factory grease lubricated and either sealed or provided with easily accessible lubrication fittings.

2.2.1.2 Hinge Description

[Hinge Type 1 shall be capable of smooth operation for a minimum of 250,000 cycles. This type of hinge shall be provided with structural quality steel pins and leafs and either rolling bearings in both the thrust and radial

directions or hardened steel washer (disc) thrust bearings and rolling radial bearings except that rolling thrust bearings and metallic journal radial bearings shall be permitted for hollow metal doors when the specified overpressure is less than 21 kPa 3 psi]. [Hinge Type 2 shall be smooth operating and shall be provided with structural quality steel pins and leafs, steel base washer (disc) thrust bearings, and metallic journal radial bearings or other approved non rolling type bearings.] [Hinge Type 3 shall be provided with metallic bearings.]

2.2.2 Latching System

2.2.2.1 Latching Points

The number of latching points shall be determined by the door manufacturer. [For multiple latching points, latching points can be provided at the head, sill, and jambs.] [For jamb latching points, latching points shall be provided at the jambs only.]

2.2.2.2 Latching System Operation

NOTE: Retain the first sentence when hinge Type 1 is specified.

Latching systems shall be capable of operating for the same number of cycles specified for the door hinges where one latch operating cycle consists of engaging and releasing using the handle. Latches shall remain engaged until manually released and shall not release under blast loads or rebound. [Manually operated latches shall remain in the released position until manually engaged.] [Self-latching latches shall provide self-activating engagement when the door is swung to the normal closed position.] Handles shall release latches under a clockwise motion.

2.2.2.3 Latching Mechanism

[Latching mechanisms and latches for structural steel doors shall be mounted on the seating face of the door.] [Latching mechanisms for hollow metal doors shall be mounted on the seating face of the door and safety covered.] [Unless otherwise approved, latch handle axles (spindles) for [structural steel doors] [and] [reinforced concrete doors] shall extend through the blast load carrying portion of the door and shall be provided with suitable metallic journal bearings.] Latch handle axles shall be manufactured of hardened steel or stainless steel, and axles requiring lubrication shall be provided with easily accessible lubrication fittings.

2.2.2.4 Safety Cover

NOTE: Safety covers apply to structural steel and hollow metal doors.

Safety covers shall consist of steel housings that enclose the latching mechanism such that only the operating rods are exposed.

2.2.2.5 Cover Plate

Cover plates for structural steel doors shall be manufactured of minimum 6

mm 1/4 inch thick plate and shall enclose the entire latching mechanism.

2.2.2.6 Latches

NOTE: Retain lever type latches for reinforced concrete doors.

Latches (latch bolts) shall be manufactured of structural quality steel and the latch bolt throw shall not be less than 19 mm 3/4 inch. Latch bolts shall be the sliding type in which the latch bolt slides into a matching strike in the door frame [or the lever type in which the latch bolt rotates into a groove in the frame as specified or indicated] [except that latches for doors with [mortise lock and latch sets] [and] [exit devices] shall be the sliding type]. Manually operated latches shall draw the door toward the frame during latching.

2.2.2.7 Handle

NOTE: Wheel or spoke handle options are recommended for structural steel doors when gasket seals are specified.

[Handles for doors without locks shall be manufactured of steel castings, forgings, pipe, round tubing, bar, or plate and shall be one piece or have welded joints except that wheel handles can be manufactured of aluminum castings.] [Handles for doors with mortise lock and latch sets shall be manufactured of [steel castings] [or] [stainless steel].] Latch handles shall be firmly fastened to axles. Lever handles shall be perpendicular to the door edge when latches are engaged. [Single lever handles shall be located at the stile opposite the hinges.] [[Wheel] [and spoke lever] [Spoke lever] handles shall be located approximately halfway between the stiles.]

2.2.3 Mortise Lock and Latch Set

NOTE: Mortise lock and latch sets are practical only for hollow metal doors. These lock and latch sets are special built and are not normally cycle tested as specified in BHMA A156.13. Mortise lock and latch sets are usually specified only when a deadbolt function is required.

Lever handles shall release latches using a torque not exceeding 3 Newton meters 27 lb-in.. Latches (latch bolts) shall be located at the stiles and operated from a single lever handle. Only one deadbolt shall be provided. The deadbolt shall be manufactured of structural quality steel and the deadbolt throw shall not be less than 25 mm 1 inch. Mortise locks shall be provided with armored fronts. The function numbers for mortise locks shall be as defined in BHMA A156.13.

2.2.4 Keying

[Keying shall conform to Section 08710 DOOR HARDWARE.] [Change keys for

locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Unless otherwise specified, two change keys shall be provided for each lock.] [Locks shall be furnished with the manufacturer's standard construction key system.]

2.2.5 Exit Device

NOTE: Exit devices are practical only for hollow metal doors and light structural steel doors.

Latches (latch bolts) shall release by depressing the actuation bar using a force of not more than 67 N 15 pounds applied perpendicular to the door in the swing direction. The exit device shall [conform to the finish test values specified in BHMA A156.3 and shall be of] [stainless steel construction] [and] plain design with straight, beveled, or smoothly rounded sides, corners, and edges. A touch bar may be provided in lieu of a conventional actuation bar (cross bar). The function numbers for exit devices shall be as defined in BHMA A156.3.

2.2.6 Straight Steel Bar Door Pull

NOTE: This door pull is intended for structural steel and reinforced concrete doors. Type III normally applies.

Straight steel bar door pulls shall be manufactured of round steel bar. The type furnished shall be [Type I: 12 mm 1/2 inch diameter, 125 mm 5 inch grip and 65 mm 2-1/2 inch projection with 12 mm 1/2 inch inside bend radiuses] [;] [and] [Type II: 16 mm 5/8 inch diameter, 300 mm 12 inch grip and 100 mm 4 inch projection with 24 mm 15/16 inch inside bend radiuses] [; and] [Type III: 16 mm 5/8 inch diameter, 200 mm 8 inch grip and 100 mm 4 inch projection with 24 mm 15/16 inch inside bend radiuses]. Grip and projection dimensions are measured from the bar centerline. The pull shall be attached to the door by fillet welding all around.

2.2.7 Padlock

NOTE: For ASTM F 883 padlock, specify Type P01 (key operated) or P02 (combination operated) and Grade 1 (lowest) to 6 (highest) performance. Available ASTM F 883 options are "A" (key is captive in cylinder when padlock is unlocked), "B" (removable cylinder), "C" (changeable combination), "D" (combination operated with key control), "E" (corrosion resistant), and "F" (provided with nonferrous shackles).

Low security padlocks shall conform to ASTM F 883, Type [P01] [P02], Option [_____] [and] [_____] , Grade [_____] .

2.2.8 Shrouded Padlock

**NOTE: Use a shrouded padlock in conjunction with a
hasp conforming to MIL-DTL-29181.**

High security padlocks with shrouded shackles shall conform to MIL-DTL-43607.

2.2.9 Hasp

Low security hasps shall conform to BHMA A156.20, Grade [1] [2] [3], steel, [safety] [or] [open hinge] type with [adjustable] [,] [or] [swivel] [,] [or] [fixed] staple, [paint finished] [or] [galvanized] [as specified] and screw fastened to the door and frame.

2.2.10 High Security Hasp

**NOTE: This high security hasp is a non-shrouded
mortise type. Styles 1 through 9 are available.
Consult referenced military specification.**

High security hasps shall conform to MIL-DTL-29181, Style [_____] [carbon] [corrosion resistant] steel, attached by [fasteners] [welding].

2.2.11 Shrouded Hasp

**NOTE: Style 1 applies to right-hand doors and Style
2 to left-hand doors.**

High security shrouded hasps shall conform to MIL-DTL-29181, Style [1] [or] [2] [as applicable].

2.2.12 Door Stop

Door stops shall be designed to resist the impact of the door. The stop shall not scratch or scar the door finish when the door is opened against the stop.

2.2.13 Surface Door Closer

**NOTE: Door closers are practical only for hollow
metal doors and light structural steel doors.**

The surface door closer shall conform to BHMA A156.4. The size and grade shall be selected by the door manufacturer.

2.2.14 Overhead Door Holder

Overhead door holder shall be surface mounted. The holder shall have a spring or other device to cushion the door action and shall limit the door swing at [85] [110] degrees. [The holder shall have a built-in, hold-open capability at the swing limit specified.] [Overhead door holders for hollow metal doors weighing less than 90 kg 200 pounds shall conform to BHMA A156.8.]

2.2.15 Gasket Seal

NOTE: Gasket seals are recommended for reinforced concrete doors.

Gasket seals installed in manually operated doors are not recommended for reliable prevention of blast leakage. Seals are typically used for reinforced concrete doors to improve the weather seal and provide a door silencer.

Sealed doors shall have the full door perimeter and all door penetrations sealed. Perimeter seals shall be the rubber gasket type. Gaskets shall be removable, capable of sealing the mating surfaces, and resistant to the atmospheric environment. One spare set of gasket seals shall be provided for each door assembly for which gasket seals are specified.

2.2.16 Door Silencer

NOTE: When gasket door seals are specified, the gasket seal will act as the silencer.

Rubber door silencers shall cushion the impact of the door against the frame so that steel-to-steel contact is not made during closing.

2.2.17 Optical Device

The optical device (spy hole) shall be wide angle and shall not be breeched or dislodged by the specified or indicated blast overpressure. The device shall permit observation from the seating face of the door and shall be located approximately 1.5 m 5 feet above the seating side floor and approximately centered between the stiles.

2.3 ACCESSORIES

2.3.1 Subframe

At the Contractor's option, a subframe can be provided and built into the structure prior to installation of the frame. The subframe and subframe anchors shall be capable of transferring blast and rebound reactions to the adjacent structure, and the frame shall be capable of transferring these reactions to the subframe. The subframe shall be fabricated in the same manner specified for the frame.

2.3.2 Nameplate

Each door assembly shall have a permanently affixed nameplate that displays the manufacturer's name, place and year of manufacture, and the applicable peak overpressure, impulse, and rebound rating.

2.3.3 Removable Threshold

The sill shall be flush with the adjacent floor when the threshold is removed. The removable threshold shall be attached using approved countersunk mechanical fasteners.

2.3.4 Ramp

The ramp shall be structural steel, portable, and weigh not more than [90] [_____] kg [200] [_____] pounds. The ramp shall be of sufficient length to extend the full door opening width and shall have the profile indicated. The ramp shall be capable of supporting [a wheel load of [_____] N pounds] [the wheel load indicated].

2.3.5 Self-Rescue Kit

NOTE: Self-rescue kits are usually specified only
when post-blast operation is desired and debris
could prevent the door from opening.

Self-rescue kits shall contain illustrated instructions, nonadjustable wrenches, screwdrivers, jacks, and all other tools required to open the blast door from the seating face to a width of at least 300 mm 12 inches. The jack capacity shall not be less than [334] [_____] kN [75,000] [_____] pounds. Tools shall be securely mounted in a steel frame using wing nuts or other approved fasteners. The self-rescue kit frame shall be fabricated in the same manner specified for the door frame and shall be securely anchored to the wall at the location indicated or as directed.

2.4 FABRICATION

2.4.1 Shop Assembly

NOTE: Delete welding of stainless steel when only
reinforced concrete doors are specified.

For reinforced concrete doors, spall plates will be specified for all cases except in extreme cases where it is certain that spall damage is nonexistent or when faceplates are used.

Specify faceplates for exterior doors in conventional weapons resistant facilities in cases where construction is to parallel NATO criteria.

Composite faceplated reinforced concrete doors with studs welded to both faceplates are also available. When these doors are required, specify the following in the fabrication paragraph: "Composite faceplated reinforced concrete doors shall be provided with studs shop welded to faceplates at both ends of the stud. Studs shall be of sufficient diameter and spacing to effectively transfer shear forces."
Specify the following under door assembly paragraph
Door Type: "Composite faceplated reinforced concrete door."

Welding shall be in accordance with AWS D1.1/D1.1M except that arc welding of steel sheet and strip shall be in accordance with AWS D1.3 and welding of concrete reinforcing bars shall be in accordance with AWS D1.4.

[Stainless steel shall be welded using electrodes conforming to AWS A5.4.] [Structural steel doors shall be of welded construction.] Fabricated steel shall be well-formed to shape and size, with sharp lines and angles. Intermediate and corner joints shall be coped or mitered. Exposed welds shall be dressed smooth. [The stiles [and top] of built-up structural steel doors shall be closed using channel shapes or plates.] [When feasible, faceplates for structural steel doors shall be one piece. When one-piece faceplates are not feasible, plates shall be joined using full penetration groove weld butt joints or other approved welds.] [Reinforced concrete doors shall be closed at the edges with structural steel channels or plates and latch housings shall be mortised. Lap splices shall not be used for flexural reinforcing bars.] [Spall plates shall be one piece, covering the entire concrete surface on the seating face of the door, and shall be securely welded to the door edges. Spall plates shall not be less than 6 mm 1/4 inch thick.] [Faceplated reinforced concrete doors shall be provided with one-piece faceplates on both door faces. Faceplates shall cover the entire concrete surface and shall be securely welded at the door edges. Faceplates shall be not less than 9 mm 3/8 inch thick.] [Hollow metal door frames shall be pressed steel or structural steel with welded joints. Steel frames or subframes installed in masonry walls shall be provided with adjustable anchors. Hollow metal doors shall be of unitized grid construction with welded grid junctions and shall have flat, one-piece face sheets spot welded to each face of the grid system. The edges of hollow metal doors shall be closed with seams continuously welded. Hollow metal doors shall be neat in appearance, free from warpage and buckle, and suitable reinforcing shall be provided for hardware.]

2.4.2 Mullion

Mullions for double doors shall be fabricated in the same manner specified for frames. [Fixed mullions shall be welded to the frame.] [Removable mullions shall be attached to the frame with mechanical fasteners that are accessible for mullion removal or, in lieu of the removable mullion, an astragal shall be provided at the seating face of the inactive door leaf.] Doors shall seat directly against the mullion, and the mullion or astragal shall be capable of transferring the door reactions to the frame.

2.4.3 Thermal Insulation

NOTE: Thermal insulation is practical only for hollow metal doors.

The interior cells between the unitized grid shall be completely filled with thermal insulation material. The U value through the door (panel) shall not exceed [1.36] [_____] W per square meter per degree K [0.24] [_____] Btu per square foot per hour per degree F.

2.4.4 Shop Finishing

[Shop priming of steel surfaces shall conform to Section 09900PAINTS AND COATINGS, except that surfaces that will be embedded in concrete need not be primed and hollow metal doors shall be either dipped in primer after welding is completed, or exposed surfaces shall be primed and interior surfaces coated with an approved rust inhibitor]. [Galvanizing of doors and frames shall conform to ASTM A 123/A 123M or other approved methods. Surfaces that will be embedded in concrete need not be galvanized and the interior of hollow metal doors may be treated with an approved rust

inhibitor in lieu of galvanizing. Galvanizing of exposed portions of concrete anchors, non stainless steel fasteners, and hardware other than factory finished hardware shall conform to ASTM A 153/A 153M or other approved methods.]

2.4.5 Clearance

[The clearance between the seated steel surfaces of structural steel doors and frames shall not exceed 1.6 mm 1/16 inch.] [The lateral clearance between flush mounted structural steel doors and frames shall not exceed [6] [_____] mm [1/4] [_____] inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed [13] [_____] mm [1/2] [_____] inch.] [The lateral clearance between hollow metal doors and frames shall not exceed 3 mm 1/8 inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed 6 mm 1/4 inch.] The clearance between the door bottom and threshold shall not exceed 19 mm 3/4 inch.

2.5 BLAST DOOR ASSEMBLIES

NOTE: The assembly paragraphs provided for structural steel, reinforced concrete, and hollow metal doors will be repeated and edited as many times as required to specify all door assemblies. The door designations will then be referenced in the door schedule on the drawings. Items shown on the drawings will not be duplicated in the door assembly paragraphs. The door assembly paragraphs are pre-edited to show normal use and hardware availability; e.g., thermal insulation, sound rating, and mortise locks are omitted for structural steel and reinforced concrete doors, Type 2 hinges are normally used for reinforced concrete doors and thus are shown without brackets, etc.

2.5.1 Door [_____] ; Steel

NOTE: Coordinate with paragraphs DESCRIPTION and BLAST DOOR ASSEMBLIES.

2.5.1.1 Type

Type shall be [structural steel] [double structural steel door with [fixed] [or] [removable] mullion] [,] [galvanized] [,] [and] [fire-rated].

2.5.1.2 Overpressure

Overpressure shall be [_____] kPa psi [with a [_____] millisecond duration] in the [seating] [unseating] direction [and [_____] kPa psi [with a [_____] millisecond duration] in the unseating direction]. The [shock and gas overpressure] [overpressure] waveform shall be as indicated.

2.5.1.3 Fragment

NOTE: Coordinate with paragraph Fragment Resistance, under paragraph DESCRIPTION.

[The fragment shall be [] g ounces with a velocity of [] m/s fps and impact [normal to] [at an angle of [] degrees measured from] the door face.] [Protection from fragments shall be provided by steel plate not less than [] mm inches in thickness.]

2.5.1.4 Rebound

NOTE: Coordinate with paragraph Rebound Resistance, under paragraph DESCRIPTION.

Rebound resistance shall be [50] [100] [] percent.

2.5.1.5 Deformation Limits

NOTE: For structural steel doors, the deformation limit criteria for accidental explosion applications is given below.

Prot. Cat. No.	Support Rotation (Deg.)	Ductility Ratio
1	2	10
2	12	20

A 2-degree support rotation and ductility ratio of 10 is recommended when post-blast opening is required. This deformation limit is recommended for conventional weapon and improvised weapon exterior door applications in order to avoid entrapment of personnel.

The ductility ratio shall not exceed [10 and the support rotation shall not exceed 2 degrees] [20 and the support rotation shall not exceed 12 degrees].

2.5.1.6 Hardware

NOTE: Coordinate with paragraph Hinges, under paragraph HARDWARE. A door pull is recommended.

Full surface hinges shall be Type [1] [2] [3]. [Multiple] [Jamb] latching points and [multiple lever handles] [,] [or] [a single lever handle] [,] [or] [a wheel handle] [,] [or] [a spoke lever handle] operated from [the seating face] [and] [opposite the seating face] with [manual] [self-latching] latch engagement and [either] sliding [or lever] latch bolts shall be provided. The latching mechanism shall be [safety] [or] [cover] plated. A [Type [I] [II] [III] straight steel bar door pull] [,] [and] [padlock] [shrouded padlock] [,] [and] [hasp] [high security hasp] [shrouded hasp] [,] [and] [door stop] [,] [and] [surface door closer] [overhead door holder] [,] [and] [gasket seals] [door silencer] [,] [and] [optical device] shall be provided.

2.5.1.7 Operating Forces

**NOTE: Coordinate with paragraph Blast Door
Operation, under paragraph DESCRIPTION.**

[Maximum operating forces shall be [135] [180] [_____] N [30] [40] [_____] pounds to set the door in motion and [90] [_____] N [20] [_____] pounds to swing the door. Maximum force to engage and release latches shall be [90] [135] [180] [_____] N [20] [30] [40] [_____] pounds.] [Operating forces shall conform to NFPA 101.]

2.5.1.8 Accessories

A [removable threshold] [or] [ramp] [and] [self-rescue kit] shall be provided.

2.5.2 Door [_____] ; Concrete

**NOTE: Coordinate with paragraph DESCRIPTION and
paragraph BLAST DOOR ASSEMBLIES.**

2.5.2.1 Type

Type shall be [reinforced concrete] [double reinforced concrete] door with [fixed] [or] [removable] [mullion] [and] [with] [spall plate] [faceplates].

2.5.2.2 Overpressure

Overpressure shall be [_____] kPa psi [with a [_____] millisecond duration] in the [seating] [unseating] direction [and [_____] kPa psi with a [_____] millisecond duration in the unseating direction]. The [shock and gas overpressure] [overpressure] waveform shall be as indicated.

2.5.2.3 Fragment

**NOTE: Coordinate with paragraph Fragment
Resistance, under paragraph DESCRIPTION.**

[The fragment shall be [_____] g ounces with a velocity of [_____] m/s fps and impact [normal to] [at an angle of [_____] degrees measured from] the door face.] [The nominal door thickness shall not be less than [100] [200] [_____] mm [4] [8] [_____] inches].

2.5.2.4 Rebound

**NOTE: Coordinate with paragraph Rebound Resistance,
under paragraph DESCRIPTION.**

Rebound resistance shall be [20] [100] [_____] percent.

2.5.2.5 Deformation Limits

NOTE: For reinforced concrete doors, the deformation limit criteria for accidental explosion applications is given below.

Door Type	Prot. Cat. No.	Support Rotation (Deg.)
One-way acting without stirrups	1	1
	2	2
One-way acting with stirrups	1	2
	2	4
Two-way acting	1	2
	2	8

A support rotation of not more than 2 degrees is recommended when post-blast opening is required. This deformation limit is recommended for conventional weapon and improvised weapon exterior door applications in order to avoid entrapment of personnel.

[The door support rotation shall not exceed [1 degree] [2 degrees] for one-way acting doors without stirrups, [2] [4] degrees for one-way acting doors with stirrups, and [2] [8] degrees for two-way acting doors.] [The support rotation shall not exceed 2 degrees except that the support rotation for one-way acting doors without stirrups shall not exceed 1 degree.]

2.5.2.6 Hardware

Hinges shall be Type 2. [Multiple] [Jamb] latching points and multiple lever handles operated from [the seating face] [and] [opposite the seating face] with manual latch engagement and lever latch bolts shall be provided.

Type [I] [II] [III] straight steel bar door pull [,] [and] [padlock] [shrouded padlock] [,] [and] [hasp] [high security hasp] [shrouded hasp] [,] [and] [door stop] [,] gasket seals [, and optical device] shall be provided.

2.5.2.7 Operating Forces

NOTE: Coordinate with paragraph Blast Door Operation, under paragraph DESCRIPTION.

Maximum operating forces shall be [180] [_____] N [40] [_____] pounds to set the door in motion and [90] [_____] N [20] [_____] pounds to swing the door. Maximum force to engage and release latches shall be [135] [_____] N [30] [_____] pounds.

2.5.2.8 Accessories

A [removable threshold] [ramp] [and] [self-rescue kit] shall be provided.

2.5.3 Door [____]; Metal

NOTE: Coordinate with paragraph DESCRIPTION and
with paragraph BLAST DOOR ASSEMBLIES.

The STC value bracketed is close to the highest
obtainable for blast doors.

2.5.3.1 Type

Type shall be [hollow metal] [double hollow metal door with a [fixed] [or]
[removable] mullion] [,] [galvanized] [;] [and] [thermal insulation]
[sound-rated to STC [40] [____]] [, and] [fire-rated].

2.5.3.2 Overpressure

Overpressure shall be [____] kPa psi in the [seating] [unseating]
direction [and [____] kPa psi in the unseating direction].

2.5.3.3 Rebound

NOTE: Coordinate with subparagraph Rebound
Resistance, under paragraph DESCRIPTION.

Rebound resistance shall be [50] [100] [____] percent.

2.5.3.4 Hardware

NOTE: Coordinate with subparagraph Hinges, under
paragraph HARDWARE.

Delete the latch sentence when a mortise lock and
latch set or exit device is specified.

[Full surface] [Mortise] hinges shall be Type [1] [2] [3]. [[Multiple]
[Jamb] latch points and [multiple lever handles] [or] [a single lever
handle] operated from the [seating face] [and] [opposite the seating face]
with [manual] [self-latching] latch engagement and [either] sliding [or]
lever] latch bolts shall be provided.] [Exit device with [multiple latch
points] [jamb latch points] [and with function [____]] shall be provided.]
[Mortise lock and latch set [with function [____]] shall be provided.] [A
[padlock] [and] [hasp] [,] [and] [door stop] [,] [and] [surface door
closer] [overhead door holder] [,] [and] [gasket seals] [door silencer] [,]
[and] [optical device] shall be provided.]

2.5.3.5 Operating Forces

NOTE: Delete the latch operating force sentence when a mortise lock and latch set or exit device is specified.

Coordinate with paragraph Blast Door Operation, under paragraph DESCRIPTION.

[Maximum operating forces shall be [90] [_____] N [20] [_____] pounds to set the door in motion and [70] [_____] N [15] [_____] pounds to swing the door.] [Operating forces shall conform to NFPA 101.] Maximum force shall be [90] [_____] N [20] [_____] pounds to engage and release latches.

2.5.3.6 Accessories

A [removable threshold] [or] [ramp] shall be provided.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

2.6.1 Prototype Static Test

NOTE: Retain this paragraph when overpressure is specified without duration.

Static tests on prototype door assemblies shall demonstrate that the door will resist the blast overpressure. Static tests will be accepted only if the door and frame proposed are manufactured using the same materials, dimensions, and tolerances as those in the prototype static test and the static overpressure used in the test is at least two times the blast overpressure. Static test reports shall be supplemented with calculations that demonstrate rebound resistance when rebound is not tested.

2.6.2 Prototype Blast Test

Blast tests on the prototype door assembly shall demonstrate that the door will resist the overpressure waveform. Blast tests will be accepted only if the door and frame proposed are manufactured using the same materials, dimensions, and tolerances as those in the prototype blast tests. The rise time of the test waveform shall be zero or subject to approval. [For an overpressure with infinite duration, the overpressure used in the test shall be not less than that specified or indicated for a duration equal to at least five times the natural period of the door and the test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance.] [For overpressure with finite duration, the overpressure waveform used in the test shall exceed the overpressure waveform in both peak overpressure and impulse and the blast test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance when the positive phase waveform duration in the test exceeds the positive phase duration specified or indicated.]

2.6.3 Shop Operating Test

Prior to shipment, each door assembly shall be fully erected in a supporting structure and tested for proper operation. Such testing shall include opening, closing, and operating all moving parts to ensure smooth operation and proper clearance, fit, and seating. The operating forces and opening and closing times shall be determined. The Contracting Officer

shall be notified at least [7] [_____] calendar days prior to the start of testing and [all doors] [door [_____] [,] [_____] [,] [and] [_____]] shall be tested in the presence of the Contracting Officer. A test report shall be prepared and [three] [_____] copies furnished within [7] [_____] calendar days after testing.

2.6.4 Air Leakage Test

NOTE: Retain and edit this paragraph when door seals or thermal insulation are specified.

Each door assembly for which [door seals] [or] [thermal insulation] [are] [is] specified shall be factory tested for air leakage rate in accordance with ASTM E 283. The rate of air leakage per unit length of crack shall not exceed [0.90] [_____] L/s [0.20] [_____] cfm using a pressure difference of [76.7] [_____] Pa [1.57] [_____] psf. Prototype tests can be substituted for door assembly tests when the prototype door, frame, and hardware tested are equivalent to that provided or when otherwise approved.

2.6.5 Sound Rating Test

NOTE: Retain this paragraph when sound-rated hollow metal doors are specified.

The sound transmission class (STC) rating shall be determined in accordance with ASTM E 90.

2.6.6 Fire Rating Test and Inspection

NOTE: Retain this paragraph when fire rating is required. The door schedule on the drawings will indicate where fire-rated doors are to be used and their rating requirements.

Fire-rated door assemblies shall bear the listing identification label of the UL, or other nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with NFPA 252 and having a listing for the tested assemblies. Doors exceeding the size for which listing label service is offered shall be inspected in accordance with NFPA 80, NFPA 80A, and NFPA 101.

PART 3 EXECUTION

3.1 INSTALLATION

Doors and frames shall be installed in accordance with the manufacturer's written instructions. [Concrete shall be placed in reinforced concrete doors using the door manufacturer's standard forms.] [Pressed steel frames for hollow metal doors shall be fully grouted.] Exposed surfaces shall be finish painted in accordance with Section 09900 PAINTS AND COATINGS. Galvanized surfaces damaged prior to final acceptance shall be repaired in accordance with ASTM A 780 to the same thickness as the original galvanizing.

3.2 TESTS

After installation is completed, each door shall be field tested for operation, clearance, fit, and seating by operating the door and hardware through at least 10 operating cycles. Door and hardware operation shall be tested using the forces specified. Personnel and equipment required to perform field testing shall be provided by the Contractor. Unless waived, all field tests shall be performed in the presence of the Contracting Officer. After testing is completed, test reports shall be prepared and [three] [_____] copies furnished.

3.3 MANUFACTURER'S FIELD SERVICE

Installation and testing of door assemblies shall be under the supervision of the door manufacturer's erection engineer. Upon completion of the work, and at a time designated by the Contracting Officer, the services of one engineer and other technical personnel as required shall be provided for a period of not less than [4] [_____] hours to instruct Government personnel in the operation and maintenance of the blast doors and all other items furnished under this specification section. The instructions shall also include use of the operation and maintenance manual. The instructions shall include videotapes. An instruction outline and procedure shall be submitted and approved prior to scheduling the instruction. One copy of all instruction material shall be provided at the time of instruction.

-- End of Section --