

# ***TRUSSBILT***

## **GUIDE SPECIFICATIONS FOR COMMERCIAL SECURITY HOLLOW METAL DOORS AND FRAMES**

*(Complies With ANSI/NAAMM HMMA 862)*

**Last Revision 7/05**

**Member  
Hollow Metal Manufacturers Association  
Division of the  
National Association of Architectural Metal Manufacturers**

**TRUSSBILT ISO 9001:2000 CERTIFIED**

**CSI Section 081\_ \_**  
**FORCED ENTRY RESISTING STEEL DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

This section includes commercial security hollow metal [bullet resistant] [blast resistant] products as scheduled in the contract drawings and as specified herein.

**1.02 PRODUCTS PROVIDED UNDER THIS SECTION**

- A. Forced Entry Resisting hollow metal doors, swinging type as scheduled in the contract drawings and as specified herein.
- B. Forced Entry Resisting hollow metal doors shall include [glass molding and stops] [louvers] [speaking devices] [other] as scheduled in the contract drawings and specified herein.
- C. Forced Entry resisting hollow metal frames with anchors.
- D. Forced Entry Resisting hollow metal frames shall include [glass molding and stops] [pass through devices] as scheduled in the contract drawings and specified herein.
- E. Forced Entry resisting hollow metal panels of the same construction as the commercial security doors.

**1.03 RELATED SECTIONS**

- A. Commercial Security Hardware 08730
- B. Security Glass and Glazing 08800
- C. Gaskets and Weatherstrips 088720

**1.04 REFERENCES**

*The publications listed in this section form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.*

- A. ANSI/UL 9, Fire Test for Window and Glass Block Assemblies
- B. ANSI/NFPA 80-95 Fire Doors and Windows

- C. ANSI/NFPA 252-95 Standard Methods of Fire Tests of Door Assemblies
- D. ANSI A115.1 to ANSI A115.11, July 1971, Specifications for Door and Frame Preparation for Hardware
- E. ANSI A 156 Series for Hardware Standards
- F. ANSI/NFPA 257-96 Methods for Fire Tests of Window Assemblies
- G. ANSI/UL 10 (B) 8th Edition, Fire Tests of Door Assemblies
- H. ANSI/UL 752 Bullet-Resisting Equipment
- I. ASTM A 569/A 569M-98 Standard Specification for Steel, Carbon, (0.15 Maximum Percent), Hot Rolled Sheet and Strip, Commercial
- J. ASTM F 1592-95a Standard Test Methods for Detention Hollow Metal Vision Systems
- K. ASTM F 1450-97 Standard Test Methods for Hollow Metal Swinging Door Assemblies for Detention Facilities
- L. ASTM A 653/A 653M-97 Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot Dipped Process (Commercial Steel)
- M. ASTM A 366/A 366M-97 Standard Specification for Commercial Steel (CS), Carbon (0.15 Maximum Percent), Cold Rolled
- N. ASTM F 476-84, Test Methods for Security of Swinging Door Assemblies
- O. ASTM A 666-96b Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
- P. ASTM B 117-97 Standard Practice for Operating Salt Spray (Fog) Apparatus
- Q. ASTM C 143-90a (1990) Standard Test Method for Slump of Hydraulic Cement Concrete
- R. ASTM D 610-95 Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
- S. ASTM D 714-87 (1994) Standard Test Method for Evaluating Degree of Blistering of Paints
- T. ASTM D 1735-97 Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
- U. LPS 1175 : Issue 3 (1994) Specification for Testing and Classifying the Burglary Resistance of Building Components, Strongpoints and security Enclosures
- V. NAAMM HMMA 850-00 Fire-Rated Hollow Metal Doors and Frames, Third Edition

- W. NILECJ-STD-0306.00, May 1976, Physical Security of Door Assemblies and Components/ Class IV
- X. State Department Standard SD-STD-01.01 Revision G Certification Standard for Forced Entry and Ballistic Resistance
- ANSI American National Standards Institute, Inc.  
11 W. 42nd Street  
New York NY 10036  
Telephone: 212.642.4900 [www.ansi.org](http://www.ansi.org)
- ASTM American Society for Testing and Materials  
100 Barr Harbor Drive  
West Conshohocken PA 19428-2959  
Telephone: 610.832.9585 [www.astm.org](http://www.astm.org)
- NAAMM National Association of Architectural Metal Manufacturers  
8 S. Michigan Avenue  
Suite 100  
Chicago IL 60603  
Telephone: 312.332.0405 [www.naamm.org](http://www.naamm.org)
- NFPA National Fire Protection Association  
1 Battery March Park  
P.O. Box 9101  
Quincy, MA 02269  
Telephone: 617.770.3000 [www.nfpa.org](http://www.nfpa.org)
- UL Underwriters Laboratory Inc.  
333 Pfingsten Road  
Northbrook, IL 60062  
Telephone: 708.272.8800 [www.ul.com](http://www.ul.com)
- LPC Loss Prevention Council  
140 Adlersgate St.  
London, England EC1A4HY  
Telephone: 011.44.171.606.3757
- DOS U.S. Department of State  
A/FBO/AP/AD/SSE, Room L600,SA-6  
P.O. Box 12248 Rosslyn Station  
Arlington, VA 22219  
Telephone: 703.875.6570

## 1.05 TESTING AND PERFORMANCE

These test methods are not to provide a measure of resistance for door and frame assembly subjected to attack by corrosive agents. These test methods are intended to evaluate simulated forced entry resistance of a door and frame assembly to attacks using battering devices, common hand tools, powered hand tools, static loading ballistics and simulated blasts.

The primary purpose of these test methods is to approximate the levels of abuse to which door and frame assemblies may be subjected in the course of a forced entry. The desired result of its use is to help provide insurance of protection to both public and private property and the safety of the inhabitants or occupants of the building where these door and frame assemblies will ultimately be used.

It is recommended that architects and building design personnel decide which security rating is required for each opening.

### A. Sampling

1. Sample door and frame assemblies shall be constructed in accordance with Section Part 2 of this specification.
2. The manufacturer shall permanently mark the test samples and retain them at the manufacturing facility for future reference for a period of one (1) year from date tested. All tests will be verified using an independent testing agency. Test reports shall include photographs of the testing apparatus and installation instructions including templates for the items of hardware used.

### B. Specimen Preparation

1. The construction and size of the test door assemblies consisting of single/double doors, frames, mulled systems and all hardware components shall be representative of the application under investigation and the desired security classification needed for the application. The same basic construction and size of test doors and assemblies shall apply to all tests. Each test door shall be equipped with a vision panel if applicable.

### C. Static Load - Forced Entry - Impact And Jamb/Wall Stiffness Test Fixturing

1. The wall and door assembly shall be installed in a fixture typically constructed from steel tube, I-beam and angles. This fixture shall simulate the rigidity normally provided to a door assembly in a building by the ceiling, floor and walls. **Figure 1 shows an acceptable fixture.**
2. The test wall shall be a rigid vertical wall section suitable for mounting the door and frame assembly in its normal attitude. The wall section shall be constructed in a manner that will not contribute to the deflection of the door and frame assembly when under static or impact loading.
3. Mounting for static load forced entry impact and jamb/wall stiffness testing.
4. Mount the door and frame assembly under test in the rough opening in accordance with the manufacturer's installation instructions. Secure any opening elements in their optimum locked condition as appropriate.

## D. Procedures

### 1. Bullet Penetration

- a. Scope: When specified by the contract documents, test door assemblies for bullet penetration resistance in accordance with [UL-752 and DOS-SD STD-01.02 Rev. G.]
- b. Significance of Use: Testing of door, frame, hardware or security glazing as individual components is acceptable if conducted in accordance with Standard UL-752 and/or SD STD-01.02 Rev. G. The level of performance shall meet the rating of super-power small arms: 44 magnum, super-power rifle arms: 30-06.
- c. The pass/fail criteria shall be in accordance with Standard UL-752 and/or SD STD-01.02 Rev. G.

### 2. Door Assembly Static Load Testing

- a. Scope: This test is designed to evaluate the capability of a commercial security hollow metal door, prepared for hardware and other options, installed in the frame to resist a steadily increasing force applied at corner points, between lock points and at the lock points.
- b. Significance of Use: Although this test method is not intended to simulate a particular field condition or abuse, it is considered a prerequisite test for adequacy of fabrication methods, door design, and quality of joints, strength of materials used and rigidity.
- c. Apparatus: The test fixture and wall described in paragraph 1.06.c.1. shall be used in this test.
  1. A 2 in. (50.8 mm) travel dial indicator with resolution of 0.001 in. (0.01 mm) and support stand shall be provided such that the deflection point of the test sample can be accurately measured as the static load is applied.
  2. A hydraulic ram and pump equipped with a gauge or load cell shall be used to provide the static load. The pump ram and gauge shall be calibrated by the testing laboratory and a chart provided that converts pounds-force per square-inch gauge (kilograms per square meter) to pounds-force (Newton's). If a load cell is used, it shall be certified by the testing laboratory prior to use. (see **figure 2 Static Load Apparatus**)
- d. Procedure: Apply static load to the attack side of the component at the locations and magnitude appropriate to the security rating desired in accordance with that specified in Table 1 and Loss Prevention Council- LPS 1175.
- e. Record the resulting deflection at 500 lb. (2.2 kn.) increments to produce a graph, static load versus deflection. Increase the load until target loads for each sample are reached.

### 3. Door Assembly Impact Testing

a. Security classes 1-2-3 soft body impacting.  
Security classes 4-5-6 hard body impacting.

b. Scope: These tests are designed to evaluate a door and frame assembly's ability to resist repetitive impact forces at the designated critical areas. The same door assembly used for the static load tests may be reused for this test, or another assembly may be used if so desired.

c. Significance of use: This test method is intended to closely simulate a sustained battering ram-style attack and provide an evaluation of the assembly's capability to prevent, delay and frustrate forced entry. Security classes 1, 2 and 3 soft body impacting, simulates a person using a foot or shoulder to gain entry. Security classes 4, 5 and 6 hard body impacting simulates a person using a sledge hammer to gain entry.

d. Apparatus: The test fixture and wall described in paragraph 1.06.C.1 shall be used in this test.

1. Ram: The ram shall be a pendular system with a steel weight capable of delivering horizontal impact of up to 200 ft. lbf (271.2J). The weight of the ram may vary from 80 to 100 lb. (36.0 to 45.0 kg). The striking nose of the ram shall be made from C1010-1020 carbon steel, the striking surface area of which shall be 4.0 +/- 0.04in sq. (25.8 cm sq.).  
**See figure 3.**

e. Procedure: In accordance with ASTM F 476, using the test fixture and test apparatus, deliver the series of impacts listed in table 1 and shown in figure 4 to the assembly on the attack side of the door.

1. For soft body testing, attach to the door, centered on the impact point, a rigid foam polystyrene impact buffer that has a diameter of 6 in. (150 mm), a thickness of 2 in. (50.8 mm) and a density of 2 lb/ft cu. (32 kg/m cu.). Position the ram such that its striking nose just touches the surface of the buffer when at rest. Pull back the pendulum weight to the height necessary to produce the required impact, and release it. Subject the door to the number of impacts in accordance with Table 1 and Figure 4, at each required impact level, attaching a new buffer for each impact.

2. Keep the door closed and locked, and keep security glazing, or plate, whichever is used in the assembly, in place throughout the testing procedure. Failure is constituted by the assembly being damaged to the extent that forcible egress can be achieved. Disengage the lock electronically or manually. If the lock will not disengage normally, disengage it using tools commonly found in a facility maintenance toolkit, such as: hand screwdrivers, (various sizes and tip configuration including tips for lock cover plates, tamper resistant security screws), claw hammer, ballpeen hammer, chisel, pliers (any common size) and vice grips. Once the lock is disengaged, open the door enough to provide normal personal egress. If the lock cannot be disengaged with conventional hand tools as listed, or the door cannot be opened enough to

provide personal egress, the assembly shall be judged to have failed the impact test.

3. For hard body testing, use the same criteria as in soft body testing less the polystyrene buffer, striking the door with the ram directly on the door surface. Use the requirements in Table 1 and Figure 4 at each required impact level. The same pass/fail criteria shall be used as described paragraph 1.06.D.3.e.2.

#### 4. Vision System Impact Testing

a. Security classes 1-2-3 soft body impacting. Security classes 4-5-6 hard body impacting.

b. Scope: These tests are designed to evaluate a glazed frame assembly's ability to resist repetitive impact at the designated critical areas. The testing of a vision panel on a door is described in Paragraph 1.06.D.3.

c. Significance of use: This test method is intended to closely simulate a sustained battering ram-style attack and provide an evaluation of the assembly's capability to prevent, delay and frustrate forced entry. Security classes 1, 2 and 3 soft body impacting, simulates a person using a foot or shoulder to gain entry. Security classes 4, 5 and 6 hard body impacting simulates a person using a sledge hammer to gain entry.

d. Apparatus: The test fixture and wall described in paragraph 1.06.C.1 shall be used in this test.

1. Ram: the ram shall be a pendular system with a steel weight capable of delivering horizontal impact of up to 200 ft. lbf (271.2J). The weight of the ram may vary from 80 to 100 lb. (36.0 to 45.0 kg). The striking nose of the ram shall be made from C1010-1020 carbon steel, the striking surface area of which shall be 4.0 +/- 0.04 in sq (25.8 cm sq). **See Figure 3.**

e. Procedure: With the fixture and test apparatus deliver the series of impacts listed in **Table 1 and shown in Figure 5** to the assembly on the fixed stop side of the frame. In lieu of glazing a .375 in. (9.5 mm) thick steel plate may be used.

f. For soft body testing, attach to the glazing, centered on the impact point, a rigid foam polystyrene impact buffer that has a diameter of 6 in. (150 mm), a thickness of 2 in. (50.8 mm) and a density of 2 lb/ft cu. (32 kg/m cu.). Position the ram such that its striking nose just touches the surface of the buffer when at rest. Pull back the pendulum weight to the height necessary to produce the required impact, and release it. Subject the door to the number of impacts in accordance with **Table 1 and Figure 5**, at each required impact level, attaching a new buffer for each impact.

g. Install and test vision in accordance with ASTM F 1592, Section 7. Use Table 1 for pass/fail criteria.

h. Keep security glazing, or plate, whichever is used, in the assembly, in place throughout the testing procedure. Failure is constituted by the assembly being damaged to the extent that forcible egress can be achieved.

i. For hard body testing, use the same criteria as in soft body testing less the polystyrene buffer, striking the glazing material with the ram directly on the surface. Use the requirements in **Table 1 and Figure 5** at each required impact level. The same pass/fail criteria shall be used as described in Paragraphs 1.06.D.4.g.

## **5. Forced Entry Attack Test**

a. Scope: This test is designed to evaluate the burglary resistance to physical attack of commercial security door and frame assemblies prepared for hardware and other options. The same door assembly used for either the static load or impact tests may be used for this test, or another may be used if so desired.

b. Significance of use: This test is intended to simulate actual field conditions whereby an assailant(s) has full access to certain handheld tools and attacks the door face, hinge elements and locking elements in an attempted forced entry.

c. Apparatus: The test fixture and wall described in Paragraph 1.06.C shall be used in this test.

d. Procedure: Install and test door and frame and/or window assemblies in accordance with LPS 1175: Issue 3 (1994) Specification for Testing and Classifying the Burglary Resistance of Building Components, Strongpoints and Security Enclosures. Use Table 1 for pass/fail criteria.

## **6. Jamb/Wall Stiffness Test**

a. Scope: This test is designated to measure the ability of a hollow metal frame prepared for hardware, installed in a wall with the specified anchorage, to resist a load applied to each jamb perpendicularly to the frame rabbets.

b. Significance of use: The test measures the frame and anchorage systems' ability to withstand prying pressure when trying to disengage the lock bolt from the strike.

c. Apparatus: The test fixture and wall described in 1.06.C shall be used in this test. **Figure 6** shows an acceptable loading fixture.

1. A one inch (25.4mm) travel dial indicator with a resolution of 0.001 in (0.01mm) and support shall be provided such that the deflection point of the test sample can be accurately measured as the load is applied.

2. A hydraulic ram and pump equipped with a gauge or load cell shall be used to provide the load. The pump and gauge shall be calibrated by the testing laboratory and a chart provided that converts pounds-force per square inch gauge (kilograms per square meter) to pound-force (Newton's). If a load cell is used, it shall be certified by the testing laboratory prior to use.

d. Procedure: Apply load to the hinge and strike jamb at the locations and magnitude appropriate to the security rating desired in accordance with that specified in Table 1 and in accordance with ASTM F 476.

e. Record the resulting deflection at 500 lbf (2.2kn) increments to produce a graph load versus deflection. Increase the load while measuring deflection until target loads for each sample are reached.

## 7. Edge Crush Test

a. Scope: This test is designed to measure the ability of the edge of a hollow metal door prepared for hardware and other options not installed in the frame to resist a load applied perpendicularly to the edge, in the plane of the door leaf.

b. Significance of use: Damage to swinging doors is frequently caused by placing objects between the jamb and door and forcing the door against the object. If the door is sufficiently dented to be unserviceable, security may be impaired.

c. This test may be used to assist in identifying a required resistance to such vandalism.

d. Apparatus: A framework shall be constructed which will hold a sample door. The framework shall be constructed so that a calibrated load cell or hydraulic ram can be used to apply force to the edge of the door, with the ram acting in the plane of the door leaf and perpendicular to the door edge. ASTM F 1450, Section 7. Figure 10 shows an acceptable apparatus.

e. An end piece shall be provided for the ram comprising a 1.5 in (38 mm) diameter steel cylinder mounted to the ram so that the axis of the cylinder is perpendicular to the surface of the door leaf.

f. An attachment point shall be provided so that a dial indicator having at least 1 in (25.4 mm) of travel with resolution of 0.001 in (0.01 mm) can be attached to the framework, and measure the travel of the hydraulic ram once it is in contact with the edge of the sample door.

g. Install and test door panels in accordance with ASTM F 1450, Section 7.7 "Door Edge Crush Test." Use Table 1 for pass/fail criteria.

## **E. Labeled Fire-Rated Doors and Frames**

1. Doors and frames shall be provided for those openings requiring fire protection ratings as determined and scheduled by the Architect. Such doors and frames shall be constructed as tested in accordance with [ANSI/NFPA 252, ANSI/UL-10B] [ANSI/UL-10C, UBC 7-2] and listed and/or classified for labeling by a recognized testing agency having a factory inspection service.

2. Window frames shall be provided for those openings requiring fire protection ratings as determined and scheduled by the Architect. Such frames shall be constructed as tested in accordance with [ANSI/NFPA 257, ANSI/UL 9] [UBC 7-4] and listed and/or classified for labeling by a recognized testing agency having a factory inspection service.

*Note: UBC 7-2, ANSI/UL 10C, and UBC 7-4 are positive pressure test standards and should be included only for jurisdictions requiring such.*

3. If doors or frames specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of design, hardware or other reasons, the Architect shall be so advised before fabricating work on that item is started.

*Note: Refer to NAAMM HMMA 850, Fire-Rated Hollow Metal Doors and Frames.*

## **1.06 QUALITY ASSURANCE**

### **A. Manufacturer's Qualifications**

1. Manufacturer shall provide evidence of having personnel and plant equipment capable of fabricating hollow metal door and frame assemblies of the type specified herein.

2. The manufacturer shall be ISO 9001 certified.

### **B. Quality Criteria**

1. Door and assemblies shall meet the requirements of Paragraph 1.06 of these specifications.

2. Fabrication methods and product quality shall meet standards set by the Hollow Metal Manufacturers Association, HMMA, a division of the National Association of Architectural Metal Manufacturers, NAAMM, as set forth in these specifications.

### 3. Job site door check

At the owner's option, a door at the job site shall be selected at random and sawed in half or otherwise taken apart as deemed necessary, for verification that construction is in accordance with these Specifications. The manufacturer shall include the cost of the replacement door in his quotation. If the door construction does not conform to these specifications the non-conforming doors shall be repaired or replaced at the manufacturer's expense.

## 1.07 SUBMITTALS

### A. Submittal Drawings

1. Show dimensioned door and frame elevations and sections.
2. Show listing of opening descriptions including locations, thicknesses, and anchors.
3. Show location and details of openings.
4. Indicate performance grade levels on the submittal as they are shown on the contract drawings and in the door schedule.

### B. Samples (if required)

1. Door: Corner section with hinge mortise and reinforcement showing internal construction.
2. Frame: Corner section showing welding of head to jamb. Include hinge mortise, reinforcement and plaster guard in one rabbet, and glazing stop applied as specified in the opposite rabbet. Glazing stop shall be applied in both head and jamb section to show corner joint.
3. Samples submitted shall be of the production type and shall represent in all respects the minimum quality of work to be furnished by the manufacturer. No work represented by the samples shall be fabricated until the samples are approved, and any downgrading of quality demonstrated by the samples can be cause for rejection of the work.

### C. Test Report

1. Manufacturer shall submit to the Architect upon request, an independent testing laboratory report certifying that door and frame assemblies meet the performance requirements of Paragraph 1.06 and are constructed in accordance with Paragraphs 2.01 and 2.03 of these specifications.

### D. Qualifications

1. Manufacturer shall submit to the architect upon request, ten (10) days prior to bid date, his qualifications as required by Paragraph 1.07.

## 1.08 WARRANTY

Hollow metal work shall be warranted from defects in workmanship and quality for a period of one (1) year from shipment.

## PART 2 - PRODUCTS

### 2.01 HOLLOW METAL DOORS

#### A. Materials

1. Doors shall be made of commercial quality, level, cold-rolled steel conforming to ASTM A 366/A 366M or hot-rolled, pickled and oiled steel conforming to ASTM A 569/A 569M. The steel shall be free of scale, pitting, coil breaks or other surface blemishes. It shall also be free of buckles, waves or any other defects caused by the use of improperly leveled sheets.
2. Interior doors: Face sheets shall be [for Grades 1 and 2, 0.053 in. (1.3 mm)] [for Grades 3 and 4, .067 in. (1.7 mm)] [for Grades 5 and 6, 0.093 in. (2.3 mm)] minimum thickness.

*Note: For interior areas subject to corrosive conditions it is recommended that zinc coated face sheets as specified in 2.01.A.3 be used.*

3. Exterior Doors: Face sheets shall be [for Grades 1 and 2, 0.053 in. (1.3 mm)] [for Grades 3 and 4, .067 in. (1.7 mm)] [for Grades 5 and 6, 0.093 in. (2.3 mm)] minimum thickness and shall have a zinc coating applied by the hot-dip process conforming to ASTM A 653/A 653M Commercial Steel (CS), coating designation A60 or G60 (Z180 or ZF180).
4. For severely corrosive conditions and where specified on individual openings either interior or exterior: Face sheets and components shall be [for Grades 1 and 2, 0.053 in. (1.3 mm)] [for Grades 3 and 4, .067 in. (1.7 mm)] [for Grades 5 and 6, 0.093 in. (2.3 mm)] minimum thickness and shall be stainless steel conforming to ASTM A 666, [Type 304 or 316].

*Note: If the Architect determines that zinc coated components are needed in addition to zinc coated or stainless face sheets, 201.A.3 and 201.A.4 are the appropriate locations to specify that requirement.*

#### B. Construction:

1. All doors shall be the types, sizes and construction in accordance with the contract documents, and shall meet the performance requirements of Section 1.06 where applicable. Alternate materials and methods of construction, which meet the aforementioned performance criteria, shall be permitted.

2. Door face sheets shall be joined at their vertical edges by a continuous weld extending the full height of the door.

*See “Weld, Continuous” and “Welded, Continuously” in the Glossary of Terms for Hollow Metal Doors and Frames, HMMA 801.*

3. Door thickness shall be 1 3/4 in. (44 mm) minimum. Doors shall be neat in appearance and free from warpage or buckle. Edge bends shall be true and straight and of minimum radius for the thickness of material used.
4. Doors shall be stiffened by continuous vertically formed steel sections. Additional core materials shall be the manufacturer’s proprietary standard, engineered and tested in accordance with the level of protection as specified by the Architect.
5. The vertical edges shall be reinforced continuously using steel, not less than the thickness of the face sheets extending the full length of the door. The top and bottom edges shall be closed with a continuous channel, not less than the thickness of the face sheets and spot welded to face sheets a maximum of 4 in. (102 mm) o.c. The closing end channel shall be continuously welded to the vertical reinforcing at all four corners producing a fully welded perimeter reinforcing.
6. The top end channel shall be fitted with an additional flush closing channel of not less than 0.053 in. (1.3 mm) thickness. The flush closing channel shall be welded in place at the corners and at the center.
7. Edge profiles shall be provided on both vertical edges of doors as follows:
  - Single acting doors - beveled 1/8 in. (3 mm) in 2 in. (50 mm) profile
  - Sliding doors or equivalent - square profile
8. Hardware reinforcements:
  - a. Doors shall be mortised, reinforced, drilled and tapped at the factory for templated mortised hardware only, in accordance with the final approved hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated mortised hardware apply, doors shall be reinforced, and all drilling and tapping shall be done by others in the field.

- b. Minimum thicknesses for hardware reinforcements shall be as follows:
- Full mortise hinges and pivots - 0.187 in. (4.7 mm)
  - Surface applied maximum security hinges - 0.250 in. (6.3 mm)
  - Strike reinforcements - 0.187 in. (4.7 mm)
  - Reinforcements for slide device hanger attachment - per device manufacturer's recommendations
  - Reinforcements for lock fronts, concealed holders, or surface mounted closer - 0.093 in. (2.3 mm)
  - Internal reinforcements for all other surface applied hardware - 0.093 in. (2.3 mm)
- c. In cases where electrically operated hardware is required, and where indicated on architectural door schedule, conduit, hardware enclosures, and/or junction boxes within the door shall be provided. Access plates, where required, shall be the same thickness as the door face sheet and fastened with four (4) #8-32 tamper resistant machine screws, not to exceed 6 in. (152 mm) o.c.

9. Glass moldings and stops:

- a. Where specified, doors shall be provided with steel moldings to secure glazing by others in accordance with glass sizes and thicknesses shown on the contract documents
- b. Fixed glass molding shall be welded to both face sheets 5.0 in. (127 mm) o.c. maximum.
- c. In glass openings for Grades 1 and 2, removable glass stops shall be pressed steel channel not less than 0.067 in. (1.7 mm) thickness with tight fitting butt or mitered corner joints, and secured with #8-32 countersunk, tamper resistant machine screws located 2 in. (51 mm) maximum from each end and 9 in. (230 mm) o.c. maximum.
- d. In glass openings for Grades 3, 4, 5, and 6, pressed steel angle glazing stops, no less than 0.093 in. (2.3 mm) thickness, shall be provided. Angle stops shall be mitered or notched and tight fitting at the corner joints, and secured in place using 1/4 - 20 or 1/4 - 28 button head tamper resistant machine screws with spacing necessary to satisfy the performance criteria outlined in Section 1.06, spaced 2 in. (51 mm) maximum from each end and 9 in. (230 mm) o.c. maximum.

*Note: It is recommended that view window stop heights be specified to provide 1 in. (25.4 mm) glass engagement.*

10. Louvers shall be of the welded inverted “V” or “Y” type construction providing free air delivery as specified. The louver opening shall be flush, fabricated using interior channels 0.093 in. (2.3 mm) minimum thickness, securely welded to the inside of both face sheets. A rectangular louver shall not exceed 18 in. (457 mm) in width without being reinforced at its midpoint by a vertical rectangular steel bar at least 0.25 in. x 1.50 in. (6.4 mm x 38 mm) or a vertical round steel bar at least 0.75 in. (19 mm) diameter. The vanes shall be not less than 0.093 in. (2.3 mm) thickness and shall be spaced so that no rigid flat instrument can be passed through them. Insect screens and flattened expanded metal not less than 0.093 in. (2.3 mm) thickness shall be provided on louvered doors in exterior locations where shown on approved submittal drawings.
11. Speaking devices shall consist of a rectangular pattern of round holes, no more than 0.25 in. (6.4 mm) dia., in both face sheets directly across from each other. The minimum size of the rectangular hole pattern shall be 1 in. (25 mm) high x 4 in. (102 mm) wide with holes spaced no more than 1 in. (25 mm) o.c. vertically and horizontally. The interior of the door between the rectangular hole patterns shall be baffled using pressed steel sections, not less than 0.067 in. (1.7 mm), so that no objects can be passed through.
12. Paper pass openings:
  - a. The pass opening shall be flush, fabricated using interior channels 0.093 in. (2.3 mm) minimum thickness, securely welded to the inside of both face sheets. The four corner seams shall be continuously welded and dressed smooth. The finished opening shall be of such construction that it cannot be dismantled or otherwise affected by tampering or scraping.
  - b. The pass shutter shall be constructed to conform with the attack resistance as specified by the Architect and conform to that of the door/frame assembly.
  - c. The shutters shall be treated for maximum paint adhesion and given a shop coat of rust inhibitive primer and shall be factory installed.

## **2.02 HOLLOW METAL PANELS**

- A. Hollow metal panels shall be made of the same materials and construction and finished in the same way as specified in Section 2.01 of this specification.

## **2.03 HOLLOW METAL FRAMES**

### **A. Materials**

1. Frames shall be constructed of commercial quality, cold rolled steel conforming to ASTM A 366/A 366M or hot rolled, pickled and oiled steel conforming to ASTM A 569/A 569M. The steel shall be free of scale, pitting, coil breaks or other surface defects.
2. Interior frames: Frame sections shall be [for Grades 1 and 2, 0.053 in. (1.3 mm)] [for Grades 3 and 4, .067 in. (1.7 mm)] [for Grades 5 and 6, 0.093 in. (2.3 mm)] minimum thickness.

*Note: For interior areas subject to corrosive conditions it is recommended that zinc coated frame sections as specified in 2.03.A.3 be used.*

3. Exterior Frames: Frame sections shall be [for Grades 1 and 2, 0.053 in. (1.3 mm)] [for Grades 3 and 4, .067 in. (1.7 mm)] [for Grades 5 and 6, 0.093 in. (2.3 mm)] minimum thickness and shall have a zinc coating applied by the hot-dip process conforming to ASTM A 653/A 653M Commercial Steel (CS), coating designation A60 or G60 (Z180 or ZF180).
4. For severely corrosive conditions and where specified on individual openings either interior or exterior: Frame sections and components shall be [for Grades 1 and 2, 0.053 in. (1.3 mm)] [for Grades 3 and 4, .067 in. (1.7 mm)] [for Grades 5 and 6, 0.093 in. (2.3 mm)] minimum thickness and shall be stainless steel meeting ASTM A 666, [Type 304 or 316].

*Note: If the Architect determines that zinc coated components are needed in addition to zinc coated or stainless face sheets, 2.03.A.3 and 203.A.4 are the appropriate locations to specify that requirement.*

#### B. Construction:

1. Frames, with the exception of cased openings such as for sliding doors, shall have integral stops and be welded units of the sizes and types shown on approved submittal drawings. Frames shall be constructed in accordance with these specifications and meet performance criteria specified in Sections 1.06 and 1.07 where applicable. Alternate materials and methods of construction which meet the aforementioned performance criteria shall be permitted.
2. All finished work shall be neat in appearance, square, and free of defects, warps and buckles. Pressed steel members shall be straight and of uniform profile throughout their lengths.
3. Jamb, header and sill profiles shall be in accordance with the frame schedule and as shown on the approved submittal drawings.
4. Corner joints shall have all contact edges closed tight with faces mitered and stops either butted or mitered. Faces and soffits shall be continuously welded (**see figure 8**) and the faces finished smooth. The use of gussets or splice plates as a substitute for welding shall not be acceptable.
5. All other face joints shall be continuously welded and finished smooth.
6. Minimum height of stops in door openings shall be 0.625 in. (16 mm). Height of stops on security glass or panel openings shall be as shown on approved submittal drawings.
7. When shipping limitations so dictate, frames for large openings shall be fabricated in sections designated for assembly in the field by others. Alignment plates or angles shall be installed at each joint. Such components shall be the same thickness as the frame. Field joints shall be made in accordance with approved submittal drawings and shall be field welded by others.
8. Frames for multiple openings shall have mullion members which, after fabrication, are closed tubular shapes conforming to profiles shown on approved submittal drawings, and having no visible seams or joints. All joints between faces of abutted members shall be continuously welded and finished smooth. All joints between stops of abutted members shall be welded along the soffit and shall be left neat and uniform in appearance. The contractor responsible for installation shall provide for welding and finishing all field joints between faces of abutted members.
9. Hardware Reinforcements and Preparation:

- a. Frames shall be mortised, reinforced, drilled and tapped at the factory for all templated mortised hardware only, in accordance with the final approved hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated mortised hardware apply, frames shall be reinforced, with all drilling and tapping done by others in the field.
- b. Minimum thickness of hardware reinforcing plates shall be as follows:
  - Hinge and pivot reinforcements - 0.187 in. x 1.5 in. x 10 in. length  
(4.7 mm x 38 mm x 254 mm)
  - Strike reinforcements - 0.187 in. (4.7 mm)
  - Closer reinforcements - 0.187 in. (4.7 mm)
  - Flush bolt reinforcements - 0.187 in. (4.7 mm)
  - Reinforcements for surface applied hardware - 0.093 in. (2.3 mm)
- c. In cases where electrically operated hardware is required, and where indicated on the architectural door schedule, hardware enclosures, and/or junction boxes shall be provided. Access plates, where required, shall be the same thickness as the frame and fastened with four (4) #8-32 tamper resistant machine screws, not to exceed 6 in. (152 mm) o.c.

10. Floor Anchors:

- a. Where applicable floor anchors shall be provided with two holes for fasteners and shall be fastened inside jambs with at least four (4) spot welds per anchor.
- b. Where so scheduled, adjustable floor anchors, providing not less than 2 in. (50 mm) height adjustment, shall be fastened in place with at least four (4) spot welds per anchor.
- c. Thickness of floor anchors shall be the same as frame.

11. Jamb Anchors:

a. Anchor Spacing

The number of anchors provided on each jamb shall be as follows:

- Borrowed light frames: 2 anchors plus 1 for each 18 in. (457 mm) or fraction thereof over 36 in. (914 mm), spaced at 18 in. (457 mm) maximum between anchors
- Door frames: 2 anchors plus 1 for each 18 in. (457 mm) or fraction thereof over 54 in. (1372 mm), spaced at 18 in. (457 mm) maximum between anchors (fire ratings can require additional anchors)

b. Masonry Type

Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the strap and stirrup type made from the same thickness steel as frame.

Straps shall be no less than 2 in. x 10 in. (50 mm x 254 mm) in size, corrugated and/or perforated.

c. Embedment Masonry Type

1. Frames for installation in prefinished masonry or concrete openings shall be provided with removable faces at the jambs, and 0.188 in. x 2 in. x 2 in. (4.7 mm x 50 mm x 50 mm) angle anchors 4 in. (102 mm) long spaced as described in Paragraph 2.03.B.11.a. The frame anchors shall be located to coincide with matching embedded anchors to be provided for installation in the wall.
2. Embedded wall anchors shall consist of a 0.188 in. (4.7 mm) x 4 in. (102 mm) wide x 6 in. (152 mm) plate with 0.188 in. x 2 in. x 2 in. (4.7 mm x 50 mm x 50 mm) angle anchors 4 in. (102 mm) long welded in place at locations to match angle anchors in frames. The embedded plate shall be provided with two (2) #4 re-bar wall anchors 10 in. (254 mm) long minimum, with 2 in. (51 mm) x 90 degree turn down on ends continuously welded in place, and spaced as described in Paragraph 2.03.B.10a. Embedments shall be prime painted in accordance with Paragraph 2.03.B.14.
3. Angle anchors shall each be fastened to jamb and to embedded plate with two (2) 1 in. (25 mm) long arc welds at each end of the anchor. Anchors shall be shipped loose.
4. Anchorage systems that require removable jamb faces shall be disassembled in the field by the contractor responsible for installation. The frames shall be moved into the opening until the frame anchors contact and match the embedded anchors. The contractor responsible for installation shall field weld all anchors and install the jamb faces in place. Embedment anchoring details shall be provided on approved submittal drawings.

d. Expansion Bolt Type

1. Frames for installation in existing masonry or concrete walls shall be prepared for expansion bolt type anchors. The preparation shall consist of a countersunk hole for a 0.5 in. (13 mm) diameter bolt and a spacer from the unexposed surface of the frame to the wall. The spacer shall be welded to the frame and the preparation spaced as described in Paragraph 2.03.B.11.a. Fasteners for such anchors shall be provided by others.
2. After sufficient tightening of the bolt, the bolt head shall be welded by the installation contractor so as to provide a non-removable condition. The welded bolt head shall be ground, dressed, and finished smooth.

- e. Frames to be installed in pre-finished concrete, masonry or steel openings shall be constructed and provided with anchoring systems of suitable design as shown on the approved submittal drawings.

12. Grout guards shall be provided at all hardware preparations, glazing stop screws and silencer preparations on frames to be set in masonry or concrete openings. Grout guards shall be sufficient to protect preparations from grout of a 4 in. (102 mm) maximum slump consistency which is hand troweled in place.

a. Grout guards for glazing stop screws shall be factory installed and shall cover the exposed portion of the screws inside the frame throat, around the perimeter. Where mullions are required to be grouted, screws inside mullions shall be protected with grout guards.

b. Silencer preparations shall be protected by steel grout guards where accessible from the frame throat. Silencers shall be furnished and installed by the contractor responsible for frame installation except where limited access prevents installation of the metal grout guards in mullions, in which cases silencers shall be factory furnished and installed.

13. All frames shall be provided with two (2) temporary steel spreaders welded to the bottom of the jambs to serve as bracing during shipping and handling. The installation contractor shall be responsible for finishing and touch-up of marks caused by spreader removal.

14. Removable glazing stops:

a. In openings where non-security glazing is specified, loose channel type glazing stops shall be cold rolled steel, not less than 0.067 in. (1.7 mm) thickness, butted at corner joints and secured to the frame using #8-32 countersunk tamper resistant countersunk machine screws, spaced 2 in. (51 mm) maximum from each end and 9 in. (230 mm) o.c. maximum.

b. In openings where security glazing is specified and where shown on the approved submittal drawings, pressed steel angle glazing stops, not less than 0.123 in. (3.1 mm), shall be provided. Angle stops shall be mitered or butted and tight fitting at the corner joints, and secured in place using machine screws of the size and spacing necessary to satisfy the performance criteria outlined in Section 1.06.D, spaced 2 in. (51 mm) maximum from each end and 9 in. (230 mm) o.c. maximum.

*Note: It is recommended that view window stop heights be specified to provide 1 in. (25.4 mm) glass engagement.*

c. The frame underneath the glazing stops and the inside of the glazing stops shall be treated for maximum paint adhesion and painted with a rust inhibitive primer prior to installation in the frame.

## 2.04 CLEARANCES AND TOLERANCES

A. Edge clearances for swinging doors shall not exceed the following:

1. Between doors and frames at head and jambs: 3/16 in. (4.7 mm) nominal
2. Between edges of pairs of doors: 3/16 in. (4.7 mm)
3. At door sills where a threshold is used: 3/8 in. (9.5 mm)
4. At door sills where no threshold is used: 3/4 in. (19.0mm)
5. Between door bottom and nominal surface of floor coverings as provided in NFPA 80, Paragraph 2.6.5: 1/2 in. (12.7 mm)

*Finished floor is defined as the top surface of floor, except when resilient tile or carpet is used, when it is the top of the concrete slab.*

*Note: All clearances are subject to change depending upon the requirements of specified hardware.*

B. Manufacturing tolerance shall be maintained within the following limits:

1. Frames for single door or pair of doors: Width, measured between rabbets at the head: Nominal opening width + 1/16 in. (1.6 mm), - 1/32 in. (0.8 mm). Height (total length of jamb rabbet): Nominal opening height  $\pm$  3/64 in. (1.2 mm). Cross sectional profile dimensions (**see Figure 8**):

Face	$\pm$ 1/32 in. (0.8 mm)
Stop	$\pm$ 1/32 in. (0.8 mm)
Rabbet	$\pm$ 1/32 in. (0.8 mm)
Depth	$\pm$ 1/32 in. (0.8 mm)
Throat	$\pm$ 1/16 in. (1.6 mm)

Frames overlapping walls to have throat dimension 1/8 in. (3.2 mm) greater than wall thickness to accommodate irregularities in wall construction.

Flatness of large frames: 1/8 in (3.2 mm) in 10 ft (3048 mm) of length or width

2. Swinging and sliding door:

Width	$\pm$ 3/64 in. (1.2 mm)
Height	$\pm$ 3/64 in. (1.2 mm)
Thickness	$\pm$ 1/16 in. (1.6 mm)
Hardware cutout dimensions	Template dimensions + 0.015 in. (0.38 mm) - 0 in.
Hardware location	$\pm$ 1/32 in. (0.8 mm)
Bow/flatness	$\pm$ 1/8 in. (3.2 mm)

## 2.05 HARDWARE LOCATIONS

The location of hardware on doors and frames shall be as listed below. Note that all dimensions except the hinge locations are referenced from the finished floor as defined in Paragraph 2.04.A.

Hinges:

Top	5 in. (127 mm) from frame head to top of hinge
Bottom	10 in. (254 mm) from finished floor to bottom of hinge
Intermediate	equally spaced between top and bottom hinges
Locks and latches	38 in. (965 mm) to centerline of knob or lever shaft
Deadlocks	46 in. (1168 mm) to centerline of cylinder
Exit hardware	38 in. (965 mm) to centerline of cross bar
Door pulls	42 in. (1067 mm) to centerline of grip
Push/pull bars	42 in. (1067 mm) to centerline of bar
Arm pulls	46 in. (1168 mm) to centerline
Push plates	46 in. (1168 mm) to centerline of plate
Intercoms	48 in. (1219 mm) to centerline of intercom push button

## 2.06 FINISH

After fabrication, all tool marks and surface imperfections shall be filled and sanded as required to make face sheets, vertical edges and weld joints free from irregularities. After appropriate metal preparation, all exposed surfaces of doors and frames shall receive a rust inhibitive primer which meets or exceeds ASTM B 117 Salt Spray for 150 hours with a rust grade of not less than 6 as defined in ASTM D 610, and ASTM D 1735 Water Fog Test for organic coatings for 200 hours with any quantity of #8 blisters but no more than "few" #6 blisters as illustrated in ASTM D 714.

## PART 3 - EXECUTION

*Note to Architect: Proper storage and installation is essential to the proper performance of doors and frames. The requirements for proper storage and installation are given in the following sections. However, it is important to recognize that installation is not the responsibility of the hollow metal manufacturer. For this reason the following requirements shall be referenced in that section of the specifications where installation of work is specified. (Reference: HMMA 840 "Installation and Storage of Hollow Metal Doors and Frames")*

### 3.01 SITE STORAGE AND PROTECTION OF MATERIALS

- A. The contractor responsible for installation shall remove wraps or covers from doors and frames upon delivery at the building site. The contractor responsible for installation shall see that any scratches or disfigurement caused in shipping or handling are promptly sanded smooth, cleaned and touched up with a compatible rust inhibitive primer.
- B. The contractor responsible for installation shall see that materials are properly stored on planks or dunnage in a dry location. Doors shall be stored in a vertical position and spaced by blocking. **Figure 10** illustrates recommended storage positioning. Materials shall be covered to protect them from damage but in such a manner as to permit air circulation.

## 3.02 INSTALLATION

The Contractor responsible for installation shall perform the following:

- A. Prior to installation, all frames shall be checked for size, and swing, and with temporary spreaders removed, corrected for squareness, alignment, twist and plumb. Permissible installation tolerances shall not exceed the following:

Squareness  $\pm 1/16$  in. (1.6 mm): Measured on a line, from jamb perpendicular to frame head.

Alignment  $\pm 1/16$  in. (1.6 mm): Measured at jambs on a horizontal line parallel to the plane of the face.

Twist  $\pm 1/16$  in. (1.6 mm): Measured at opposite face corners of jambs on parallel lines, perpendicular to the plane of the door rabbet.

Plumb  $\pm 1/16$  in. (1.6 mm) Measured at jambs on a perpendicular line from the head to the floor.

The details in **Figure 9** illustrate methods of measuring the above specified tolerances.

*Note: The above tolerances provide a reasonable guideline for proper installation of hollow metal frames. However, it should be noted that the cumulative effect of the tolerances at their maximum levels will result in sufficient misalignment which will prevent the door from functioning properly. Installers should be careful not to create a tolerance buildup. Tolerance buildup occurs when more than one dimension is at or near its maximum tolerance.*

- B. Frame jambs, shall be fully grouted to provide added security protection against battering, wedging, spreading and other means of forcing open the door. Jamb mounted lock preparations, grout guards for hardware preparations and glazing stop screws, and junction boxes are intended to protect hardware mortises, exposed removable screws, and tapped mounting holes from masonry grout of 4 in. (102 mm) maximum slump consistency which is hand troweled in place. If a light consistency grout (greater than 5.0 in. (127 mm) slump in accordance with ASTM C 143) is to be used, special precautions shall be taken in the field by the installation contractor to protect tapped holes, electrical knock-outs, lock pockets, grout guards, junction boxes, etc. in the frames.

Frames are not intended or designed to act as forms for grout or concrete. Grouting of hollow metal sections shall be done in "lifts" or precautions shall be otherwise taken by the contractor to insure that frames are not deformed or damaged by the hydraulic forces that occur during this process.

- C. Proper door clearances shall be maintained in accordance with 2.04 of these specifications, except for special conditions otherwise noted. Where necessary, metal hinge shims, furnished by the Contractor responsible for installation, are acceptable to maintain clearances.
- D. Hardware shall be applied in accordance with hardware manufacturer's templates and instructions.
- E. Any grout or other bonding material shall be cleaned off of frames or doors immediately following installation. Exposed hollow metal surfaces shall be kept free of grout, tar, or other bonding material or sealer.

- F. Exposed field welds shall be finished smooth and touched up with a rust inhibitive primer.
- G. Primed or painted surfaces which have been scratched or otherwise marred during installation (including field welding) and/or cleaning shall promptly be finished smooth, cleaned, treated for maximum paint adhesion and touched up with a rust inhibitive primer comparable and compatible to shop primer.



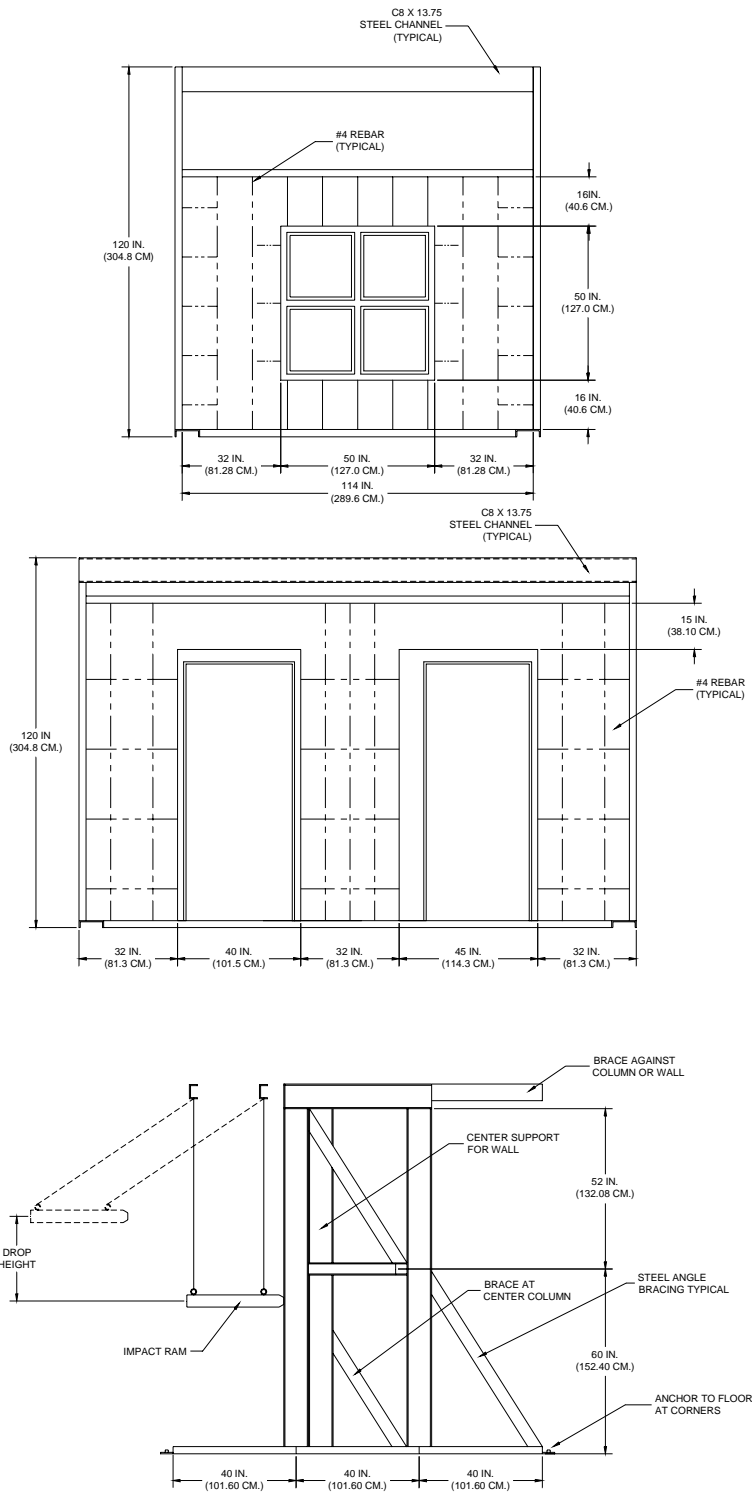


FIG. 1 Test Wall

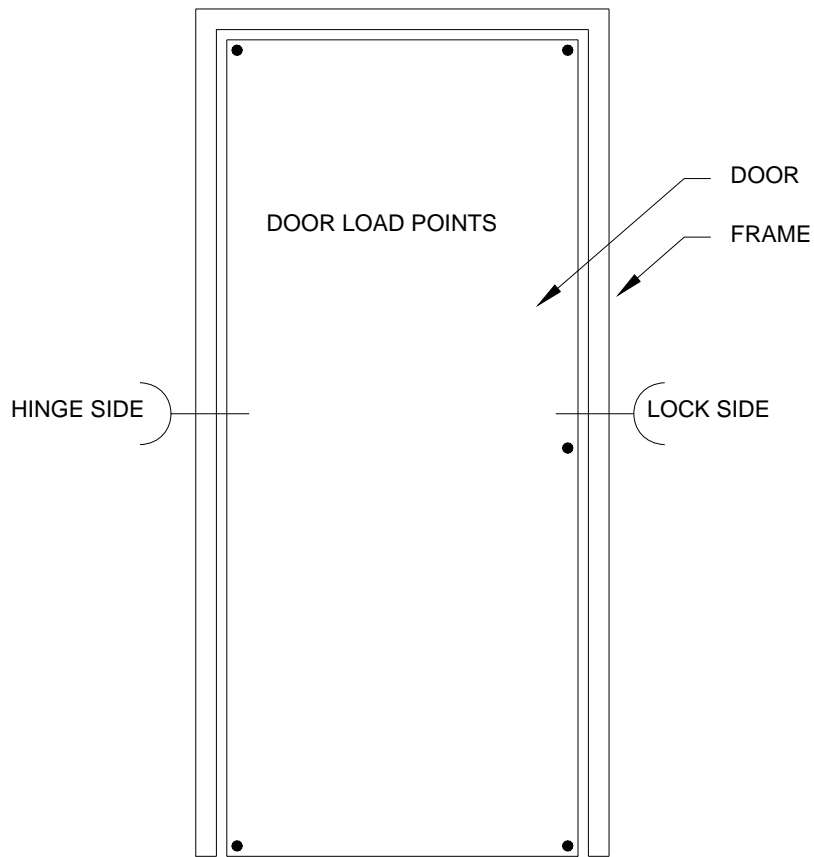
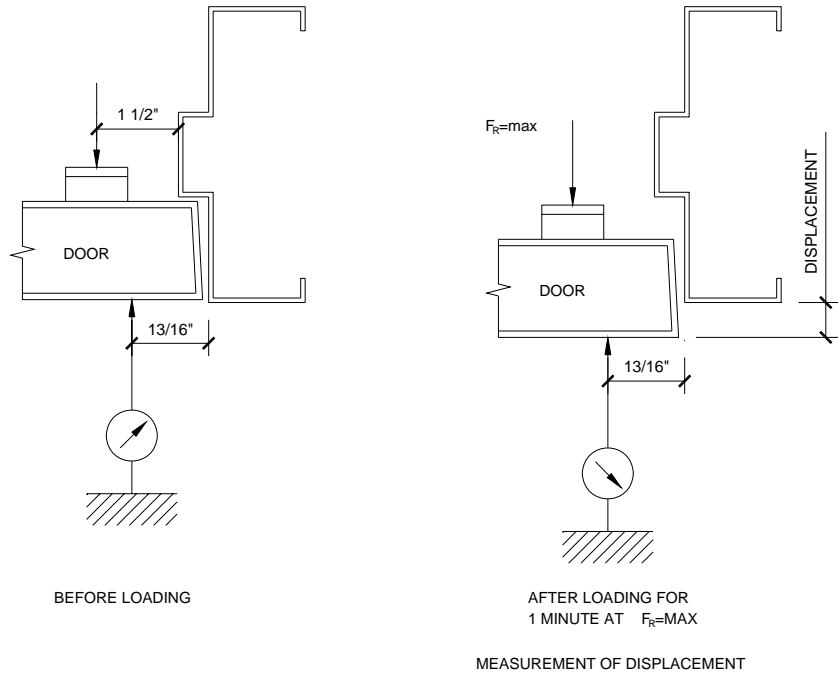
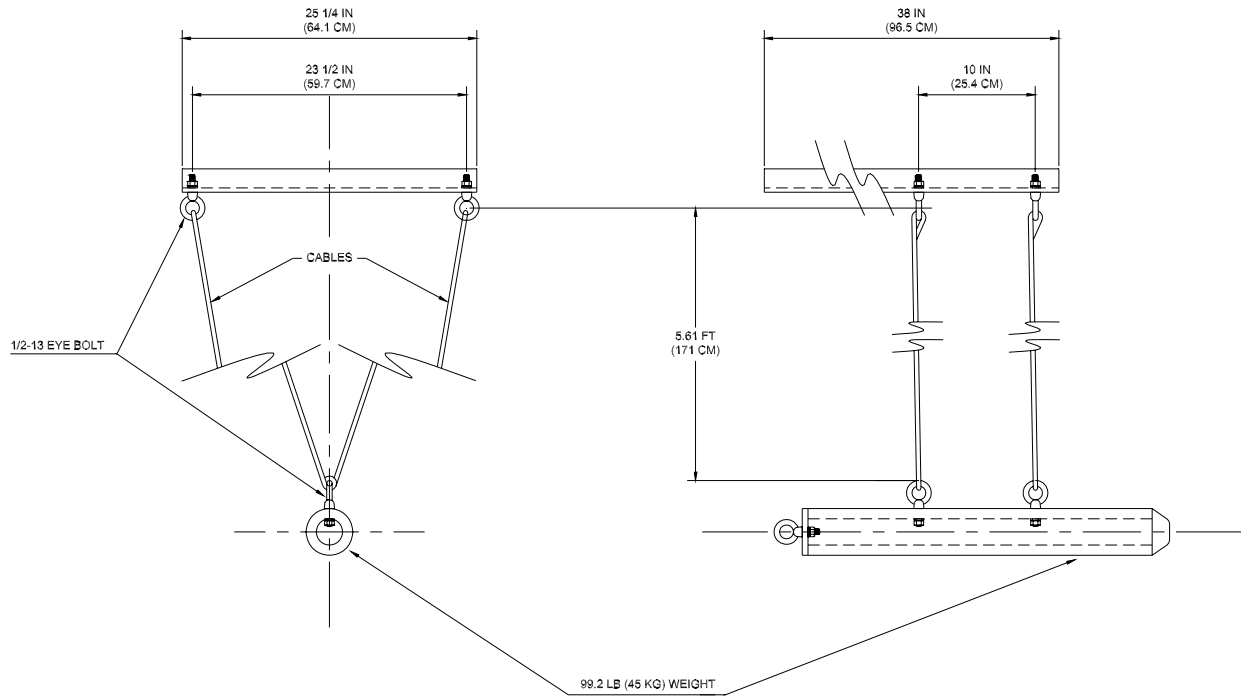
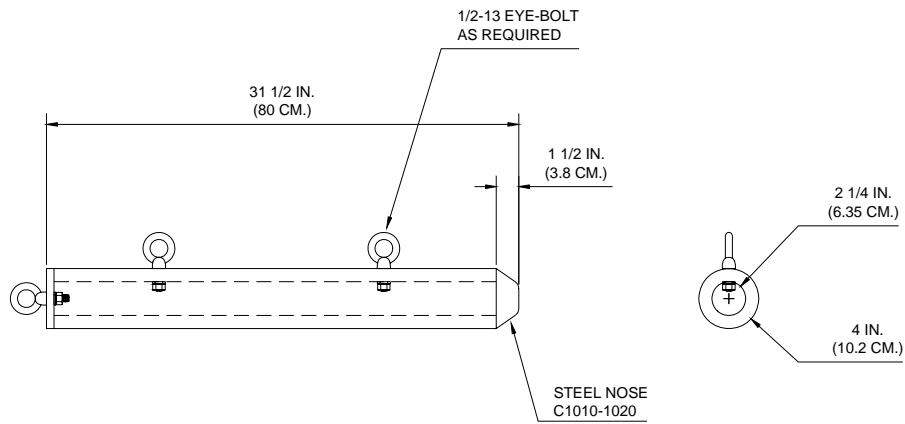


FIGURE 2



Door Ram Suspension System



WEIGHT: 80 LB - 100 LB (36.3 KG - 45.4 KG)

NOTE: Any material applied to or inside the ram to satisfy weight requirement shall be rigidly attached to prevent shifting during test procedures.

FIGURE 3 Steel Impact Ram for Hollow Metal Systems

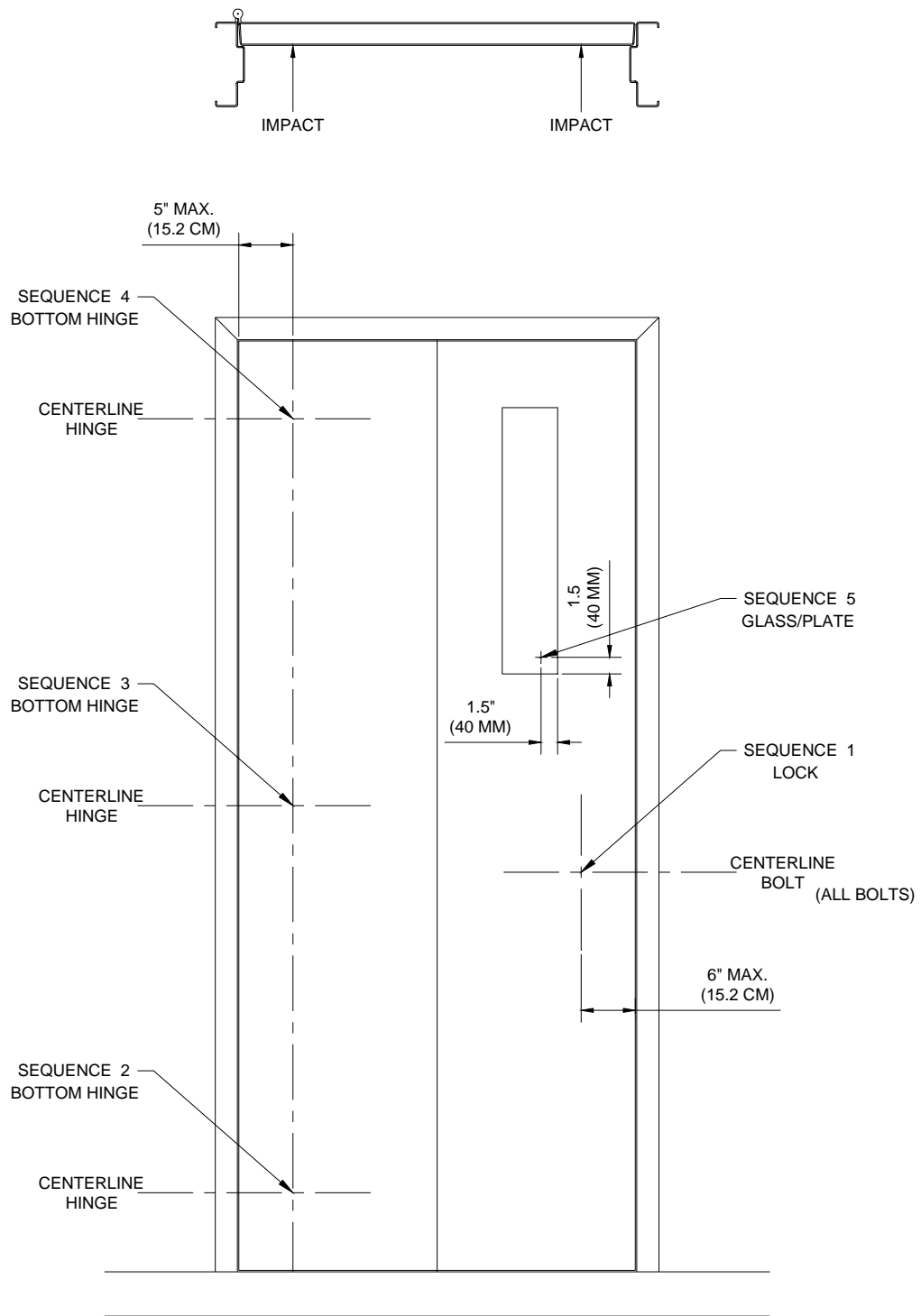
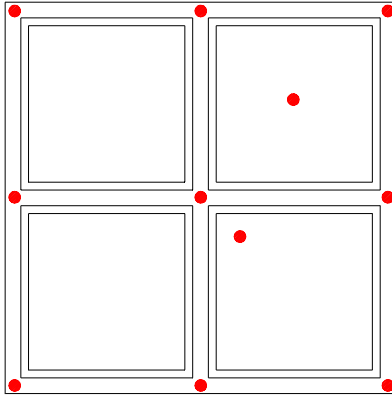
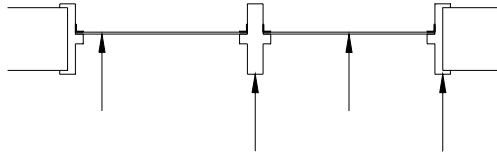


FIGURE 4 Test Assembly Elevation Location of Impact Points Described in Table 1



Test Assembly Elevation Location of Impact Points

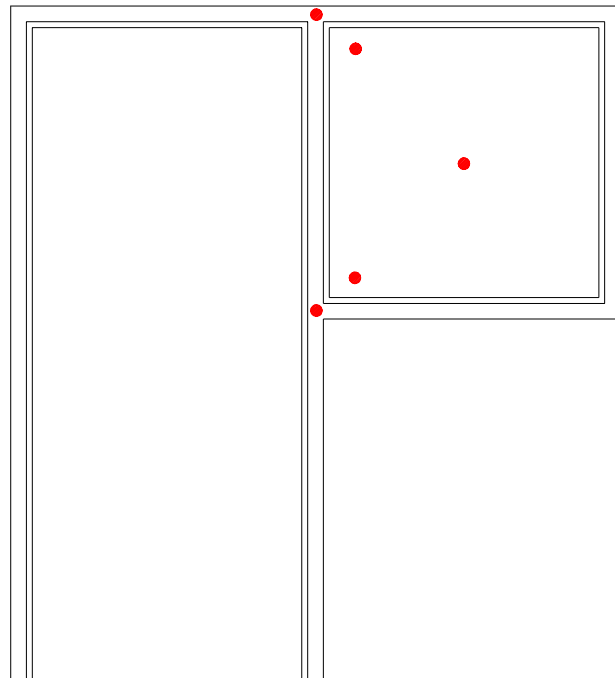
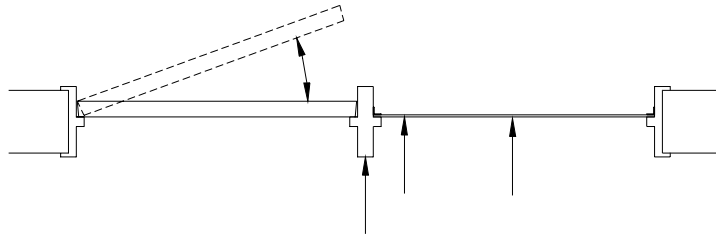


FIGURE 5 Test Assembly Elevation Location of Impact Points

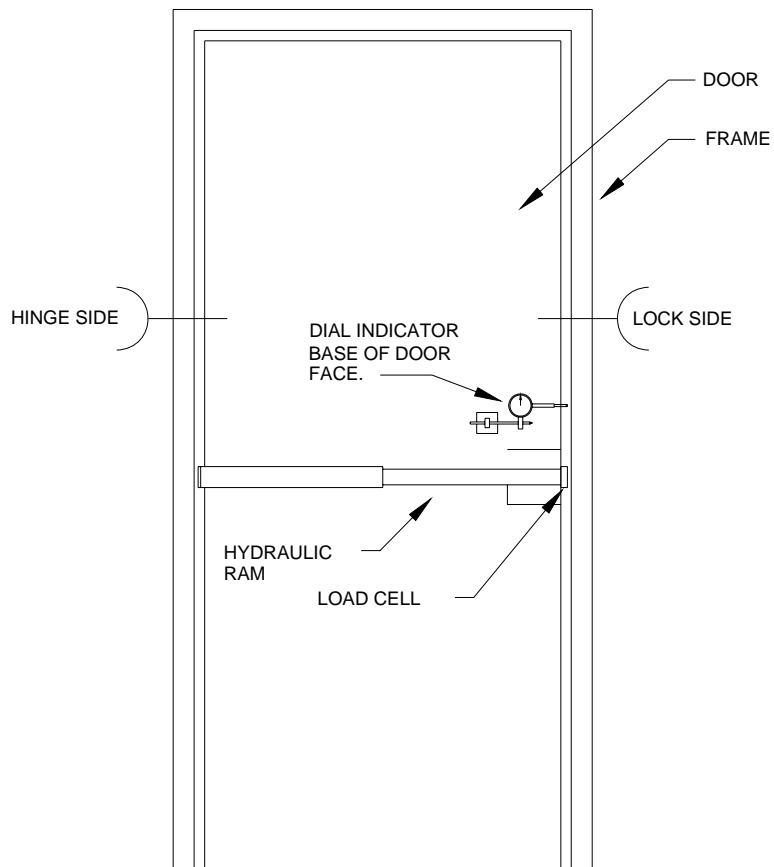
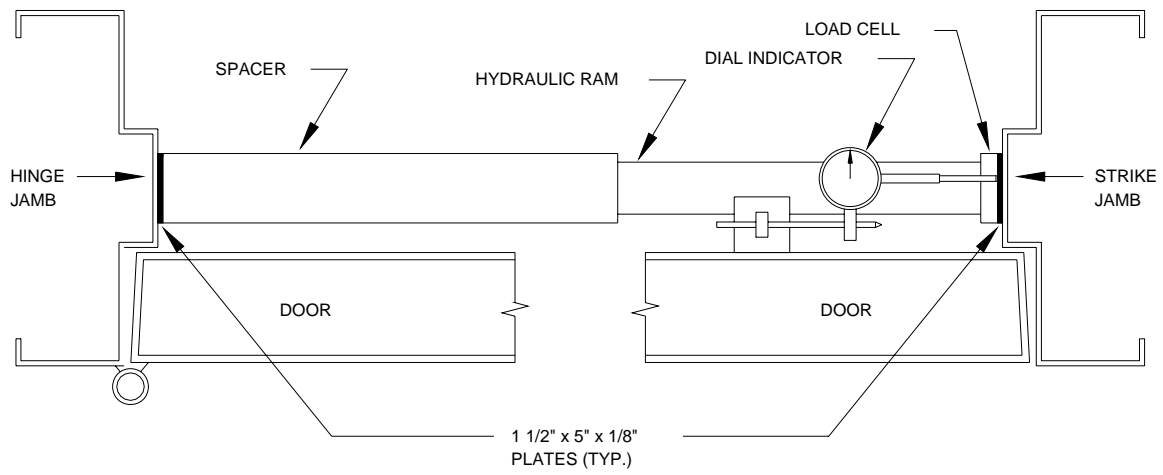


FIGURE 6

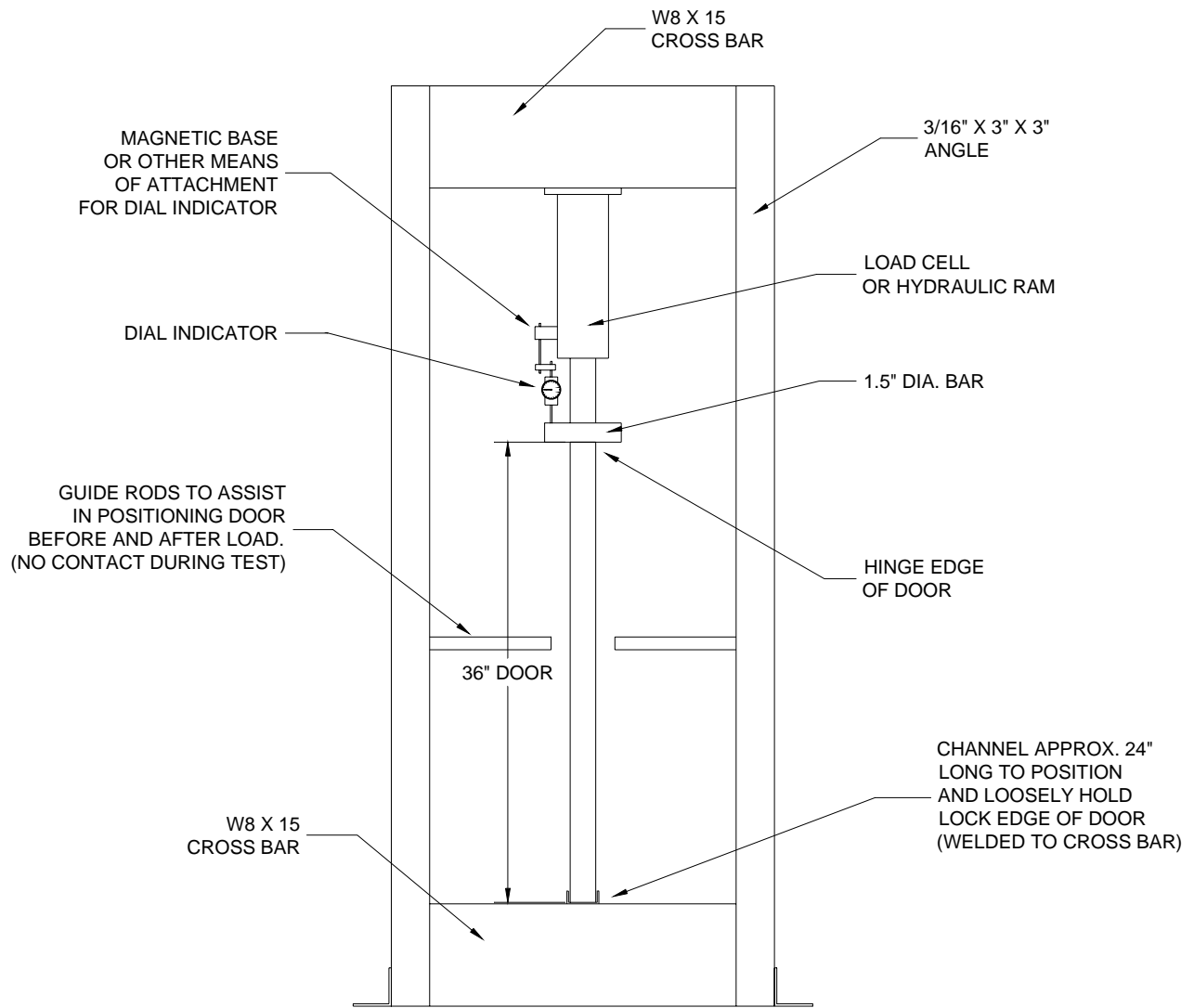


FIGURE 7 Edge Crush Test Fixture (End View)

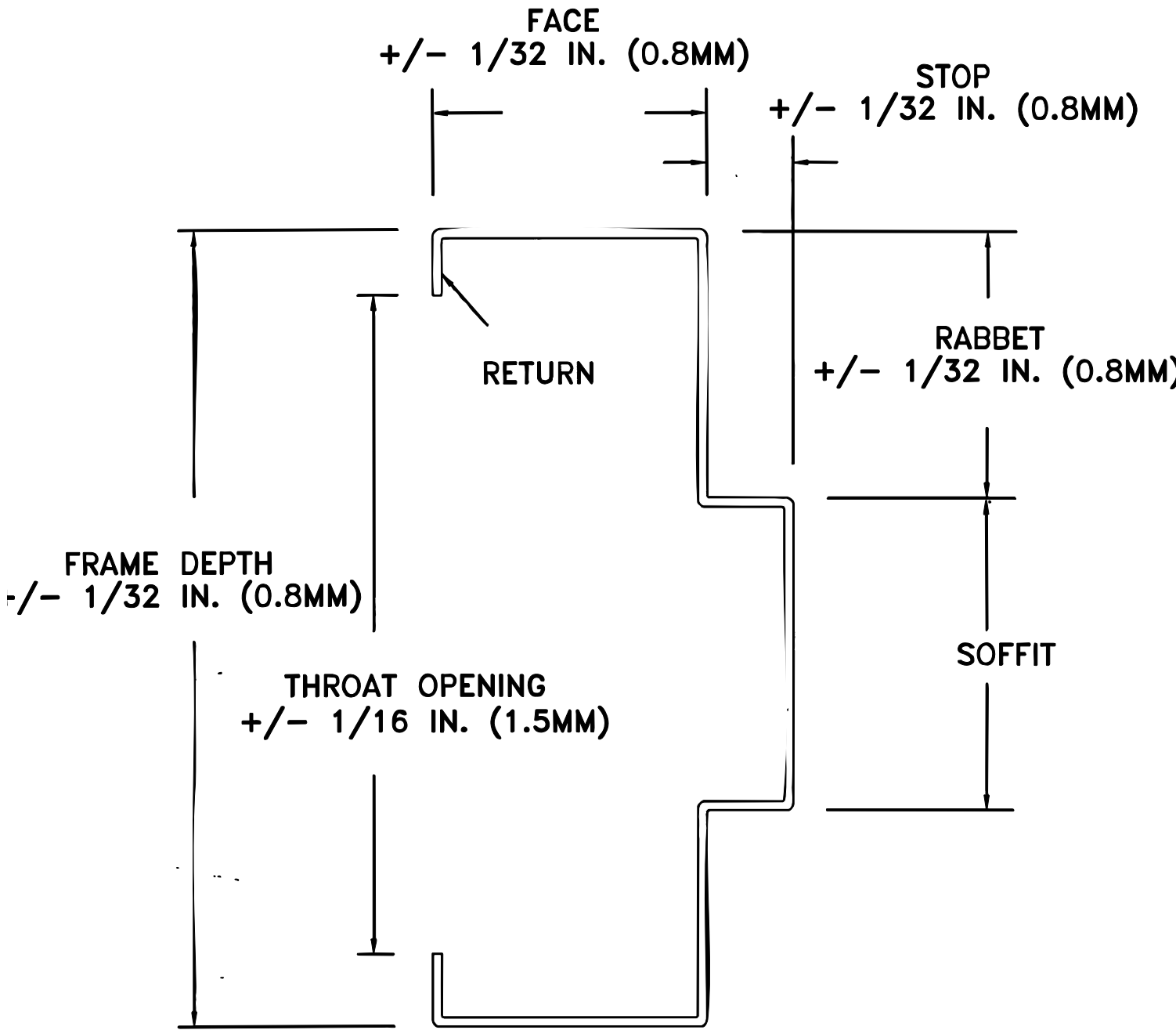


Figure 8

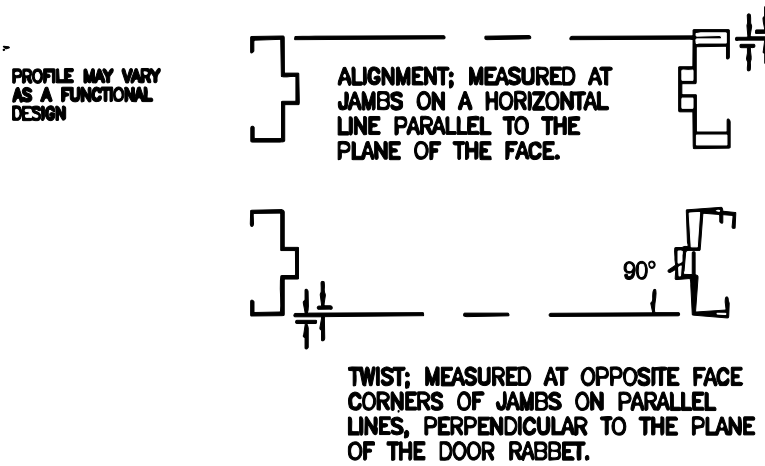
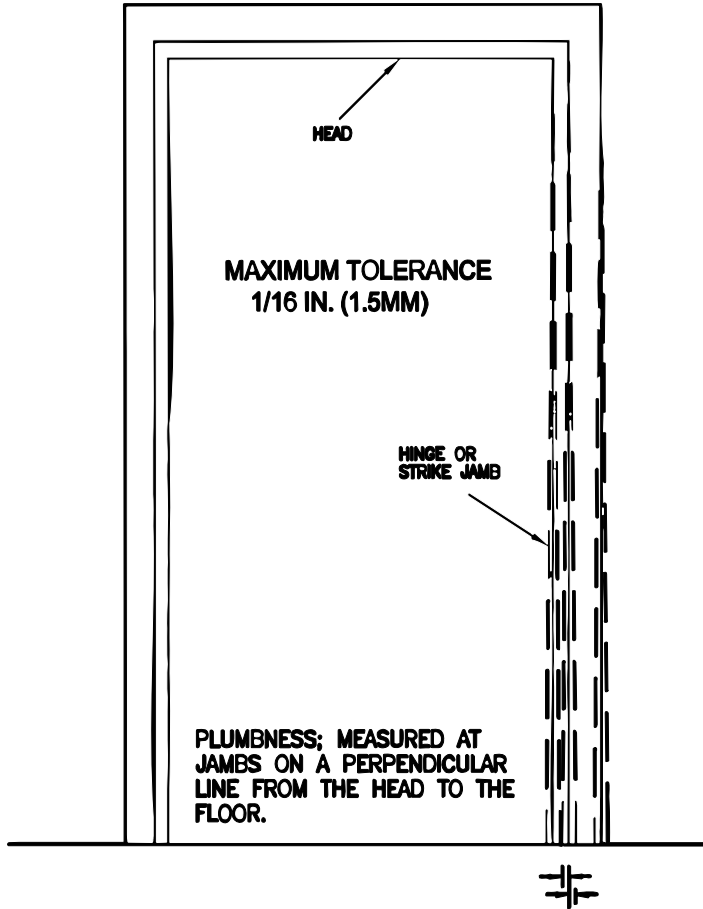
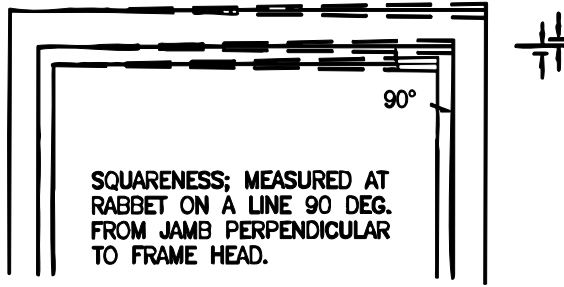


Figure 9