

Fact File

Compilation of SDI Technical Documents and
ANSI/SDI Standards and Test Methods



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Steel Door Institute

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Steel Door Institute Publications

Summary of Documents	Provides a description of each technical document
ANSI/SDI-100-91	See ANSI A250.8
SDI-108-18	Recommended Selection and Usage Guide for Standard Steel Doors
SDI-110-18	Standard Steel Doors and Frames for Modular Masonry Construction
SDI-111-09	Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components
111-A	Recommended Standard Steel Door Details
111-B	Recommended Standard Details for Dutch Doors
111-C	Recommended Louver Details for Standard Steel Doors
111-D	Recommended Door, Frame and Hardware Schedule for Standard Steel Doors and Frames
111-E	Recommended Guidelines for the Use of Gasketing and Thresholds for Standard Steel Doors and Frames
111-F	Recommended Existing Wall Anchors for Standard Steel Doors and Frames
111-G	Recommended Standard Preparation for Double Type (Interconnected) Locks on Standard Steel Doors and Frames
111-H	High Frequency Hinge Preparations for Frames
SDI-112-08 (R18)*	Zinc-Coated (Galvanized/Galvannealed) Steel Doors and Frames
SDI-113-13 (R18)*	Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies
SDI-117-19	Manufacturing Tolerances for Standard Steel Doors and Frames
SDI-118-19	Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements
SDI-122-15	Installation Troubleshooting Guide for Standard Steel Doors and Frames
SDI-124-16	Maintenance of Standard Steel Doors and Frames
SDI-127	Series - Industry Alerts (A through L)
SDI-127-A-06 (R14)*	End Closure
SDI-127-B-19	Door Edge Cutouts
SDI-127-C-19	Frame Cutout Limits
SDI-127-D-14	Electric Strikes & Electric Hinges in Stud Walls
SDI-127-E-06 (R19)*	Prime Painted Materials Alert

SDI-127-F-19	Butted Frames Rough Opening Sizes
SDI-127-G-06 (R14)*	Environmental Considerations Relating to Factory Painted Steel Doors and Frames
SDI-127-H-02 (R14)*	Water Penetration
SDI-127-I-04 (R19)*	Grouting Frames in Drywall
SDI-127-J-14	Bituminous Back-Coating of Frames
SDI-127-K-09 (R14)*	Improper Wedges as Hold-Opens
SDI-127-L-09 (R14)*	Buyer Beware: Steel Doors with Lead-Based Primer
SDI-128-19	Guidelines for Acoustical Performance of Standard Steel Doors and Frames
SDI-129-19	Hinge and Strike Spacing
SDI-130-19	Electrified Hinge Preparations
SDI-131-15	Accelerated Physical Endurance Test Procedure for Steel Doors
SDI-133-16	Guideline for Specifying Steel Doors and Frames for Blast Resistance
SDI-134-20	Glossary of Terms for Hollow Metal Doors and Frames
SDI-135-18	Guidelines to Measure for Replacement Doors in Existing Frame Openings
SDI-136-19	Guideline for Specifying Windstorm Products
ANSI/SDI A250.3-2019	Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames
ANSI/SDI A250.4-2018	Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
ANSI/SDI A250.6-2015	Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
ANSI/SDI A250.8-2017	Specifications for Standard Steel Doors and Frames (SDI-100)
ANSI/SDI A250.10-2020	Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
ANSI/SDI A250.11-2012	Recommended Erection Instructions for Steel Frames
ANSI/SDI A250.13-2008 (R2018)*	Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes

*Document was reviewed by the Steel Door Institute Technical Committee and approved for reaffirmation; ie., no revision was necessary to previously published document.

Summary of Documents

SDI-108 Recommended Selection and Usage Guide for Standard Steel Doors

Establishes guide criteria for the selection and usage of 1-3/4" and 1-3/8" standard steel doors.

SDI-110 Standard Steel Doors and Frames for Modular Masonry Construction

Contains information on the installation of standard steel doors and frames in modular masonry construction.

SDI-111 Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components

This document is divided into seven sections, each dealing with a specific area as follows:

111-A covers recommended steel door frame details as they are affected by common wall conditions.

111-B details standard dimensions for Dutch doors.

111-C covers a variety of louver designs and sizes for standard steel doors.

111-D contains a suggested door, frame and hardware schedule form and defines "handing".

111-E contains details which represent the recommendations of the SDI in respect to weather-stripping of standard steel doors and frames.

111-F is a guide for architects to aid them in recognizing available options to the traditional sub buck detail that has been widely used in the past. It illustrates anchoring systems which are available in regular and labeled frames.

111-G dimensions for standard door and frame preparation for double type (interconnected) locks.

111-H contains specifications for steel frames used in extremely high frequency or high use areas which need to be supplied with additional reinforcing to eliminate potential door sag.

SDI-112 Zinc-Coated (Galvanized/Galvannealed) Steel Doors and Frames

Provides information regarding the zinc-coated sheet used in steel door and frame construction when a requirement for zinc-coated doors and frames is specified.

SDI-113 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies

Establishes a minimum standard and a method of test for thermal effectiveness of steel door and frame assemblies under circumstances that might reasonably be considered normal field applications and conditions.

SDI-117 Manufacturing Tolerances for Standard Steel Doors and Frames

Provides users of standard steel doors and frames with definitive information regarding manufacturing tolerances.

SDI-118 Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements

Contains rules and other information in a condensed simplified manner in respect to code requirements for the design and use of fire doors.

SDI-122 Installation Troubleshooting Guide for Standard Steel Doors and Frames

Covers field installation problems most commonly experienced with standard steel door and frame installations. Most problems encountered are because of inappropriate application of the products and/or improper installation.

SDI-124 Maintenance of Standard Steel Doors and Frames

This document is intended to serve as a general outline of maintenance activities needed for hollow metal doors and frames. It should be noted that the door and frame are virtually maintenance free. Maintenance will be, for the most part, associated with accessories and hardware attached to the door and frame.

SDI-127 Series - Industry Alerts (A through L)

127-A End Closure

127-B Door Edge Cutouts

127-C Frame Cutout Limits

127-D Electric Strikes & Electric Hinges in Stud Walls

127-E Prime Painted Materials Alert

127-F Butted Frames Rough Opening Sizes

127-G Environmental Considerations Relating to Factory Painted Steel Doors and Frames

127-H Water Penetration

127-I Grouting Frames in Drywall

127-J Bituminous Back-Coating of Frames

127-K Improper Wedges as Hold-Opens

127-L Buyer Beware: Steel Doors with Lead-Based Primer

SDI-128 Guidelines for Acoustical Performance of Standard Steel Doors and Frames

Provides guidelines for the specifying, installing, and adjusting of standard steel doors and frames in applications where sound control is a consideration.

SDI-129 Hinge and Strike Spacing

A reference of standard locations used in the manufacture of steel door and frames by SDI member companies for a variety of door sizes.

SDI-130 Electrified Hinge Preparations

Provides an acceptable method for preparing frames for 4-1/2", 5" or continuous electric hinges, allowing frame manufacturers to provide frames prior to having knowledge of the specific electric hinge being used.

SDI-131 Accelerated Physical Endurance Test Procedure for Steel Doors

This test procedure provides manufacturers with a method of quickly testing the performance of doors.

SDI-133 Guideline for Specifying Steel Doors and Frames for Blast Resistance

Serves as a guide on the specification of blast resistant door assemblies.

SDI-134 Glossary of Terms for Hollow Metal Doors and Frames

Definitions of terms commonly used in connection with Hollow Metal Work, defined as they apply specifically to hollow metal, may be defined differently by other industries.

SDI-135 Guidelines to Measure for Replacement Doors in Existing Frame Openings

Provides guidance for measurement and recording of existing opening and/or door dimensions required to fully detail a replacement door(s).

SDI-136 Guideline for Specifying Windstorm Products

Covers the methodology and criteria used for the specification and selection of windstorm resistant door opening assemblies for non-residential construction.

* * *

A250.3 Test Procedure and Acceptance Criteria for Factory Applied Finish for and Frames

Prescribes the procedure to be followed in the selection of material, chemical preparation, coating application, testing, and evaluation of factory applied finish painted steel surfaces for steel doors and frames.

A250.4 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors

A standard method of testing the performance of a steel door mounted in a hollow metal or channel iron frame under conditions that might be considered an accelerated field operating condition.

A250.6 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames

Provides users of standard steel doors and frames with practical information regarding accepted design methods for reinforcing, and recommended practices for proper field preparation and installation of builders' hardware.

A250.8 Specifications for Standard Steel Doors and Frames (SDI-100)

The basic standard of the industry covers specifications for swinging steel doors and frames. It offers a number of choices in both regular and fire rated door and frame construction design. The specification covers sizes, types, materials, general construction requirements, and finishing of 1-3/4 " and 1-3/8" steel doors together with frames and accessories.

A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

Procedures for the selection of material, chemical preparation, painting, testing and evaluation of prime painted steel surfaces for steel doors and frames.

A250.11 Recommended Erection Instructions for Steel Frames

Covers the storage of frames on the jobsite, grouting and back painting of frames and assembly of frames. It also addresses bracing frames before wall construction and the installation of frames in masonry, steel stud wall construction, wood stud wall construction and drywall construction.

A250.13 Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes (Not applicable for FEMA 320/361 or ICC-500 Shelters)

Provides procedures for testing and establishing load ratings (design load in pounds per square foot or pounds force) for components of exterior swinging door assemblies. It is the intent of this document to test the protection of openings during severe windstorm conditions, such as a hurricane, that produces sustained wind speeds or gusts in a range of 110 to 150 miles per hour as defined by ASCE

7. It is not intended to simulate wind forces generated by tornadoes.

Recommended
Selection and Usage Guide
for
Standard Steel Doors



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STEEL DOOR INSTITUTE

30200 DETROIT ROAD • CLEVELAND, OHIO 44145

Recommended Selection and Usage Guide for Standard Steel Doors

Purpose

To establish guide criteria for the selection and usage of 1- $\frac{3}{4}$ " and 1- $\frac{3}{8}$ " standard steel doors.

Selection

Standard steel doors are classified in four levels: Level 1 – 1- $\frac{3}{4}$ " and 1- $\frac{3}{8}$ " standard duty, Level 2 – 1- $\frac{3}{4}$ " heavy duty, Level 3 – 1- $\frac{3}{4}$ " extra heavy duty and Level 4 – 1- $\frac{3}{4}$ " maximum duty.

Each of the four levels noted above offer a range of construction models and designs to meet architectural requirements for preference and appearance. The standard steel door construction models are full flush, seamless and, stile and rail.

Recommended minimum gauge requirements for the various levels and models of standard steel doors are indicated in table 1.

Usage

Selection of standard steel doors for general usage is made by analyzing criteria such as frequency of use, including subsection to and degree of possible abuse. Other criteria to be considered in door selection are: conformance to local building codes and fire code regulations; sound attenuation and/or insulation requirements; and architectural design and appearance.

Table 2 is a reference aid matching standard duty, heavy duty, extra heavy duty and maximum duty doors with general usage requirements within the classification of buildings. Where optional door levels and models are indicated, further analysis on an individual job basis is recommended.

When unusual or special door usage conditions are encountered, contact a representative member of the Steel Door Institute for consultation and guidance.

Notes

Tolerances – All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

Gauge vs. Thickness – While the term 'gauge' is no longer common for defining material thickness it is still used to specify doors and frames for ordering purposes. The term 'thickness' is used when defining the actual dimension of an item, and the term 'gauge' is used in the context of specifying a particular door or frame.







Table 1 – Standard steel door grades and models

Level		Model	Full Flush or Seamless			Construction
			MSG No.	IP in	SI mm	
1	Standard Duty	1	20	0.032	0.8	Full Flush
		2				Seamless
2	Heavy Duty	1	18	0.042	1	Full Flush
		2				Seamless
3	Extra Heavy Duty	1	16	0.053	1.3	Full Flush
		2				Seamless
		3				*Stile & Rail
4	Maximum Duty	1	14	0.067	1.6	Full Flush
		2				Seamless

*Stiles and rails are 16 gauge; flush panels, when specified, are 18 gauge.

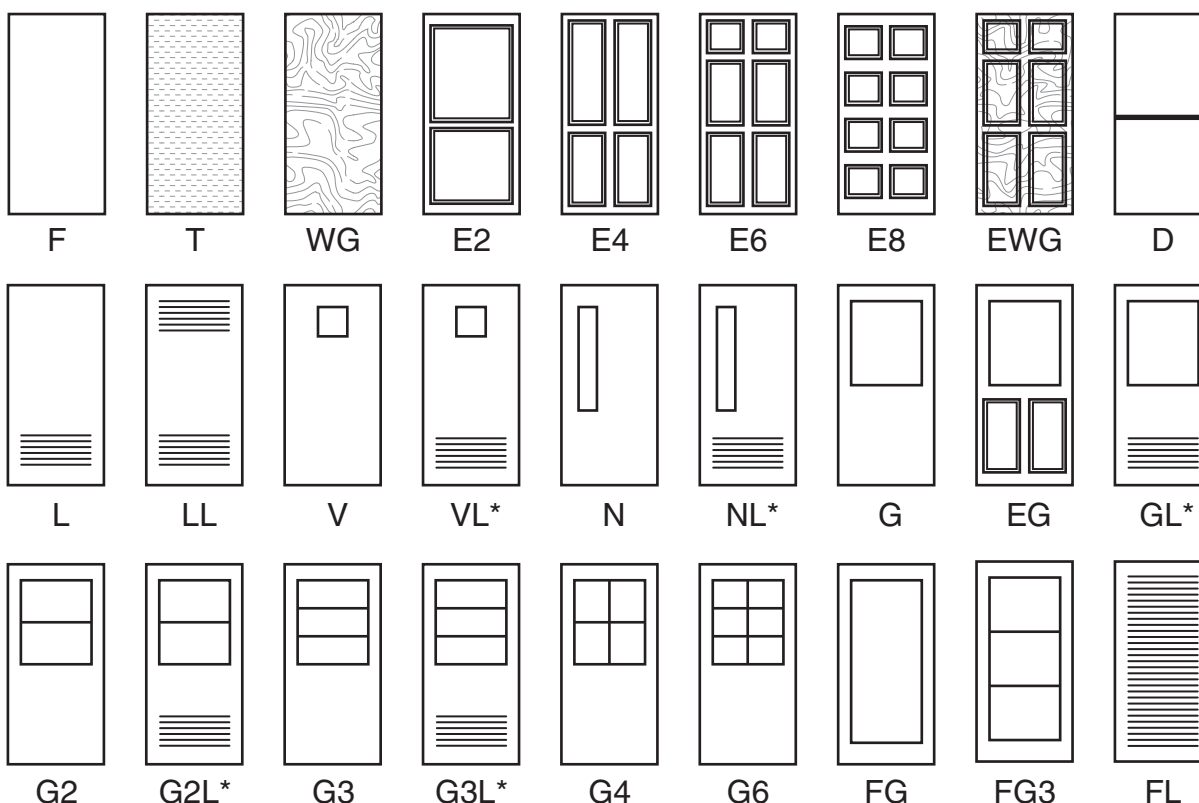
For complete standard steel door construction specifications and available sizes, refer to ANSI/SDI A250.8-2017, *Specifications for Standard Steel Doors and Frames (SDI-100)* and ANSI/SDI A250.4-2018 *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors*.

Table 2 – Suggested door levels and applications

Building Types	Standard Steel Door Levels				Door Design Nomenclature					
	Level 1 Standard Duty 1-3/8" 1-3/4"	Level 2 Heavy Duty 1-3/4" only	Level 3 Extra Heavy Duty 1-3/4" only	Level 4 Maximum Duty 1-3/4" only	 F	 G	 V	 FG	 N	 L
Apartment										
Main Entrance		•	•		•	•		•	•	
Unit Entrance	•	•	•		•					
Bedroom	•				•					
Bathroom	•				•					•
Closet	•				•					•
Stairwell		•	•				•		•	
Mechanical		•	•		•					•
Dormitory										
Main Entrance		•	•	•		•		•	•	
Unit Entrance	•	•			•					
Bedroom	•	•			•					
Bathroom	•	•			•					•
Closet	•	•			•					•
Stairwell		•	•				•		•	
Hotel – Motel										
Unit Entrance	•	•			•					
Bathroom	•				•					
Closet	•				•					•
Stairwell		•	•				•		•	
Storage & Utility		•	•		•					•
Medical										
Main Entrance			•			•		•	•	
Patient Room		•			•					
Stairwell		•	•				•		•	
Operating & Exam.		•	•		•		•		•	
Bathroom		•	•		•					•
Closet	•	•			•					•
Recreation		•			•		•			
Kitchen		•	•				•			
Mechanical/Storage/ Utility		•	•		•					•
Industrial										
Entrance & Exit			•	•		•		•	•	
Office	•	•			•	•				
Production			•			•			•	•
Toilet		•	•		•					•
Tool			•	•	•					
Trucking			•	•		•				
Monorail			•	•	•					
Office										
Entrance			•			•		•	•	
Individual Office	•				•	•				
Closet	•				•					•
Toilet		•	•		•					
Stairwell		•	•				•		•	
Equipment		•	•		•					
Boiler		•	•		•					•
School										
Entrance & Exit			•	•		•		•	•	
Classroom		•				•			•	
Toilet		•	•		•					•
Gymnasium			•	•	•	•	•		•	
Cafeteria		•	•			•				
Stairwell		•	•				•		•	
Closet	•	•	•	•	•					•

Note: Table 2 is only a guide. Please consult ANSI/SDI A250.8 and applicable building codes for additional requirements. For additional designs refer to SDI-134, *Nomenclature for Standard Steel Doors and Steel Frames*.

Steel Door Institute Standard Steel Door Design Nomenclature



* Note: Design combination is indicated by light followed by louver.

Consult SDI-134 for further information on standard design nomenclature for Standard Steel Doors.

Nomenclature Letter Symbols

F – Flush	EWG – 6 Panel Embossed and Wood Grain	NL – Narrow Light and Louvered
T – Textured	D – Dutch Door	G – Half Glass (options G2, G3, G4 and G6)
WG – Wood Grain	L – Louvered (top or bottom)	EG – Embossed and Half Glass
E2 – 2 Panel Embossed	LL – Louvered (top and bottom)	GL – Half Glass and Louvered
E4 – 4 Panel Embossed	V – Vision Light	FG – Full Glass (option FG3)
E6 – 6 Panel Embossed	VL – Vision Light and Louvered	FL – Full Louver
E8 – 8 Panel Embossed	N – Narrow Light	

Louvered door designs are further specified as inserted louver (I), pierced (P), or air condition grille (A).
When ordering, specify design, louver size and/or free area requirements.



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**Standard Steel Doors
and Frames**
for
Modular Masonry Construction



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Standard Steel Doors and Frames for Modular Masonry Construction

The Module

Definition:

The size of any individual part, taken as a unit of measure for regular proportion. A basic unit of measure adopted by the building industry as 4 inches.

Concept:

The use of a standard modular dimension common to building products such as masonry improves finished buildings and structures in the following ways:

- Increased accuracy, legibility, and simplicity of contract documents.
- Added aesthetic flexibility induced by small unit standardization, allowing freedom of architectural design.
- Increased flexibility of finished structure through lower modification, addition, and renovation costs.
- Reduced overall material and labor costs by facilitating the use of standard practices and definable operating procedures.
- Interchangeability of materials is facilitated by the ability to substitute modular components.
- Estimating and takeoff simplified.
- Detailing and drawing coordination between trades and specialties simplified by small size standard grid.

Dimensions:

Concrete masonry units (CMU) have been standardized to a nominal 8" high and 16" long module.

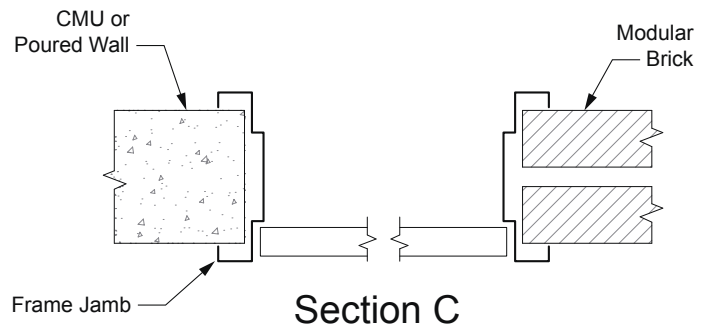
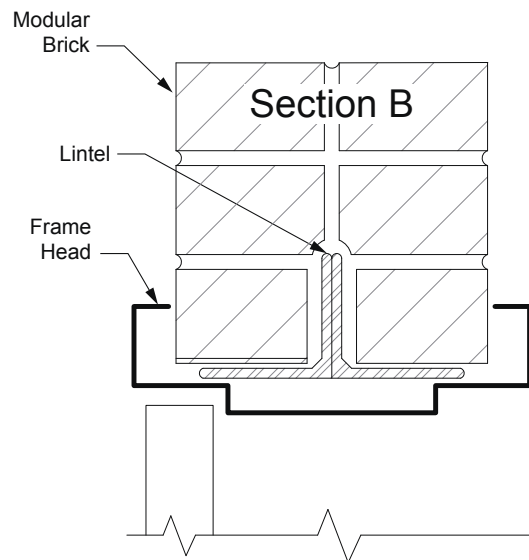
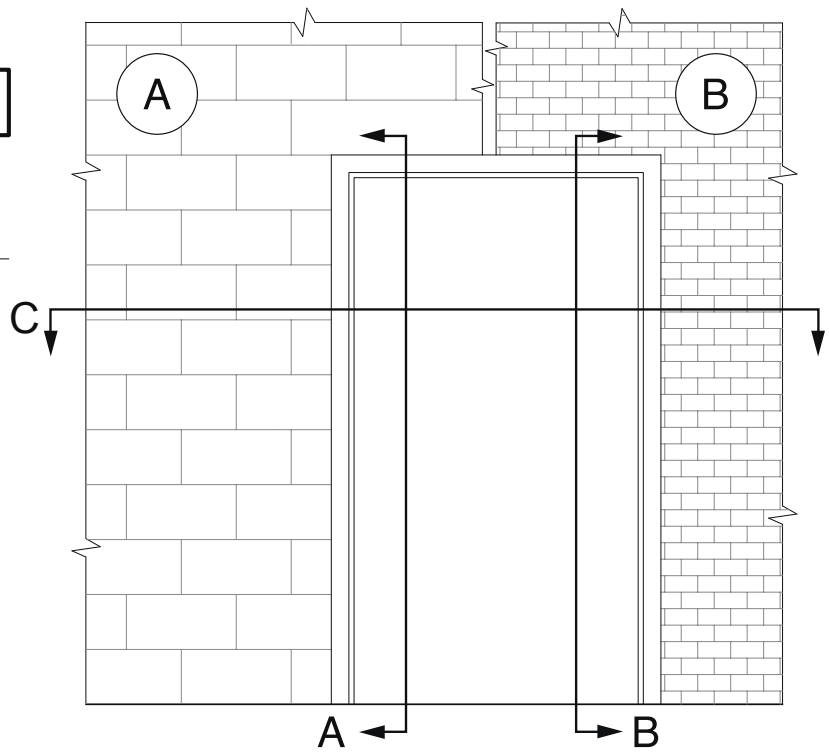
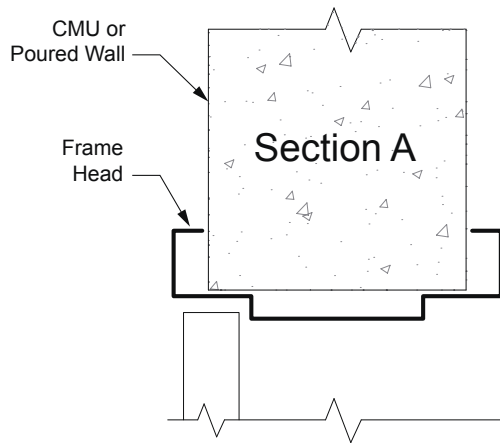
Modular bricks have been standardized to a nominal $2\frac{2}{3}$ " high and 8" long module, therefore 6 bricks correspond to the modular size of CMU. This relationship is clearly shown on the following pages.

Frame Installation in Cast-In-Place Concrete Walls

While the use of hollow metal frames in cast-in-place concrete walls is a common construction practice, the SDI does not recommend the inclusion of the frame as part of the process of pouring the wall. Instead, a rough-opening should be blocked out no less than $\frac{3}{16}$ " (4.8 mm) larger than the frame on all three sides. For example the opening for a 3'0" x 7' 0" standard frame with 2" faces would be 3' $4\frac{3}{8}$ " x 7' $2\frac{3}{16}$ " minimum. The installer is responsible for anchoring the frame per the manufacturer's installation instructions, shimming and aligning as necessary.

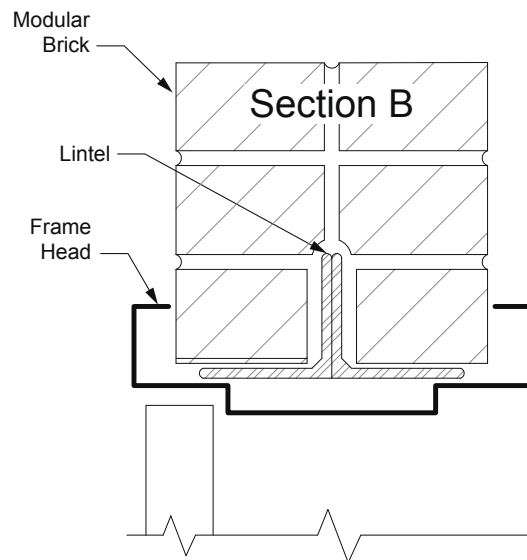
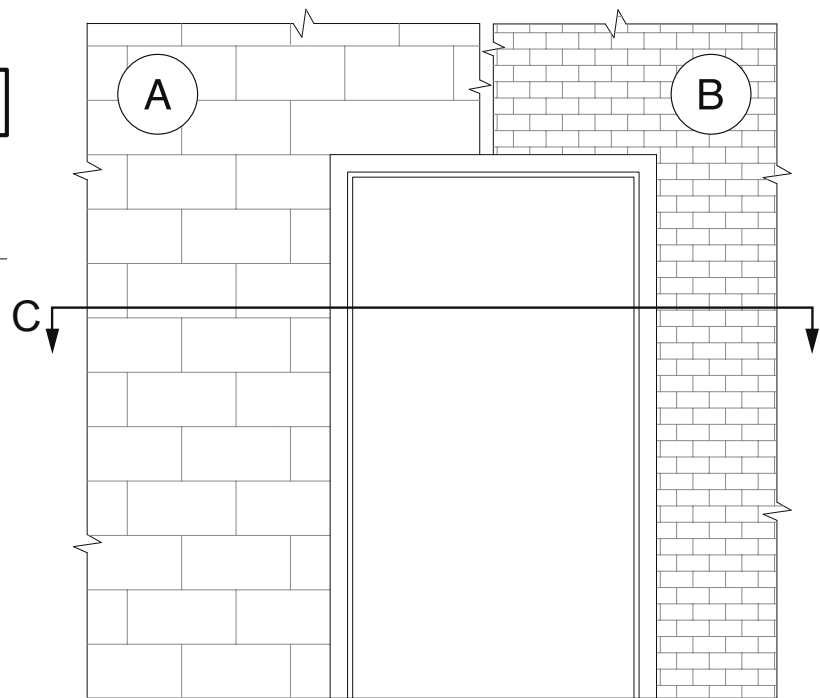
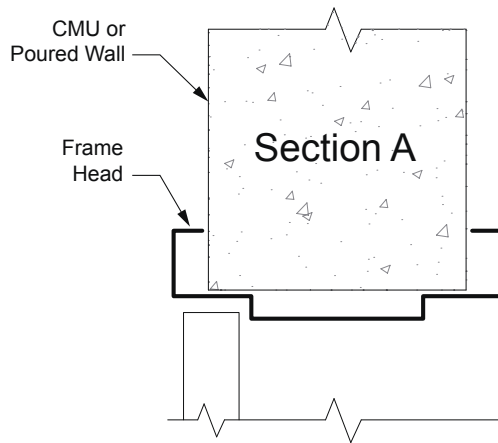
Wrap Around Frame

6' 8" or 8' 0" Door

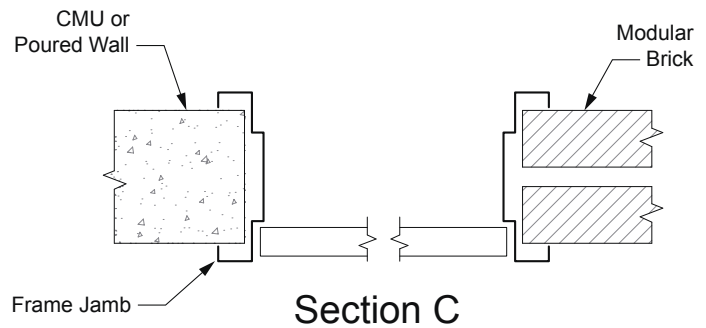


Wrap Around Frame

7' 0" Door

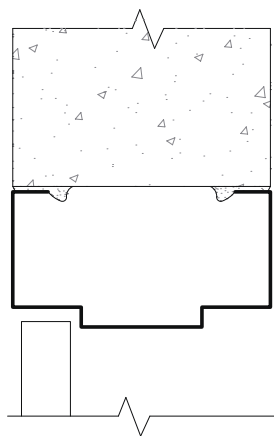
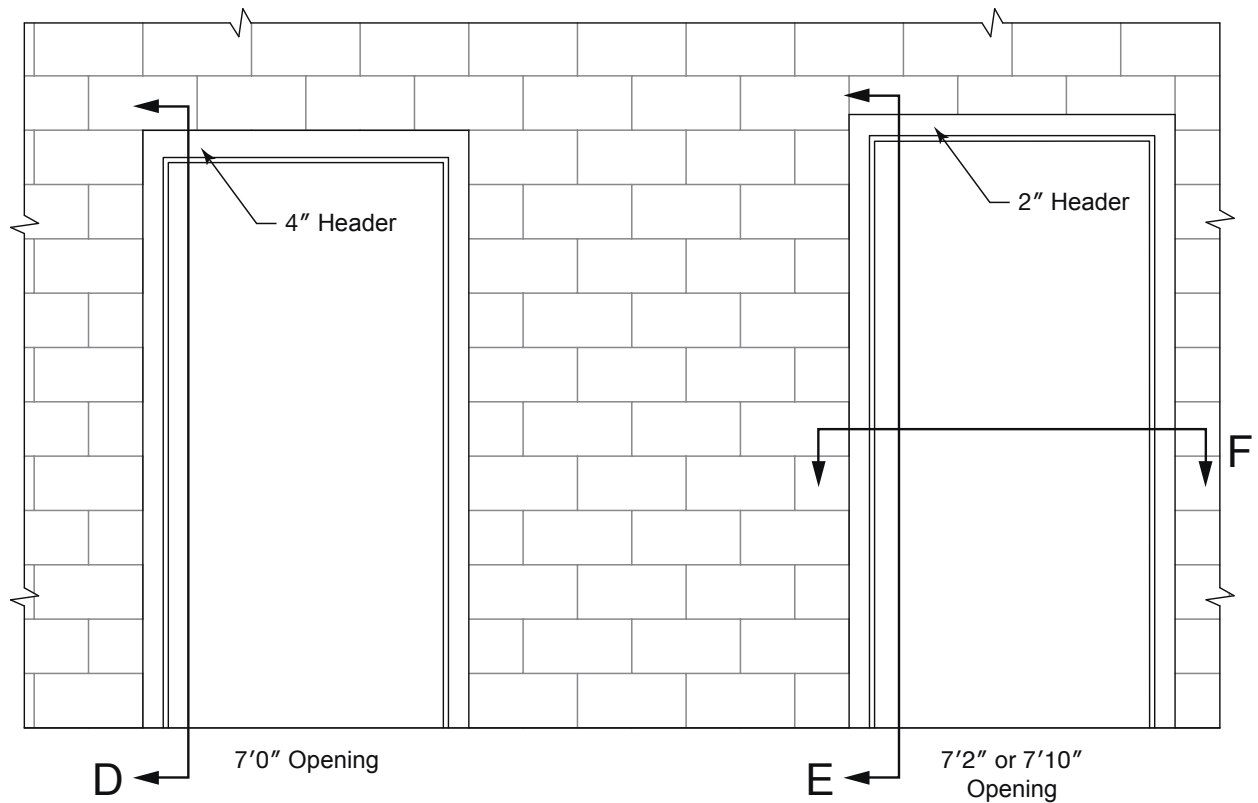


Note: A starter course of 4" modular masonry may be used to create alignment of the frame head with the masonry joints.

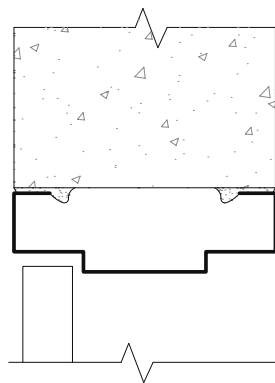


Butt Type Frame

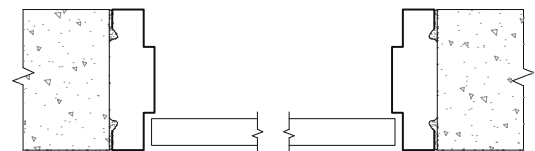
**7' 0" Door with 4" Header or
7' 2" and 7' 10" Doors with 2" Header**



Section D



Section E



Section F

Recommended Details for
**Standard Steel Doors,
Frames, Accessories
and Related Components**

The information that follows represents the Standard Steel Door and Frame Industry's considered views on a number of details normally encountered in building plans and specifications.

The Steel Door Institute recommends that they be followed except when very unusual details necessitate special drawings. The enclosed may be used as a reference document or added directly to the job drawings.

SDI 111-2009

Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories

Table of Contents:

- 111-A** Recommended Standard Steel Door Frame Details
- 111-B** Recommended Standard Details for Dutch Doors
- 111-C** Recommended Louver Details for Standard Steel Doors
- 111-D** Recommended Door, Frame and Hardware Schedule for Standard Steel Doors and Frames
- 111-E** Recommended Guidelines for the Use of Gasketing and Thresholds for Standard Steel Doors and Frames
- 111-F** Recommended Existing Wall Anchors for Standard Steel Doors and Frames
- 111-G** Recommended Standard Preparation for Double Type (Interconnected) Locks on Standard Steel Doors and Frames
- 111-H** High Frequency Hinge Preparations for Frames

Definition of “STANDARD”

We call our products Standard for three reasons:

FIRST, because our products are made to conform to published standards and established dimensions.

SECOND, our products are manufactured to meet established performance requirements.

THIRD, the fabrication of our products is controlled by standard manufacturing procedures which ensure uniform high quality.

Recommended
**Standard Steel Door
Frame Details**



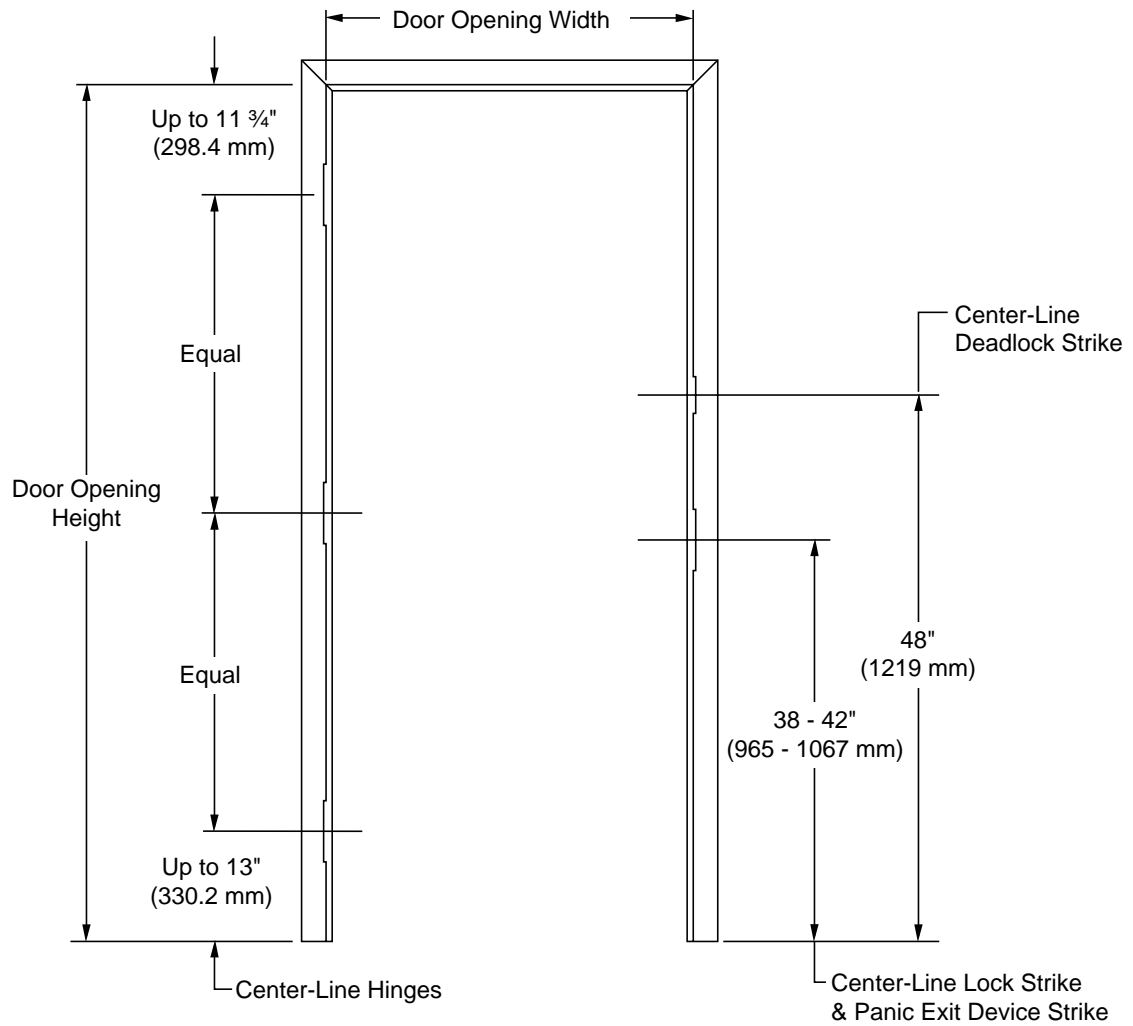
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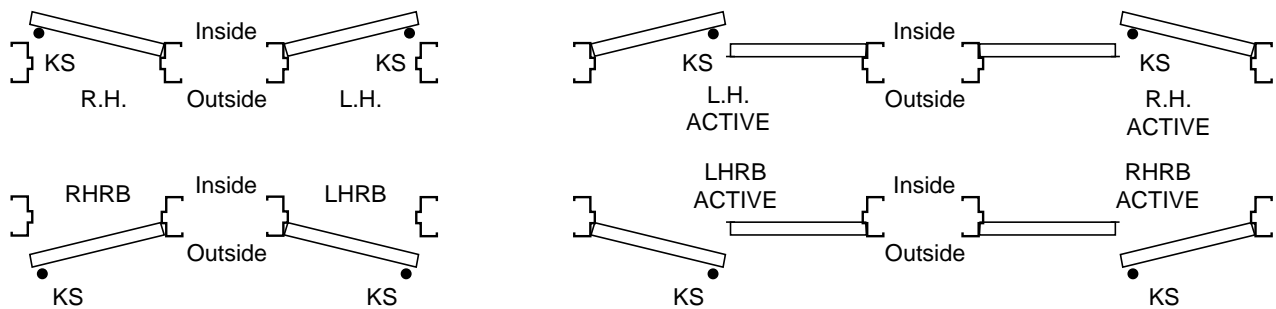
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Hardware Locations



Note: Center Hinge Omitted on 6' 8" (2032mm), 1 $\frac{3}{8}$ " (34.5mm) Doors, Unless Specified.

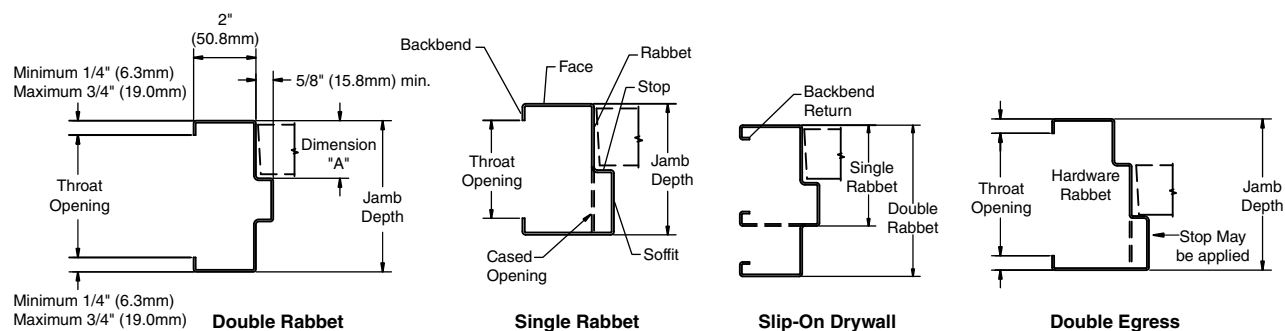
Handing Chart



KS indicates keyed side of lockset.

Standard Frame Details

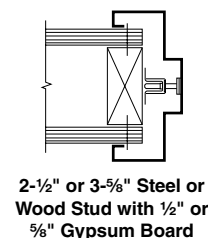
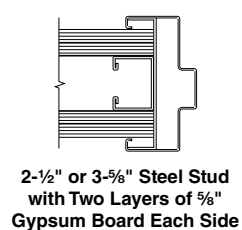
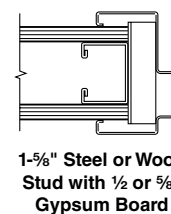
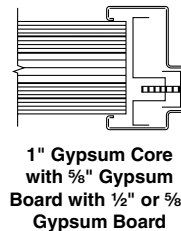
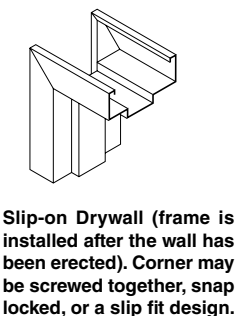
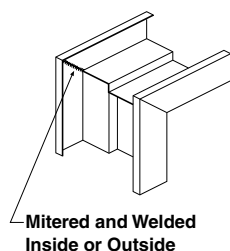
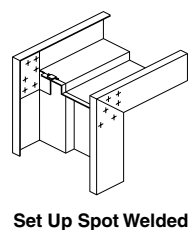
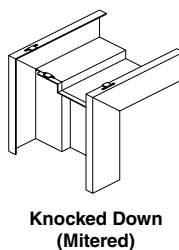
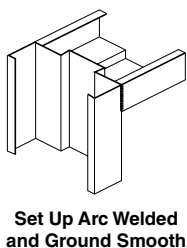
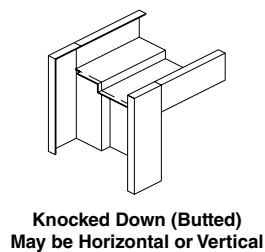
Standard Profiles



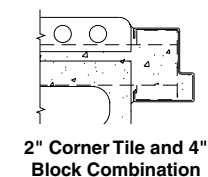
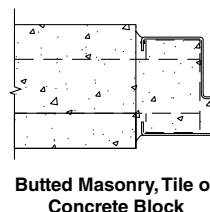
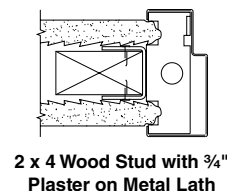
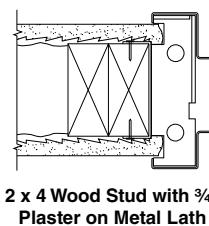
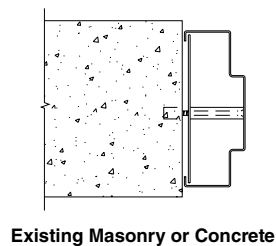
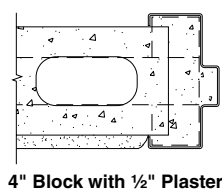
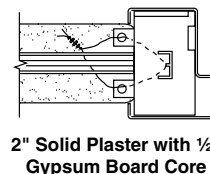
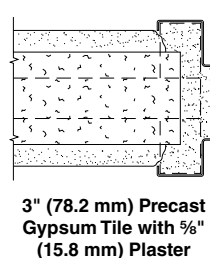
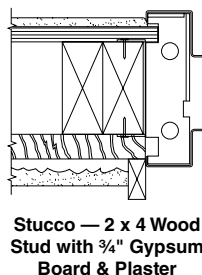
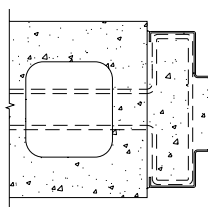
Door Thk.	Dim. "A"
1-3/8" (34.9mm)	1-9/16" (39.6mm)
1-3/4" (44.4mm)	1-19/16" (49.2mm)

Drywall

Corners

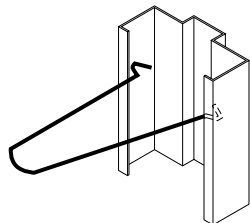


Common Wall Conditions

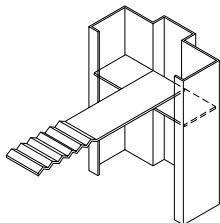


Special Frame Construction Details and Typical Hardware Preparations

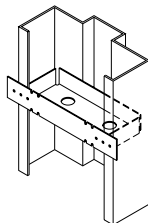
Anchor Details



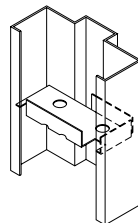
Masonry Wire Anchor



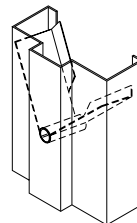
Masonry Tee Anchor



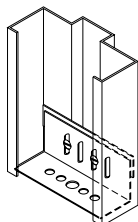
Wood Stud Anchor



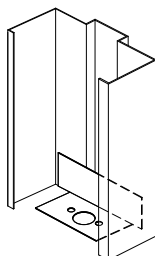
Steel Stud Anchor



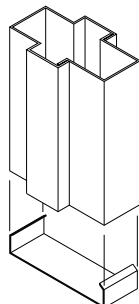
Existing Wall Anchor



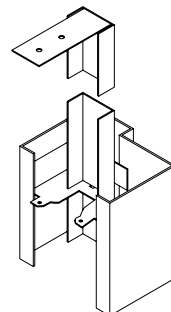
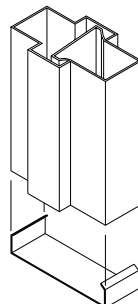
Adjustable Base Anchor



Standard Base Anchor

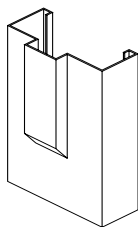


Typical Mullion Sections
with Base Anchor

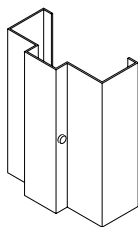


Plaster Partition Anchor
(Ceiling Strut Optional)

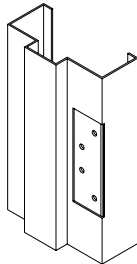
Special Frame Details



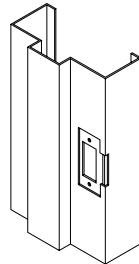
Hospital Stop



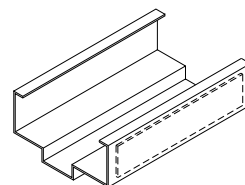
Rubber Silencers



Mortise Hinge



Strike



Surface Hardware Reinforcement.
Weld-in Reinforcement Shown,
Loose Reinforcing Sleeve Available
for Field Installation.

Hardware Preparations

For more information on steel doors and frames, contact any of the following members of the Steel Door Institute:

BLACK MOUNTAIN DOOR

310 Flint Drive
Mt. Sterling, KY 40353
(859) 274-0411
www.blackmountaindoor.com

CECO DOOR

9159 Telecom Drive
Milan, TN 38358
(731) 686-8345
www.cecodoor.com

CURRIES

P.O. Box 1648
Mason City, IA 50402-1648
(641) 423-1334
www.curries.com

DEANSTEEL MANUFACTURING CO.

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

DOOR COMPONENTS INC.

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

HOLLOW METAL XPRESS

602 S. 65th Avenue
Phoenix, AZ 85043
623-936-7000
www.HMXpress.com

MESKER DOOR, INC.

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

MPI

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

PIONEER INDUSTRIES, INC.

171 South Newman Street
Hackensack, NJ 07601
(201) 933-1900
www.pioneerindustries.com

REPUBLIC DOORS & FRAMES

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

SECURITY METAL PRODUCTS

5700 Hannum Avenue, Suite 250
Culver City, CA 90230
(310) 641-6690
www.secmct.com

STEELCRAFT

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

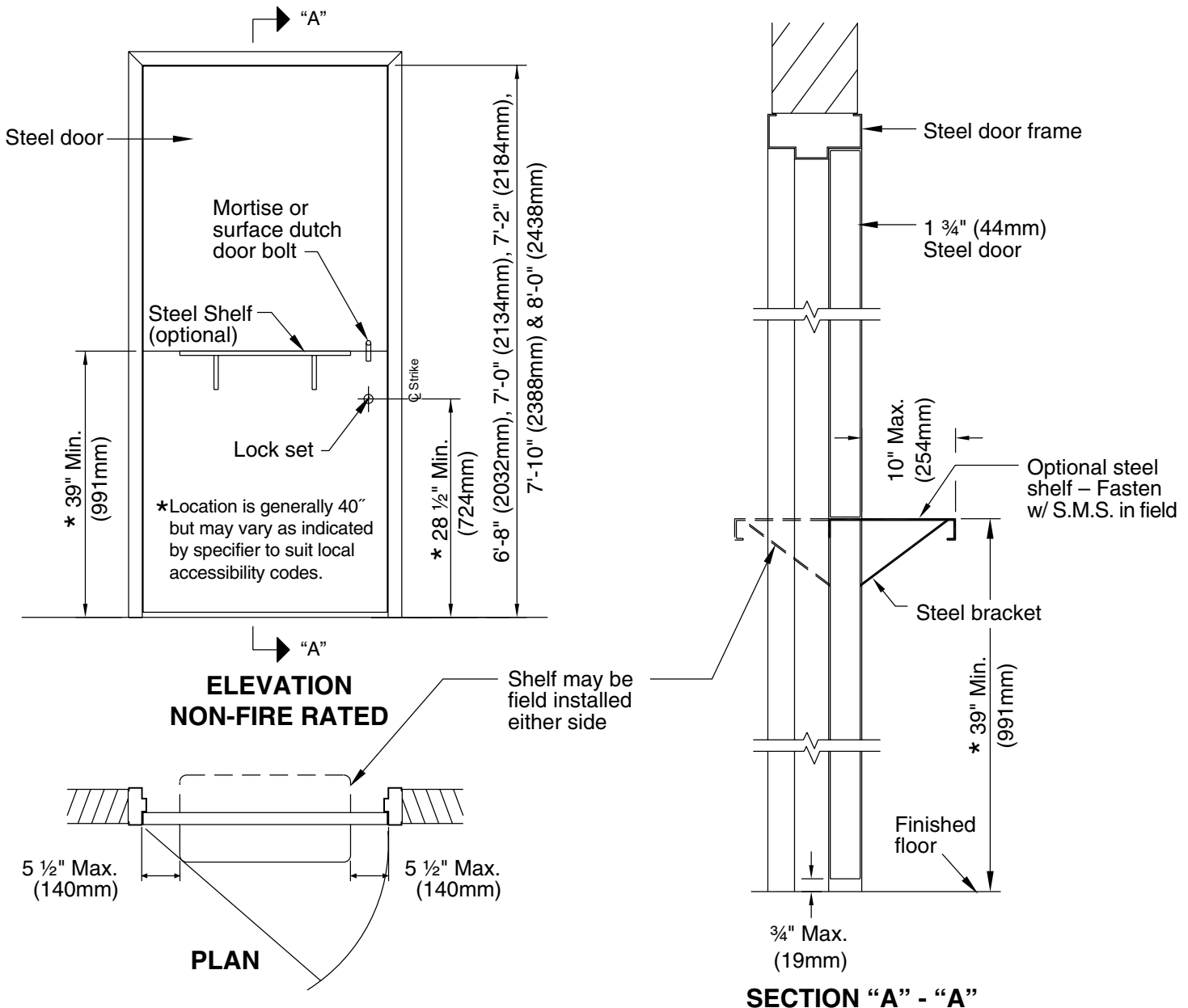


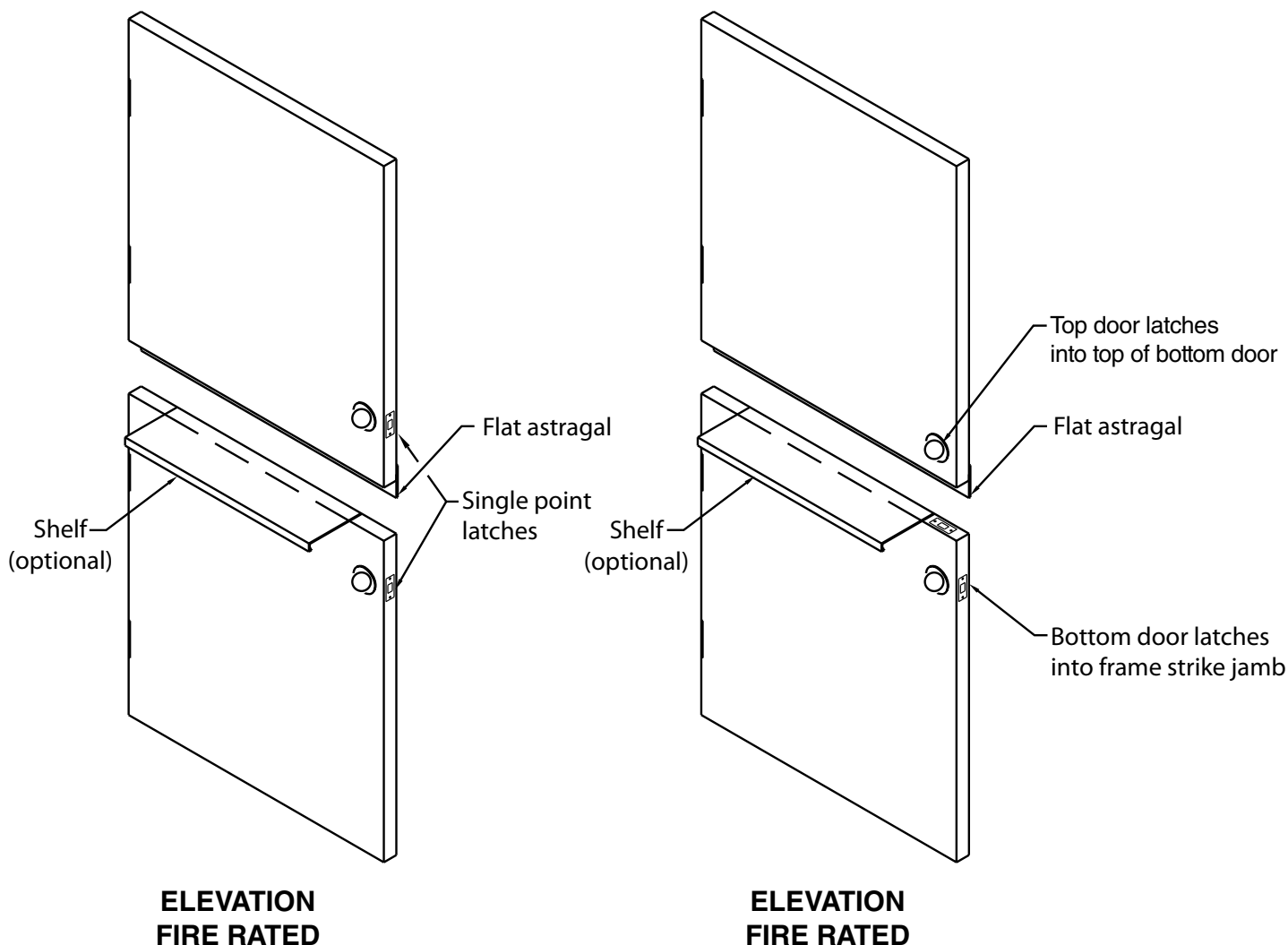
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440.899.0010 • FAX 440.892.1404 • www.steeldoor.org

Recommended Standard Details for Dutch Doors





For more information on steel doors and frames, contact any of the following members of the Steel Door Institute

BLACK MOUNTAIN DOOR

310 Flint Drive
Mt. Sterling, KY 40353
(859) 274-0411
www.blackmountaindoor.com

CECO DOOR

9159 Telecom Drive
Milan, TN 38358
(731) 686-8345
www.cecodoor.com

CURRIES

P.O. Box 1648
Mason City, IA 50402-1648
(641) 423-1334
www.curries.com

DEANSTEEL MANUFACTURING CO.

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

DOOR COMPONENTS INC.

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

HOLLOW METAL XPRESS

602 S. 65th Avenue
Phoenix, AZ 85043
623-936-7000
www.HMXpress.com

MESKER DOOR, INC.

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

MPI

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

PIONEER INDUSTRIES, INC.

171 South Newman Street
Hackensack, NJ 07601
(201) 933-1900
www.pioneerindustries.com

REPUBLIC DOORS & FRAMES

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

SECURITY METAL PRODUCTS

5700 Hannum Avenue, Suite 250
Culver City, CA 90230
(310) 641-6690
www.secmet.com

STEELCRAFT

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



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Recommended
**Louver Details
for
Standard Steel Doors**

Standard steel doors can be provided with a variety of louver designs and sizes. This publication contains explanations and details of louver designs that are most commonly available within the standard door industry.

When specified, doors shall be provided with louvers at the bottom and/or top. The choice of which to use must be determined by the architect on aesthetic, functional, and economic grounds.



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Recommended Louver Details for Standard Steel Doors

Function – Louvers permit free air passage, controlling the volume by their size or design. They diffuse or control direction of air flow by blade design.

Insert louvers – Louvers commonly used in standard steel doors are of the “insert” type designed to be mounted into a cutout in the door and an overlapping frame. Inverted “V” blade, “Z” blade, inverted “Y” or chevron-type blade, lightproof, adjustable blade, grille type, and fusible link self-closing fire door types are available in a wide range of sizes. Also available from some steel door manufacturers is a pierced louver design. Insert louvers intended for exterior doors or other doors where security is a consideration should have fasteners or materials specified accordingly.

Note: If a louver door is required to provide security, the steel door manufacturer should be consulted.

Bird or insect screens are available with many of the standard design louvers. Where specified, consult steel door manufacturer for availability.

Weatherproof louvers – True weatherproof designs do not exist. Some louvers are manufactured to provide a certain degree of rain protection.

Louver construction – Standard louver frames are a minimum 20 gauge steel with louver blades of a minimum 24 gauge steel. The louver blades can be welded or tenoned to the frame and the entire assembly is generally fastened to the door with moldings. Generally, one molding will be an integral part of the louver, while the other molding will be detachable. When louvers are installed, the detachable moldings should be located on the room or non-security side of the door. Where doors are manufactured as non-handed, louvers may require reversing during door installation to suit actual handing.

Application:

Inverted “V” or “Z” blade types allow maximum free air flow with minimum static pressure differential.

Inverted “Y” or chevron blade types, while offering less free air flow, offer a higher strength factor for schools and other areas where vandalism or hard usage may occur.

Lightproof louvers are used where light transmission must be avoided, but provide minimal free air flow.

Adjustable blade louvers are used where air flow is varied in velocity and control of flow is needed.

Grille type louvers are normally associated with air conditioning, where air must be diffused in random flow, avoiding higher velocity air flow patterns.

Fusible link louvers are used in fire doors where flames and intense heat passage must be controlled. The link release temperature recommended is 135°F (57°C). These louvers must be labeled and may not exceed 24” x 24”. Fusible link louvers are allowed only at the bottom of fire doors. Since closing is heat activated, these louvers are not to be used on smoke control doors.

Pierced louvers, available from some steel door manufacturers, offer a flush condition and may be furnished with internal insect screens. Louvers are formed by embossing the door face sheets.

Louver size determinations – As a guide, the following approximate percentages of louver size may be used to determine the free area in a given size louver:

• Pierced louver	20%
• Inverted “V” inserted louver	50 – 60%
• Inverted “Y” (chevron) inserted louver	40 – 60%
• “Z” type inserted louver	40 – 45%
• Adjustable inserted louver	40 – 50%
• Lightproof inserted louver	20%
• Fusible link inserted louver	45%

The above percentages assume there is no air pressure drop from one side of the door to the other. On air condition grilles an air pressure drop is normal. An average 70% of the grille size can be used in computing free area on doors with air condition grilles.

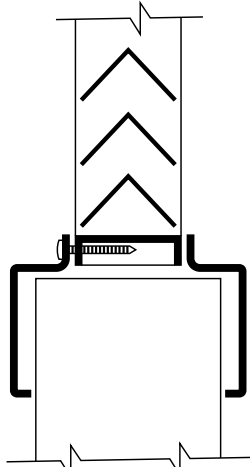
The percentages noted above are approximates. Consult the individual manufacturer’s literature for the specific sizes and ratings normal to their program.

Coordination – A combination of glass lights and louvers is common in steel door work. Care should be taken to avoid specifying too long a narrow light when a louver or grille occurs in the bottom of the same unit. In addition, handicap codes may dictate the location of the louver relative to the bottom of the door.

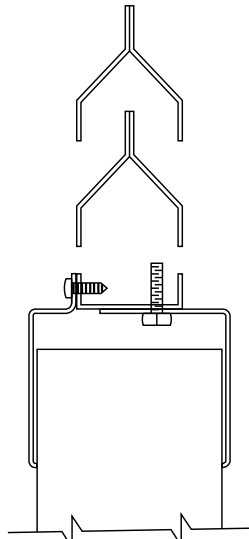
Full louver doors – A minimum 5” (127.0mm) rail occurs at the top and at the vertical stiles and an 8” (203.2mm) minimum rail occurs at the bottom of these doors (Consult door manufacturer for exact stile/rail dimensions). Stile and top rail sizes must be coordinated with closer dimensions, lock preparations, and lever handles. Pierced louvers are not available on full louvered doors.

Finish – The finish is to be prime painted, except when the louver is used in a factory prefinished door, in which case the louver will be finish painted with a color to match the door. For exterior doors, zinc coated louvers are available where specified.

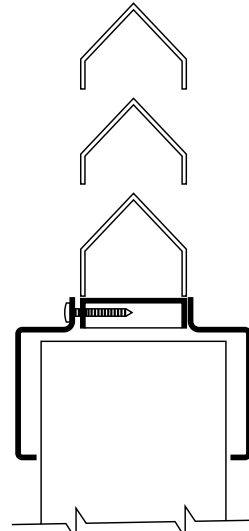
Cross Section Details



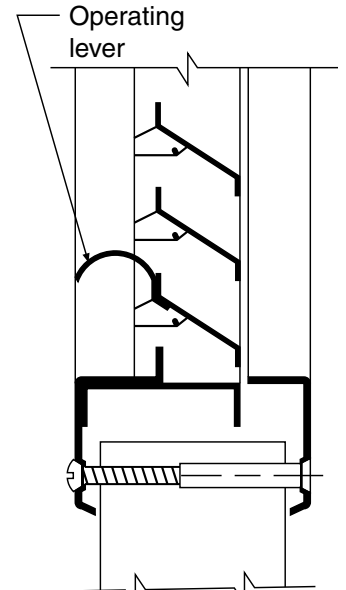
Inverted "V" Blade



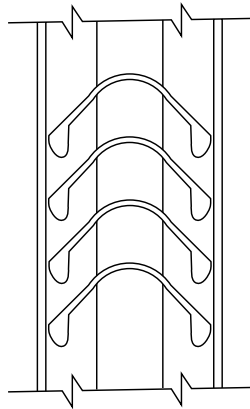
Inverted "Y" Blade



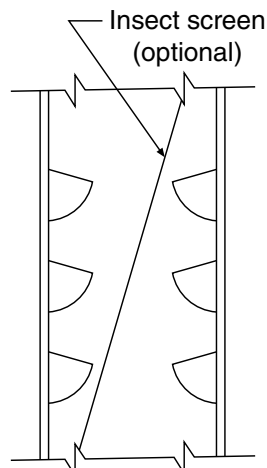
Chevron or Hood-Type
Blade



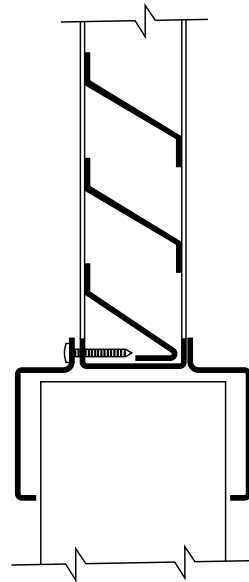
Fusible Link



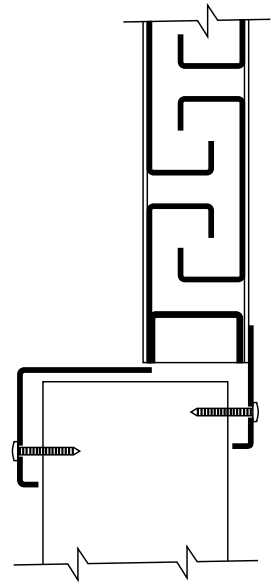
Grille



Pierced



"Z" Blade



Lightproof

Recommended Door, Frame and Hardware Schedule for Standard Steel Doors and Frames

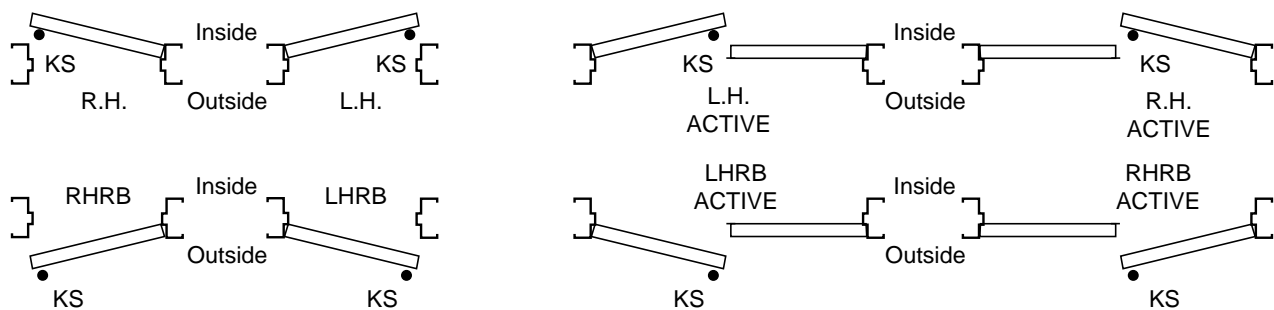
The purpose of this publication is to establish a guide for architects and those responsible for scheduling doors, frames, and hardware requirements.

Although primarily designed for steel doors and frames, this suggested schedule is flexible enough to list total door and frame requirements of a complete job.

Items not specifically covered in the schedule may be listed in the "Remarks" and extra columns near the end.

Typical handing of doors and hardware is to be based on the format below:

Handing Chart



KS indicates keyed side of lockset.



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ITEM NO.	LOCATION			QTY.	HAND	LABEL (1)	FRAMES						DOORS				HARDWARE								REMARKS (3) (7)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
	ARCH. NO	FROM	TO				GAUGE (4)	ELEV. (6)	DEPTH	ANCHOR/ WALL TYPE	DETAILS			TYPE (5)	DOOR OPENING		HDWE. GROUP NO.	HINGES	LOCK	CLOSER	(2)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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(1) If a fire door is required, it is to be designated in the "Label" column of schedule with appropriate hourly rating. Also, note in the "Remarks" column whether door is to have an Underwriters' Laboratories (UL) Factory Mutual (FM), or Warnock Hersey (WHI) label.

(3) Any special item not listed in schedule for doors, frames, or hardware is to be shown in the "Remarks" column.

(4) Indicate gauge of material for steel. When materials other than steel are used, indicate AL for aluminum or WD for wood.

(5) Refer to SDI-106 for Recommended Standard Door Design Nomenclature.

(6) When frame elevations are indicated, supplemental drawings must be attached.

(7) Doors provided with $\frac{3}{4}$ " undercut unless otherwise specified.

Recommended

Guidelines for the Use of Gasketing and Thresholds for Standard Steel Doors and Frames

The following details represent the recommendation of The Steel Door Institute in this important corollary area. This document should in no way be considered an endorsement of any manufacturer nor does it imply that any materials not shown should be considered inferior weatherstripping.

The criteria employed in the selection of these details included:

1. The experience of the Institute with the details shown.
2. The adaptability of the material shown to standard steel doors and frames.
3. The ability to maintain gasketing at the door and frame during periods of normal thermal movement to the balance of the building structure.
4. The availability of the material from normal commercial sources.
5. Ease of maintenance.

Disclaimer/Source Reference

Since the members of the STEEL DOOR INSTITUTE do not manufacture gasketing, it is strongly suggest that the BHMA Members' catalogs and BHMA documents be consulted to establish "fit and function" criteria for specifying of any gasketing. BHMA Documents are available from:

Builders Hardware Manufacturers Association
355 Lexington Avenue, 15th Floor
New York, NY 10017
Phone: (212) 297-2122
Fax: (212) 370-9047
www.buildershardware.com

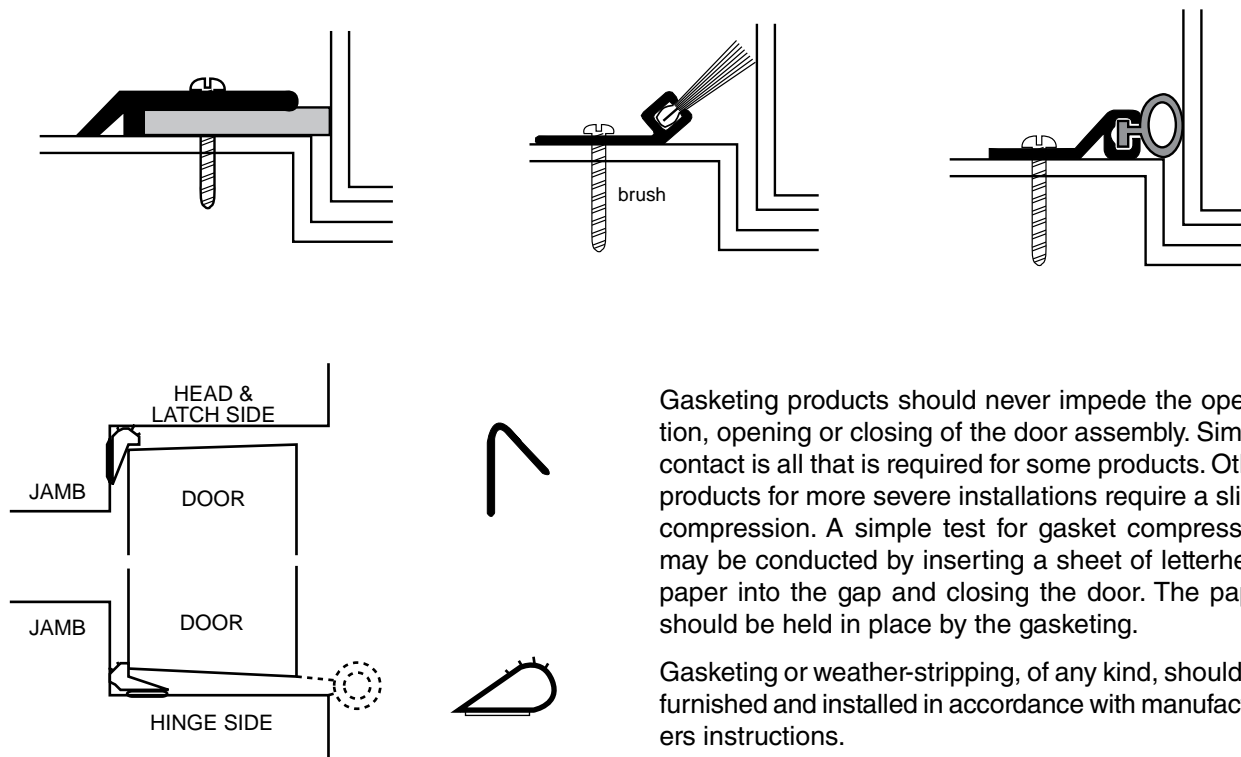
Recommended Guidelines for the Use of Gasketing and Thresholds for Standard Steel Doors and Frames

General

Gasketing and thresholds are used to control the flow of air, smoke, heat or cold, water, sound or other environmental factors through the door opening. The location or intended use of the door assembly, the environment to which it is exposed, and the performance expected will dictate the selection of gasketing and threshold products. The variety of materials, their composition, profiles, and performance are virtually limitless. These are described in ANSI/BHMA A156.21 or A156.22. Generally, gasket materials are sponge neoprene, rubber, vinyl, brushes, or magnets. Retainers are generally steel, aluminum, brass, bronze, vinyl, or other non-ferrous materials. Information in catalogs published by BHMA members aid in the selection of perimeter sealing “systems” to meet the applicable performance criteria of the door assembly.

Perimeter Seals

Sealing of gaps between door edges and the header or jambs generally has the greatest effect on performance of the door opening. The available options are as varied as their applications and their mounting surfaces e.g. steel, structural steel, or wood. Care should be taken to select materials that will assure performance under specific job requirements as well as meeting the mounting surface criteria.



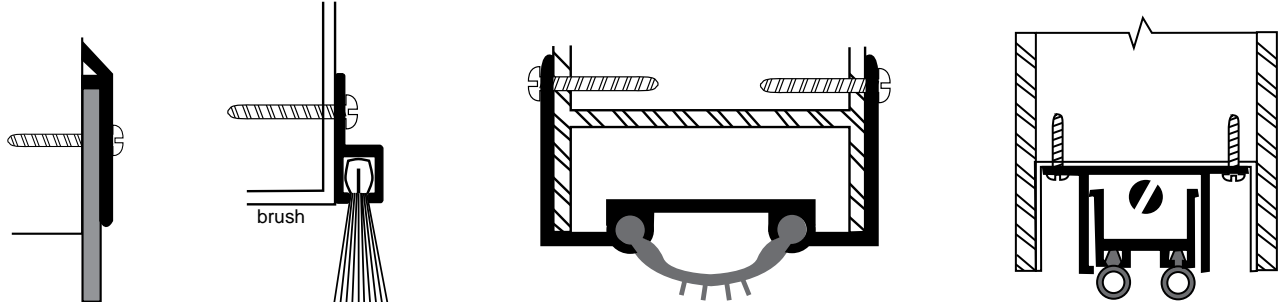
Gasketing products should never impede the operation, opening or closing of the door assembly. Simple contact is all that is required for some products. Other products for more severe installations require a slight compression. A simple test for gasket compression may be conducted by inserting a sheet of letterhead paper into the gap and closing the door. The paper should be held in place by the gasketing.

Gasketing or weather-stripping, of any kind, should be furnished and installed in accordance with manufacturers instructions.

Door Bottom Seals

In most instances, sealing of gaps between the bottom of doors and flooring or thresholds is accomplished with door bottoms or overlapping strips in metal retainers. These may be of a design that extends beyond the bottom of the door mechanically, or of a fixed protruding or overlapping design.

Door bottom gaskets must compress against a solid object to affect a proper seal. Carpeting by its pliant nature does not provide a proper seal.



Automatic Door Bottom

Astragal Seals

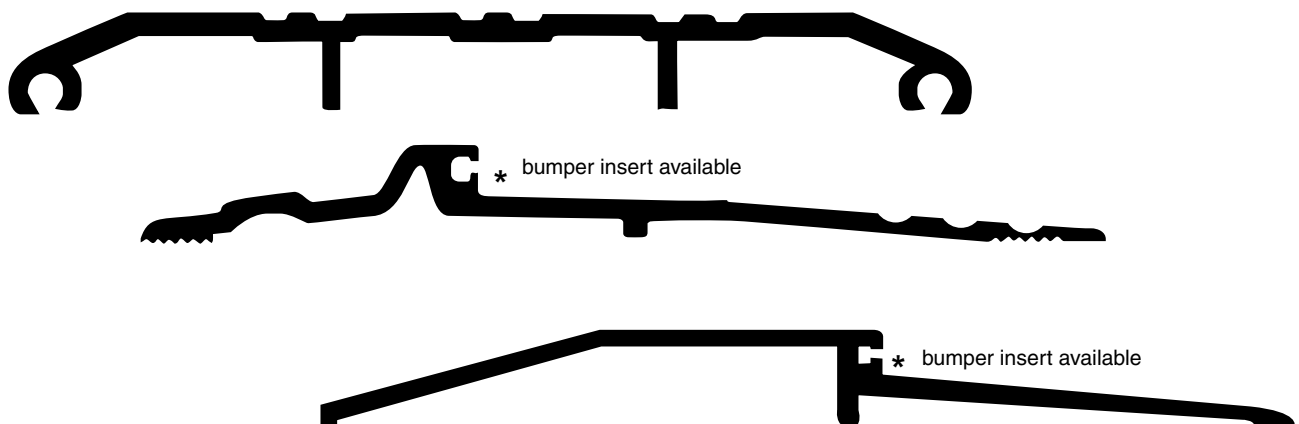
Sealing of door edges at meeting stiles, in lieu of or in addition to factory mounted astragals is accomplished by supplemental gasketing. This gasketing may be closely abutting fixed members or by overlapping strips in metal retainers.

Overlapping gasketing is normally used to avoid interference with edge mounted hardware such as locksets or flush bolts. Closely abutting gasketing is commonly used where both doors must operate simultaneously or independently as in egress doors.



Thresholds

Thresholds may be used in addition to or in lieu of door bottom seals. They may incorporate gaskets or other formed profiles to allow for exit device latching or may be prepared for flush bolt latching. Thresholds should be provided under the door and between the frame to allow for a smooth transition between floor coverings of different heights or materials. Special consideration should be given to threshold designs used in means of egress or in handicap accessible situations. The latter limitations are covered in ANSI/ICC A117.1.



Fire Door Considerations

When supplying products to be used on fire rated openings, care should be taken to maintain the proper clearances around the perimeter of the door assembly in accordance with NFPA 80. Gasketing materials must be investigated or "Listed" to determine that their installation does not adversely affect the fire resistance performance of the assembly. For example, the performance of gasketing is observed during the fire test to ensure that flaming does not occur on the exposed surface of door assemblies. It is important to note, however, that the ANSI/UL 10B, ANSI/UL 10C and ANSI/NFPA 252 standard fire tests do not include evaluation of the door assembly relative to preventing the passing of smoke or other products of combustion through or around the assembly. Openings that require a smoke seal must be tested in accordance with NFPA 105, UL 1784 or UBC 7-2 Part 11, 1997. In fire door applications it is VITAL that gasketing does not inhibit the ability of the door assembly to close and latch.

Performance Testing Criteria

Gasketing products are covered under ANSI/BHMA A156.22.

Included in that standard are:

- Closing Force test
- Heat Test
- Cold Test
- Air Infiltration Test

Thresholds are covered under ANSI/BHMA A156.21.

Included in that standard are:

- Weight bearing test

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Recommended
Existing Wall Anchors
for
**Standard Steel Doors
and Frames**



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Recommended Existing Wall Anchors for Standard Steel Doors and Frames

This standard is a guide for architects to help them recognize available options to the traditional sub buck detail widely used in the past. The anchoring systems shown are available in regular and labeled frames.

The details shown are typical of those employed by members of the Steel Door Institute, but all of the details are not made by all of the members of the Institute. A general reference to this document in your specifications should result in all of the members of the SDI and most of the non-members being able to bid on the job without a multitude of exceptions.

In order to make the installation successful, careful consideration shall be given to all tolerances involved and that sufficient clearance is figured to allow for them.

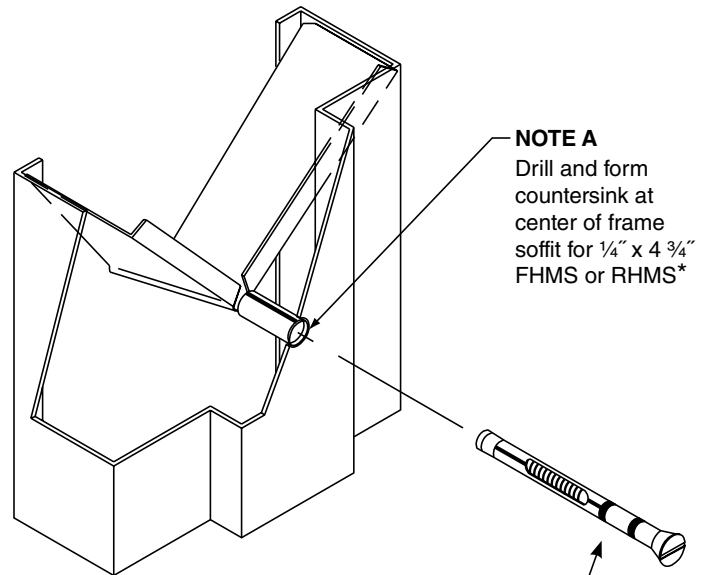
It has been "customary" to allow $\frac{1}{4}$ " clearance around the frame perimeter when establishing rough opening sizes or when figuring non-standard overall frame sizes. Although this dimensional requirement does not appear in Industry publications, it is based on the following:

- Both SDI 117-00 and ANSI/NAAMM HMMA 861-00 recognize a + tolerance in opening width and height.
- Both of these documents recognize a \pm tolerance in frame face dimensions.
- Both ANSI/NAAMM HMMA 861-00 and SDI 117-00 recognize a \pm installation tolerance for vertical plumb.

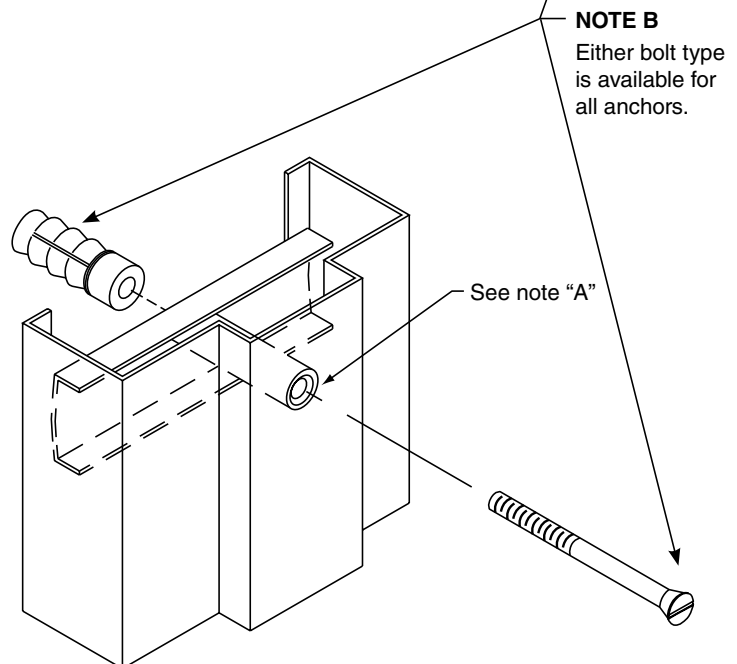
Frames will "fit and function" if made to these dimensional tolerances and installed within tolerances.

There is, however, relatively no assurance that the substrate (walls) will be of suitable size or alignment.

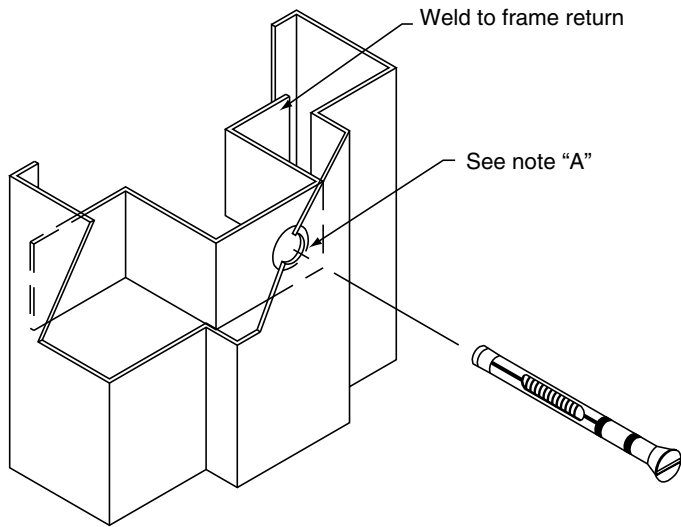
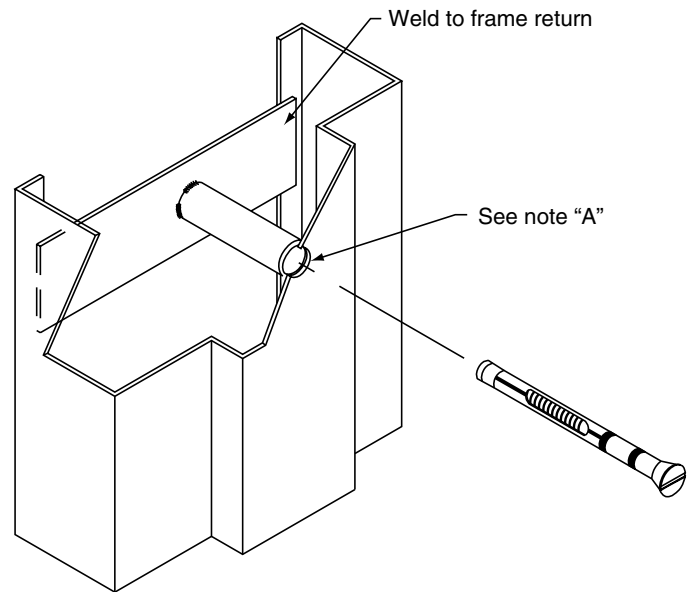
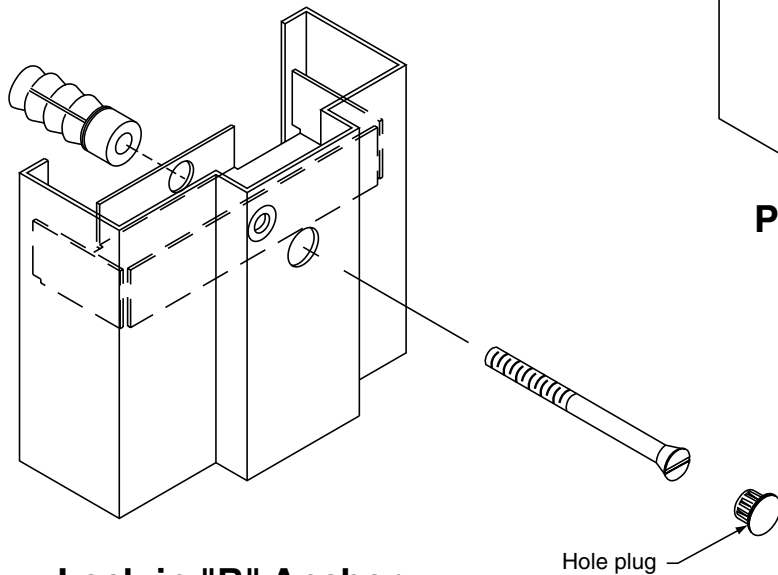
We therefore recommend that the rough openings for these cases be no less than $\frac{3}{16}$ " larger on all 3 sides than the "intended" overall frame size. (Example: 3070 standard frame = 3'-4 $\frac{3}{8}$ " x 7'-2 $\frac{3}{16}$ "). The installer carries the responsibility for shimming and aligning as necessary. Gaps are normally sealed as part of the installation or caulking/painting process. Architectural Specifications are to be consulted to determine the appropriate sealant material to be used at fire door or smoke control frames.



Adjustable Anchor



Lock-in "A" Anchor

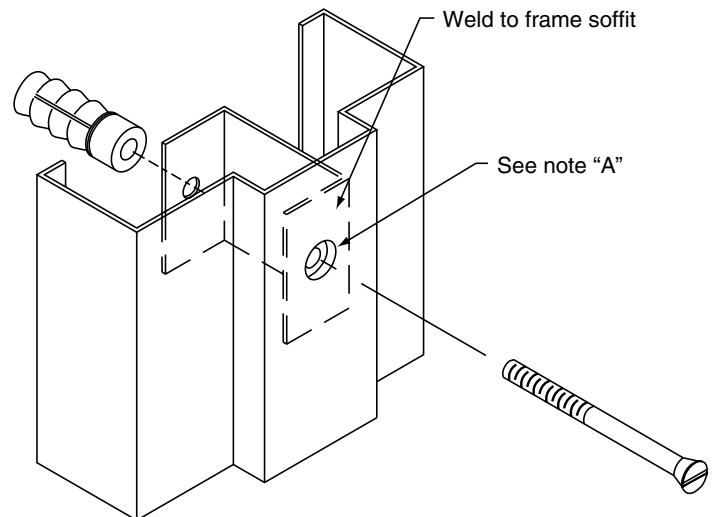
**Hat Anchor****Pipe Anchor****Lock-in "B" Anchor****NOTE C**

The head of the bolt may be filled in field with appropriate filler.

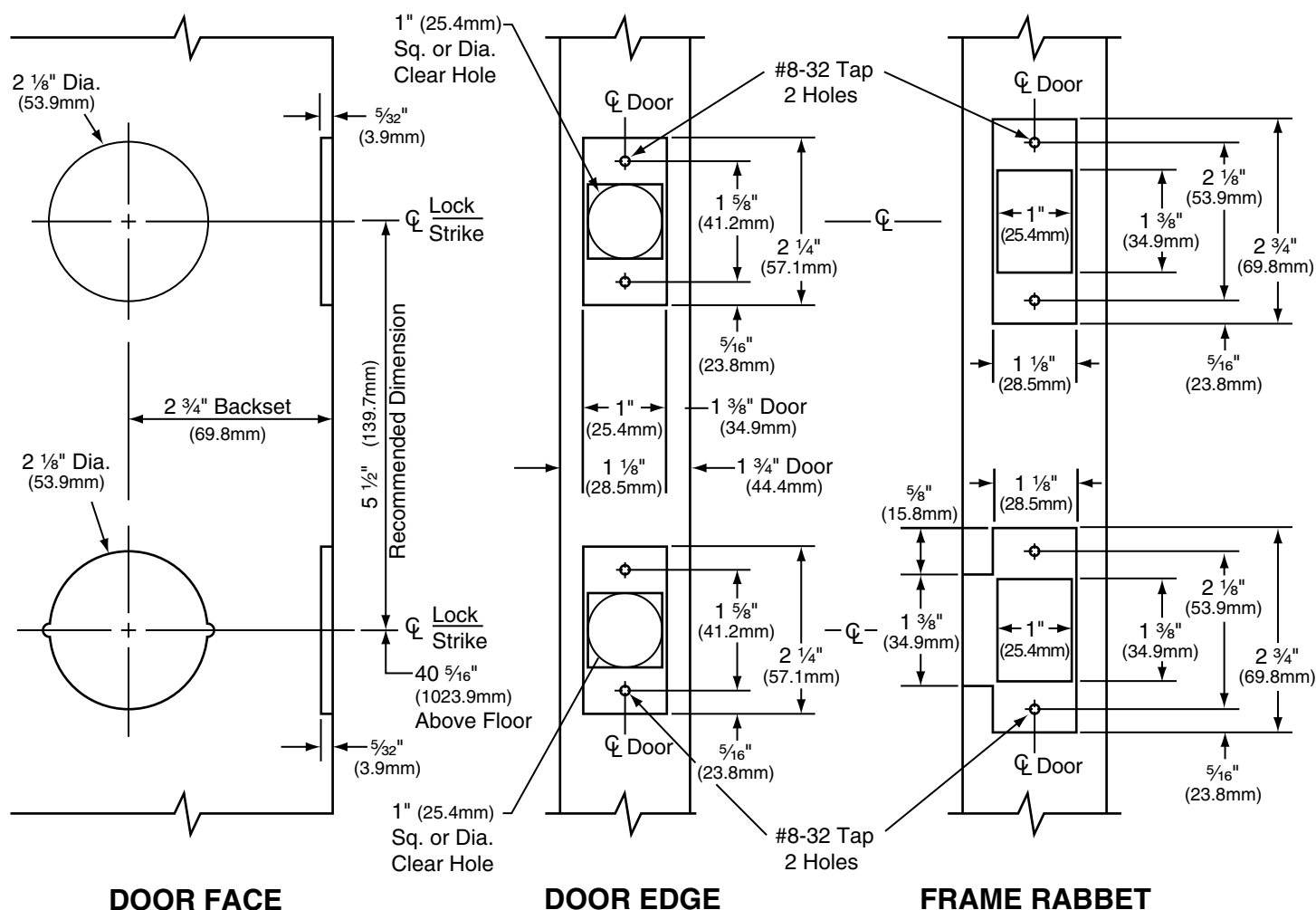
NOTE D

Up to 7'6" (2286 mm) height minimum four (4) anchor required per jamb

* Fire rated frames require $\frac{3}{8}$ " (9.5 mm) diameter bolts. Steel expansion shields must be used instead of lead shields.

**"C" Anchor**

Recommended Standard Preparation for Double Type (Interconnected) Locks on Standard Steel Doors and Frames



Note: Minimum size of cutout as noted is subject to manufacturer's standard clearance tolerances.



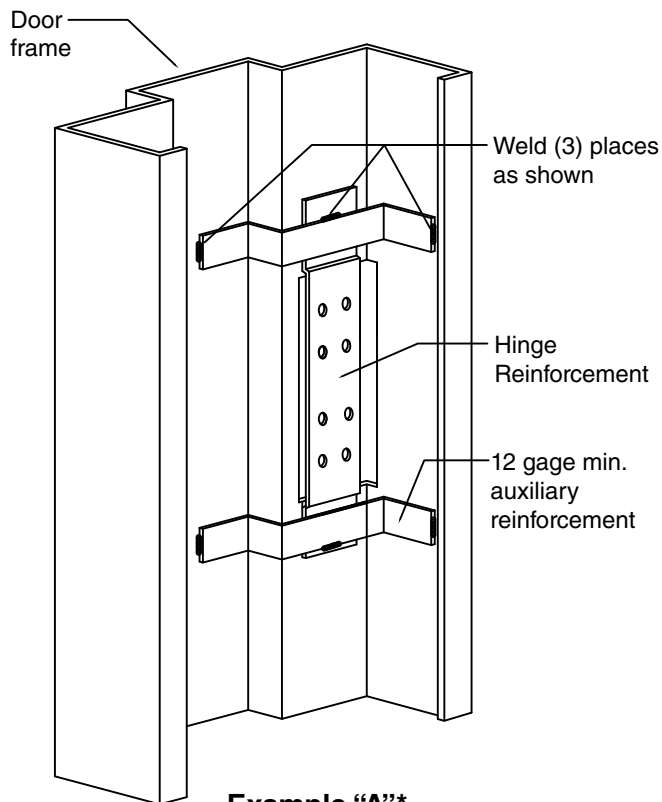
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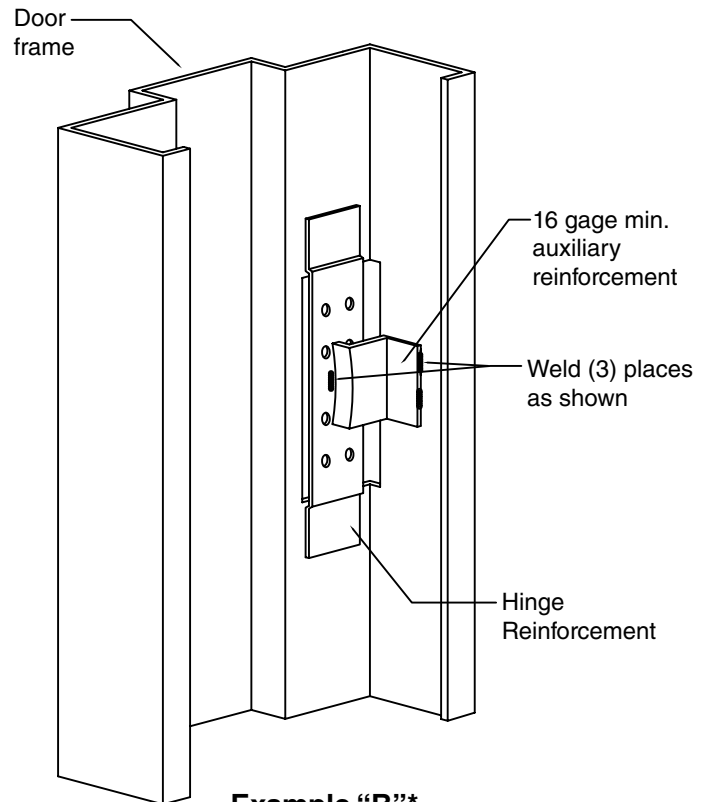
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High Frequency Hinge Preparations for Frames



Example "A"*



Example "B"*

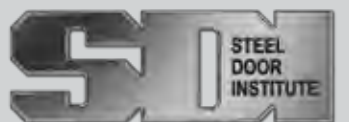
Background:

There are occasions where steel frames used in extremely high frequency or high use areas need to be supplied with additional reinforcing to eliminate potential door sag. These types of openings would include: main entrances to schools, rear exits where severe wind abuse could be a factor, auditoriums, gymnasiums, and the like. When these types of installations are required, there is a method in which this can be handled, efficiently and economically, through providing auxiliary reinforcing to standard door frames. The specification for this is as follows:

Specification:

When a high frequency preparation is required, the top hinge of the door frame shall be provided with an auxiliary reinforcing as shown in example 'A' or 'B.' For additional strength, the center and bottom hinge reinforcement may also be provided with additional reinforcements.

* High frequency hinge preparations may vary between manufacturers.



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AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

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

AUDIO-VISUAL PROGRAMS ALSO AVAILABLE

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Zinc-Coated (Galvanized/Galvannealed) Steel Doors and Frames



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Zinc-Coated (Galvanized/Galvannealed) Steel Doors and Frames

Purpose

It is the intent of this document to provide information regarding the zinc-coated sheet used in steel door and frame construction when a requirement for zinc-coated doors and frames is specified. It should be noted that doors and frames of cold rolled or hot rolled steel are normally protected with a satisfactorily applied coat of rust inhibiting paint, and that zinc-coated doors and frames need only be specified when they are to be exposed to corrosive atmospheric conditions.

Applicable standards

ASTM A 924/A 924M – Standard Specification for General Requirements For Steel Sheet, Metallic-Coated by the Hot-Dip Process.

ASTM A 653/A 653M – Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

Types of zinc coatings

Galvanized steel doors and frames are fabricated from carbon steel sheet that has been coated with zinc on two sides by the continuous hot-dip process. The process results in a layer of zinc on each side of the steel sheet that is tightly adhered to the steel sheet through the formation of an iron-zinc alloy bonding layer that is formed by a diffusion process while the heated steel strip is in contact with the molten zinc. The relatively pure zinc coating exhibits a bright metallic color with a pronounced “spangled” appearance. These coatings have a free zinc spangled surface and may be processed in a manner that reduces spangle and results in a smooth dull-gray appearance. This type of coating is referenced with a “G” designation (or “Z” in SI Units).

Galvannealed steel doors and frames are fabricated from carbon steel sheet that has been coated by the continuous hot-dip process and further treated to convert the zinc coating into a zinc-iron alloy. The zinc coated sheet receives an in-line heat treatment immediately as the strip exits the molten zinc bath to convert the entire coating layer to a zinc-iron alloy by diffusion of iron from the sheet into the zinc coating. The galvannealed surface has a non-spangled matte finish with a nominal composition of 90% zinc and 10% iron. This type of coating is referred to with an “A” designation (or “ZF” in SI Units).

The galvannealed coating has several advantages compared to the galvanized coating: 1) improved paint adhesion; 2) the coated surface accepts paint very readily without a pretreatment (a pretreatment will enhance the performance); 3) the zinc-iron alloy coating can be welded more easily; and 4) the coating is harder and more resistant to manufacturing processes.

Coating designations

Coating designations are written to represent the coating type, either G or A (Z or ZF in SI Units), and the coating weight. The coating weight is the amount of zinc on the steel surface and is expressed to represent the ounces per square foot of zinc as the total weight on both surfaces of the steel sheet.

Minimum coating weights

There are two coating weights used to specify zinc-coated steel doors and frames. In a coating weight of 40 there are 0.4 ounces of zinc per square foot of steel, and in 60 there are 0.6 ounces of zinc per square foot of steel.

Average coating thickness

The average coating thickness specified in table 1 is based on the conversion factor of one ounce of zinc coating per square foot of surface corresponding to an average coating thickness of 0.0017" (0.043 mm).

This coating thickness is not significant enough to make an appreciable difference in the measurable thickness of coated or uncoated steel of the same gage.

Refer to table 1 showing the coating designations, minimum coating weights, and average coating thickness.

Corrosion resistance is directly proportionate to coating weight. The heavier the coating weight the more zinc is present and the more corrosion protection it will provide. Therefore, under normal atmospheric conditions a 60 designation will provide 50% more corrosion protection than a 40 designation coating.

Painting

Painting zinc-coated steel is recommended. In the factory, steel is first chemically treated to ensure proper paint adhesion; then a factory applied coating of rust inhibiting primer is applied to the fabricated doors and frames. When additional priming is required, care must be taken to ensure compatibility with the factory-applied zinc surface.

NOTES:

- **Zinc-coating after fabrication is not available due to thermal distortion of the product.**
- **Although sometimes specified, the G Type zinc-coating designation is not recommended for door and frame construction.**

Table 1 – Coating designations, minimum coating weights, and average coating thickness

Type	Coating Designation		Coating Weight				Average Coating Thickness / Side	
			Minimum Check Limit Triple Spot Test		Minimum Check Limit Single Spot Test			
	in-lb	SI	oz/ft² *	g/m² *	oz/ft² *	g/m² *	inches	mm
Galvanized	G60	Z180	0.60	180	0.50	150	.0005	.013
	G40	Z120	0.40	120	0.30	90	.0003	.009
Galvannealed	A60	ZF180	0.60	180	0.50	150	.0005	.013
	A40	ZF120	0.40	120	0.30	90	.0003	.009

* NOTE: The weight of coating refers to the total coating on both surfaces.

AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

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**Standard Practice
for
Determining the
Steady-State Thermal
Transmittance
of
Steel Door
and Frame Assemblies**



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Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies

1 Purpose

- 1.1** The purpose of this practice is to establish a standard test specimen size, test conditions and a rating system for determining the thermal transmittance of operable steel door and frame assemblies.
- 1.2** This practice refers to the standardized thermal transmittance; U_{st} of an operable steel door and frame assembly installed vertically in the absence of solar and air leakage effects.
- 1.3** This practice employs the use of ASTM C1363-05, *Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus*, ASTM C1199-09e1, *Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods* and ASTM E1423-06 *Practice for Determining Steady State Thermal Transmittance of Fenestration Systems*.

2 Test Specimen

- 2.1** Single doors and pairs of doors shall be tested as nominal 3'0" (914mm) wide x 7'0" (2134mm) high and 6'0" (1828mm) wide x 7'0" (2134mm) high openings, respectively.
- 2.2** The test specimens shall consist of door, frame, weather-stripping system, glazing (if included) and hardware and be fully operable prior to the sealing of the assembly.

Note: ASTM E1423 requires sealing of the test specimen to prevent air leakage.

3 Experimental Procedure

- 3.1** The specimen shall be tested in accordance with ASTM C1199, C1363 and E1423.

4 Calculation

- 4.1** The standardized Thermal Transmittance (U_{st}) shall be calculated per the CTS method described in ASTM C1199.

5 Performance Ratings

Table 1

U-Value	< ½ Light	> ½ Light	Rating
> 0.46	>0.52	> 0.57	0
≤ 0.45	≤ 0.51	≤ 0.56	1
≤ 0.43	≤ 0.49	≤ 0.54	2
≤ 0.41	≤ 0.47	≤ 0.52	3
≤ 0.39	≤ 0.45	≤ 0.50	4
≤ 0.37	≤ 0.43	≤ 0.48	5
≤ 0.35	≤ 0.41	≤ 0.46	6
≤ 0.33	≤ 0.39	≤ 0.44	7
≤ 0.31	≤ 0.37	≤ 0.42	8
≤ 0.29	≤ 0.35	≤ 0.40	9
≤ 0.27	≤ 0.33	≤ 0.38	10

6 Report

- 6.1** The report shall contain the following information:
- 6.2** A detailed description of the test specimen components, i.e. Door, frame, hardware, glazing and weather-strip that includes model or series numbers.
- 6.3** If the test specimen is of a size other than that specified in Section 2.1, the reason for the deviation should be noted.
- 6.4** All of the information specified in Section 9 of test method ASTM C1199.
- 6.5** A statement affirming that the test was conducted in accordance with this standardized procedure.
- 6.6** A rating as defined in Table 1.



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Manufacturing Tolerances *for* **Standard Steel Doors** **and Frames**



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Manufacturing Tolerances for Standard Steel Doors and Frames

1 Introduction

It is the intent of this publication to provide users of standard steel doors and frames with definitive information regarding manufacturing tolerances. It is also intended to provide installation contractor(s) of the tolerances to be considered to assure proper operation of the complete opening. This document is intended for in-plant inspections. It may be used for on-site inspections where there is no evidence of damage to material or improper installation.

The information contained herein pertains to doors and frames manufactured in accordance with ANSI A250.8, *Recommended Specifications for Standard Steel Doors and Frames*. It is not intended to reference to special or unusual door and frame conditions.

2 Reference Documents:

ANSI/SDI A250.8 *SDI 100 Recommended Specifications for Standard Steel Doors & Frames*

ANSI/SDI A250.6 *Recommended Practice for Hardware Reinforcings on Standard Steel Doors and Frames*

ANSI/SDI A250.7 *Nomenclature for Standard Steel Doors & Steel Frames*

ANSI/SDI A250.3 *Test Procedure & Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors & Frames*

ANSI/SDI A250.10 *Test Procedure & Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors & Frames*

ANSI/SDI A250.11 *Recommended Erection Instructions for Steel Frames*

ANSI/BHMA A115 *Specifications for Steel Door and Frame Preparation for Hardware (A115.1 – A115.18)*

ASTM A568 *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*

ASTM A653 *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM A924 *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process*

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2007 Edition (National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269; www.nfpa.org)

SDI 122, *Installation and Troubleshooting Guide for Standard Steel Doors and Frames*

3 Notes

3.1 Tolerances

All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

3.2 Gauge vs. Thickness

While the term 'gauge' is no longer common for defining material thickness it is still used to specify doors and frames for ordering purposes. The term 'thickness' is used when defining the actual dimension of an item, and the term 'gauge' is used in the context of specifying a particular door or frame.

4 Materials and Finishes

4.1 Steel Thickness

Manufacturers no longer order sheet and coil to a specific gage, but rather to a minimum decimal thickness. This thickness is the lowest of the range for a specific gage. The steel supplier is therefore permitted to exceed, but not be less than the specified decimal thickness. These minimum values meet the stringent requirements of both Underwriters Laboratories Inc. and ITS/Warnock Hersey. Examples of minimum allowable steel thickness:

Gage (MSG)	Minimum
20	0.032"
18	0.042"
16	0.053"

Gage (MSG) are for reference purposes only.

Gage (MSG)	Minimum
14	0.067"
12	0.093"
10	0.123"
7	0.167"

Gage (MSG) are for reference purposes only.

4.2 Steel Coatings

Thickness of metallic coatings (generally zinc) are defined by ASTM A924, *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process* and A653, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*. The two most commonly used designations are A40 and A60. Minimum requirements for these designations are:

A40 = 0.40 oz/ft² total both sides.

A60 = 0.60 oz/ft² total both sides.

For reference, 1 oz/ft² = 1.7 mils thickness.

4.3 Factory Applied Coatings

Since factory applied coatings (primer, finish paint, etc.) are subject to performance standards rather than thickness, the dry film thickness is irrelevant. Such coatings must comply with performance criteria of:

ANSI/SDI A250.3 – *Test Procedure and Acceptance Criteria for Factory Applied Finished Painted Steel Surfaces for Steel Doors and Frames*

OR

ANSI/SDI A250.10 – *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*.

5 Frame Tolerances

5.1 Frame Cross Section Profile

Permissible tolerances in frame profile surfaces are as shown below:

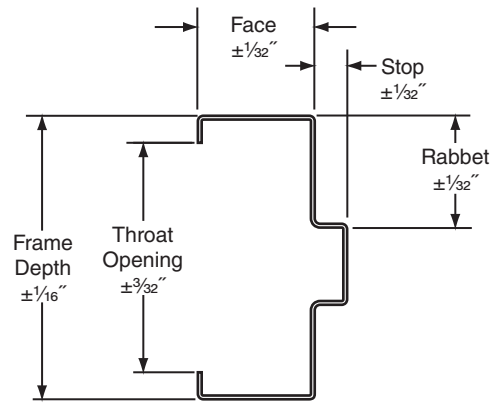


Figure A – Profile Tolerances

5.2 Frame Opening & Vertical Locations

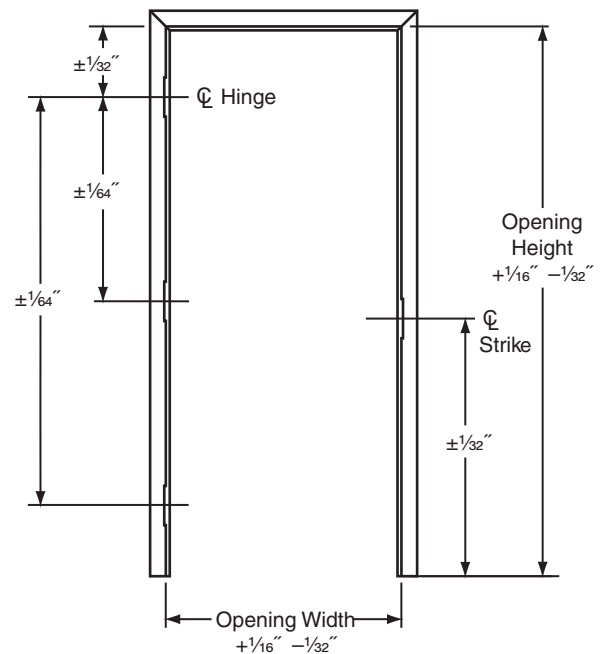


Figure B – Opening Tolerances

5.3 Bow or Twist of Jambs or Header

Realizing that frames are somewhat “pliable,” and require bracing and alignment during installation, allowable deformation (bow, twist, etc.) of jambs or header of frame **prior to installation** shall not result in a reduction of opening sizes more than 1/16" beyond those shown in Figure “B” when measured at any point.

5.4 Horizontal Alignment of Door Within Rabbet

Hinge and strike backsets shall allow the horizontal centerline of the door to be in line with the horizontal centerline of the frame rabbet $\pm \frac{1}{32}$ " **prior to installation**. Figure "C" is an example based on a $1 \frac{3}{4}$ " door in a $1 \frac{5}{16}$ " rabbet.

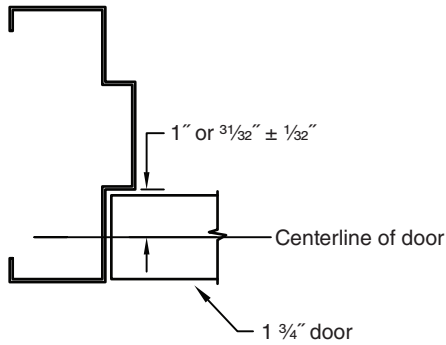


Figure C – Horizontal Alignment

5.5 Frames with Lights or Panels

Opening sizes (width or height) for side or transom lights or panels and for borrowed light frames shall be subject to a tolerance of $\pm \frac{1}{16}$ " for each individual light or panel. These tolerances shall be non-accumulative so that the overall frame opening sizes are not increased by more than $\frac{1}{8}$ ".

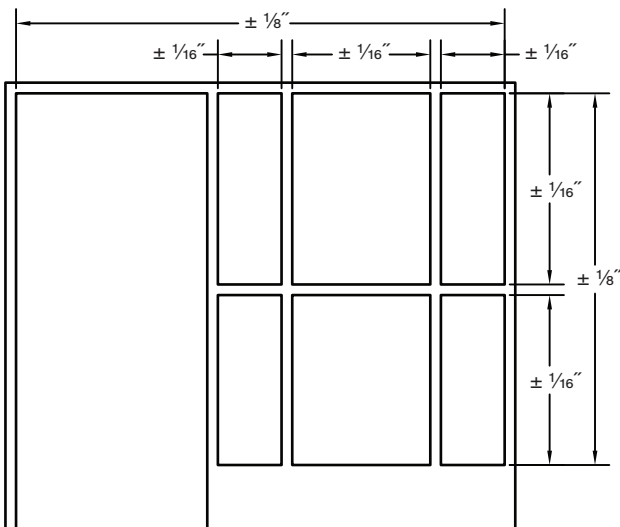


Figure D – Frames with Lights or Panels

6 Door Tolerances

6.1 Door Size, Thickness, and Vertical Locations

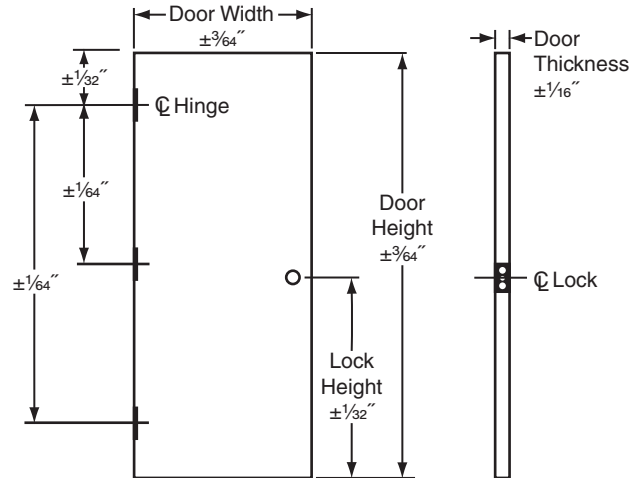


Figure E – Doors

6.2 Door Squareness

When measured diagonally from corner to corner along the same face, the measurements shall be within $\frac{1}{16}$ " of each other.

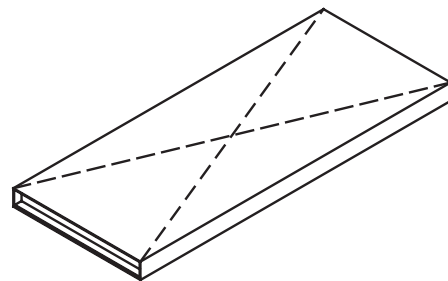


Figure F – Squareness

6.3 Door Perimeter Flatness

When a suitable straightedge is laid against the door face at or within $\frac{1}{4}$ " of the top, bottom, hinge edge, and lock edge on both faces any deviation between the face and the straightedge shall not allow a 0.0625" rod or block to pass.

Note: The straightedge shall be allowed to "rest" naturally on the door surface, not pulled down at one end to meet the door.

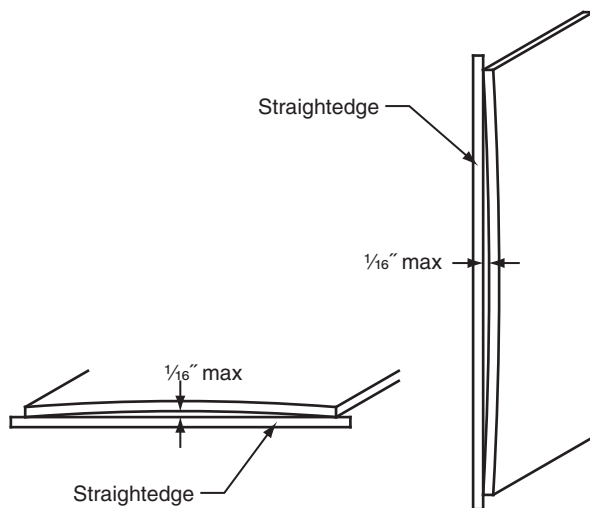


Figure G – Flatness

6.4 Door Face Bow or Crown

When a suitable straightedge is laid diagonally against the door face at least $\frac{1}{2}$ " from corners any deviation between the face and the straightedge shall not allow a 0.125" rod or block to pass.

Note: The straightedge shall be allowed to "rest" naturally on the door surface, not pulled down at one end to meet the door.

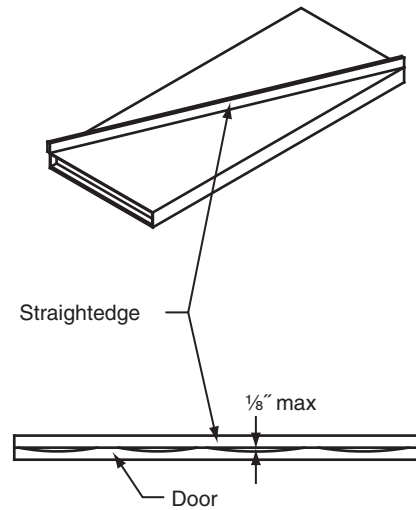


Figure H – Flatness

6.5 Door Twist

The door is laid onto a suitable, flat fixture or surface that is free of any warp, bow, or twist. Support blocks of identical heights shall be inserted between the fixture and the door face at all four corners of the door. Any deviation between the face and the support blocks shall not allow a 0.0625" rod or block to pass.

Note: The door shall be allowed to "rest" naturally on the support blocks, not pulled down at any corner to meet the blocks.

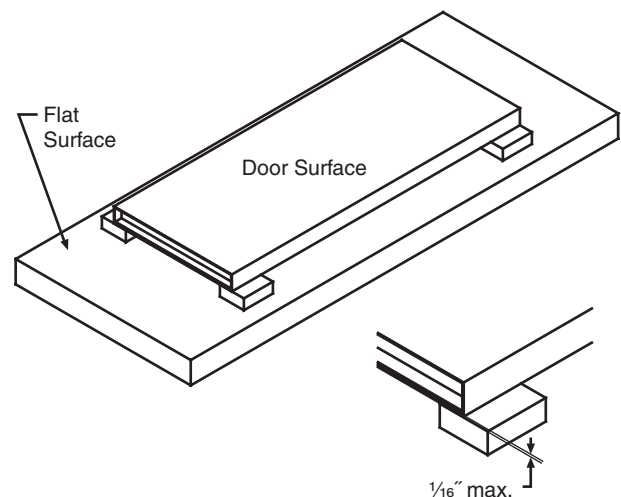


Figure I – Door Twist

6.6 Doors with Lights or Panels

Opening sizes (width or height) for lights or panels cut into doors shall be subject to a tolerance of $\pm 1/16"$ for each individual light or panel.

7 Hardware Preparations

7.1 Vertical Locations

Tolerances for vertical locations are as noted in Paragraphs 4.2 and 5.1.

7.2 Horizontal Alignment

Tolerances for horizontal alignment of door and rabbet are as noted in Paragraph 4.4.

7.3 Mortise Depth

The depth of hardware items mortised into edges of doors (such as hinges, strikes, lock fronts, flushbolts) shall be as defined on manufacturer's templates and/or ANSI A156.115 documents subject to an additional tolerance of $\pm 1/64"$.

7.3.1 Cutout Depth at Frame or Door Faces

In order to allow for field adjustment, usually accomplished by shimming, hardware cutouts (such as hinges) that extend from door edges around to faces or from frame rabbet around to faces are allowed to exceed mortise depth by $1/16"$. See Paragraph 7 for examples of common hinge shimming procedures.

7.3.2 Depth for Recessed or Concealed Hardware

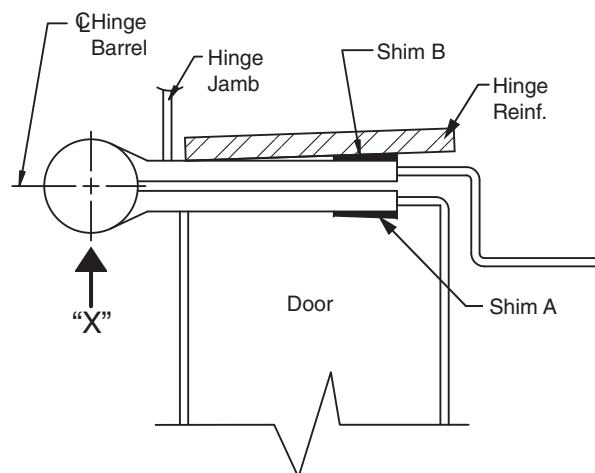
The depth for hardware items recessed into top or bottom of doors or edges of doors (such as pocket pivots, floor closers, top pivots, concealed closers or holders, etc) shall be as defined on manufacturer's templates subject to an additional tolerance of $+1/16" - 0"$. Notches in door faces shall have similar tolerances.

8 Frame Installation and Door Adjustments

8.1 Adjusting Pivot Point by Shimming

Providing extra depth along door or frame faces allows for hinge knuckles to be offset, thus changing the pivot point of the opening. Shims are usually thin strips of $1/4"$ wide material approximately equal to the hinge height.

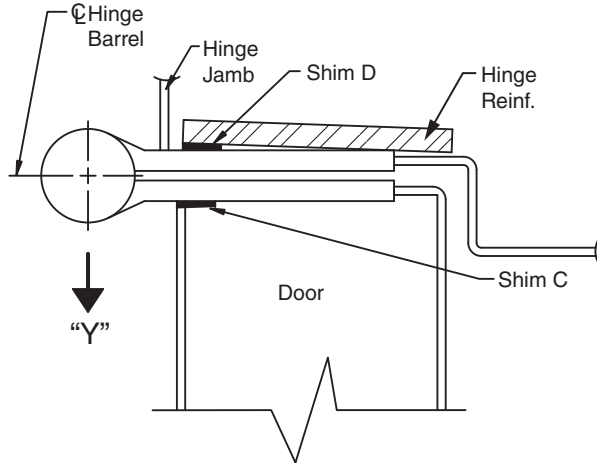
8.1.1 Figure "J" shows how to relocate the pivot point toward the jamb.



- Using shim "A" only, door will be relocated in the direction of arrow "X".
- Using shim "B" only, will move both door and centerline of hinge barrel in direction of Arrow "X".
- Using both shims "A" and "B" will relocate the door in direction of Arrow "E" by a greater amount than by using shim "B" alone.

Figure J – Hinge Bind, Shims A and B

8.1.2 Figure "K" shows how to relocate the pivot point away from the jamb.



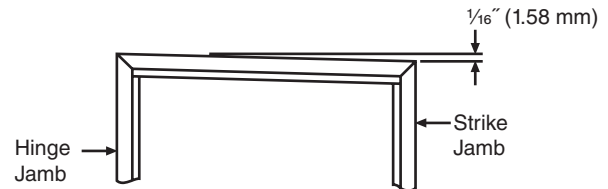
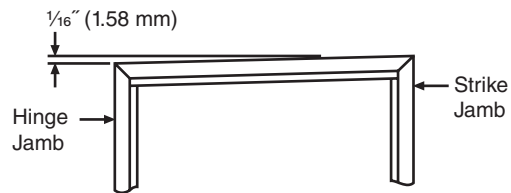
- Using shim "C" only, door will be relocated in direction of Arrow "Y".
- Using "D" only, both door and centerline of hinge barrel will move in the direction of Arrow "F".
- Using both shims "C" and "D" will relocate the door in direction of Arrow "F" by a greater amount than by using either "C" or "D" alone. The centerline of hinge barrel will be relocated the same as by using shim "D" alone.

Figure K – Hinge Bind, Shims C and D

8.2 Frame Installation Tolerances

While this document is mainly concerned with tolerances relating to the manufacturing process, openings will not function properly if the frame is not installed within recognized tolerances.

Figures "L-M-N-O" show examples of the accuracy to be maintained while setting frames. Instructions for installation may be found in ANSI A250.11.



Maximum 1/16" allowable tolerance on total opening.

Figure L – Squareness

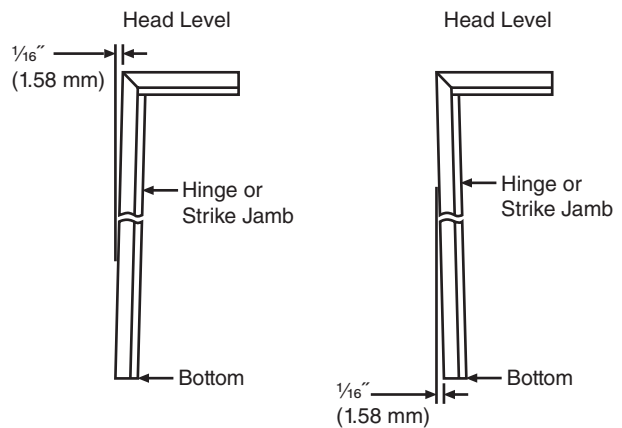


Figure M – Plumbness

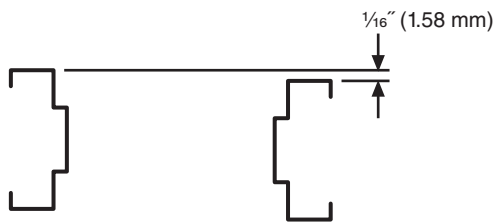


Figure N – Alignment

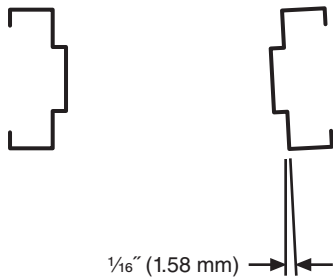


Figure O – Twist

8.3 Troubleshooting

Further information regarding corrective actions for door & frame openings may be found in SDI-122.

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**Basic Fire Door,
Fire Door Frame,
Transom/Sidelight Frame,
and Window Frame
Requirements**



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Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements

1 Introduction

Fire testing of doors, door frames, transom/sidelight frames, window frames, glazing, and hardware and the resulting labeling programs granted by third-party testing agencies are complex subjects better understood when basic rules and guidelines are applied. The following information is based upon the requirements of the IBC.

2 Doors

The fire rating classification of the wall into which the door is installed dictates the required fire rating of the door. The location of the wall in the building and prevailing building codes establish the fire rating requirements for the

wall. The associated door ratings are shown in Table 1 below.


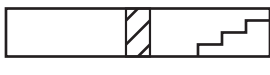

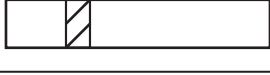
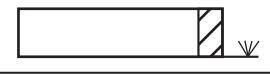
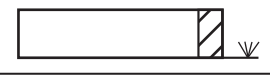
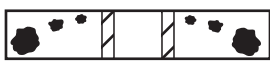
2.1 Hourly ratings

Steel fire doors are “rated” by time (in minutes or hours) that a door can withstand exposure to fire test conditions. Hourly ratings include 1-½-hours, 1-hour, ¾-hour, and ⅓-hour, with the maximum rating required of any swinging type fire door being three hours. All doors have been subjected to a hose stream test, unless otherwise noted.

2.2 Three-hour (180-minute) doors

A door with a three-hour fire protection rating is usually required in walls that separate buildings or that divide a large building into smaller fire areas. The wall rating is four hours.

Table 1 – Fire door openings

Opening	Wall Rating	Door and Frame Rating	Description and Use
	4 Hour	3 Hour (180 minutes)	These openings are in walls that separate buildings or divide a single building into designated fire areas.
	2 Hour	1-½ Hour (90 minute)	Openings of this type are used in enclosures of vertical communication or egress through buildings. Examples of these types of openings include stairwells and elevator shafts.
	1 Hour	1 Hour (60 minute)	These door and frame assemblies divide occupancies in a building.
	1 Hour	¾ Hour (45 minute)	For use where there are openings in corridors or room partitions.
	2 Hour	1-½ Hour (90 minute)	This opening is in a wall where there is the potential for severe fire exposure from the exterior of the building.
	1 Hour	¾ Hour (45 minute)	This opening is in an exterior wall that has the potential to be exposed to moderate to light fire from the exterior of the building.
	1 Hour	⅓ Hour (20 minute)	These openings are in corridors where smoke and draft control is required. The minimum wall rating is ½ hour.

2.3 1-½-hour (90-minute) doors

Doors rated for 1-½ hours are required in 2-hour rated walls. These doors are commonly located in stairwells, or other enclosures of vertical passage through a building. They also occur in boiler rooms and in exterior walls that have the potential for severe fire exposure from the outside of the building.

2.4 One-hour (60 minute) doors

One-hour rated doors are used in occupancy separation walls, which are also one-hour rated.

2.5 ¾-hour (45 minute) doors

Doors with ¾-hour fire protection ratings are used in one-hour walls. A ¾-hour rated door is required in walls of corridors and room partitions. A door with this rating may also be located in the exterior wall of a building subject to moderate fire exposure from the outside of the building.

2.6 ⅓-hour (20 minute) doors

One-third-hour or 20 minute doors are used in one-hour walls. These doors are used for corridor applications and in other applications where smoke and draft control is a primary concern.

2.7 Doors tested without hose stream

Doors may be rated as 20 minutes without a hose stream. These doors have successfully passed a 20-minute fire test, with the omission of the hose stream test, and bear a label that specifically states “Twenty-Minute-Rating Tested Without Hose Stream.” These doors may be provided with vision lights only limited in size by the door manufacturer’s fire labeling procedure authority.

Assemblies identified as “Twenty-Minute-Rating Tested Without Hose Stream” should not be confused with ⅓-hour fire rated doors, which have been tested in accordance with the standard fire test procedure that includes the hose stream test.

2.8 Summary

Doors are rated for three-fourths of the rating of the surrounding wall: A 3-hour door is used in a 4-hour rated wall; a 1-½-hour fire door is used in a 2-hour rated wall; and a ¾-hour door is used in a one-hour rated wall. The notable exception is that ⅓-hour rated doors are also used with one-hour rated walls.

However, a door with a higher fire rating than the opening requires may also be specified. For example, a door rated for 3 hours may be used in a 1-½-hour opening. All requirements for the 3-hour rating, such as maximum glazing materials size, door size, and other restrictions for the higher rated door must be met.

3 Glazing Materials

A wide variety of glazing materials and glazing compounds are available for use in fire doors and frames. Wired glass that is ¼" thick and ceramic glass are the most common types of glazing used in fire rated doors. The hourly rating of the door dictates the number and maximum size of the vision lights used in the door.

For ¼" thick wired glass, the maximum exposed area for a transom light shall not exceed 1296 square inches with no dimension of exposed wired glass greater than 54" in width or 48" in height, unless otherwise indicated in the individual glazing manufacturer’s published listings. Wired glass, ¼" thick is rated for ¾-hour for an exposed area not exceeding 1296 square inches.

For glazing materials other than ¼" thick wired glass and for ¼" thick wired glass in sizes larger than those described above, the maximum exposed area per individual light, the minimum groove depth, glazing compound and the rating shall be as indicated in the individual glazing manufacturer’s published listings. Consult with the door and glazing manufacturers for the limitations of size, area and number of vision lights in a door. The approved listings for fire door, transom/sidelight frame, window frame, and glazing manufacturers may be obtained through the listing agencies as follows:

Underwriters Laboratories

Use the following hyperlink to access the Underwriters Laboratories “Online Certifications Directory”. Enter the “UL Category Code” indicated below for a listing of approved manufacturers.

<http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm> (link valid as of 6/1/2017)

Fire Door Manufacturers – GSYX or GSZN

Fire Door and Window Frame Manufacturers – GVTV

Glazing Manufacturers – KCMZ or CCET

Intertek Testing Services (Warnock Hersey)

Use the following link to access the Intertek “Listed Product Directories.” Enter keywords such as glass, glazing, fire door, fire door frame, fire window, or transom frame for a list of approved manufacturers.

https://bpdirectory.intertek.com/Pages/DLP_Search.aspx (link valid as of 6/1/2017)

Vision lights are not allowed in 3-hour rated fire doors, unless allowed by the local authority having jurisdiction. The vision light kit or window frame must be approved for use in a fire rated door.

Two categories of glazing used in doors, door frames, transom/sidelight frames, and borrowed light frames are available as follows:

Fire-Protection-Rated Glazing – This glazing is evaluated for fire protection ratings measured in minutes or hours in doors in accordance with UL 10c and NFPA 252 and frames in accordance with UL 9 and NFPA 257.

Fire-Resistance-Rated Glazing – Fire-resistance-rated glazing is designed to limit the temperature rise on the unexposed surface in accordance with UL 263 and ASTM E119. Performance is rated in terms of temperature rise on the unexposed face at increments of time (minutes or hours). This glazing may be used in Temperature Rise Doors which are explained in the next section.

Fire protection and fire resistance glazing installed in fire doors and fire windows that are subject to human impact shall meet applicable impact safety standards (e.g. – 16 CFR 1201, U.S. Consumer Product Safety Commission, “Standard for Architectural Glazing”).

4 Temperature rise doors

In certain applications, fire doors are required to minimize the transmission of heat from one side of the door to the other, as in the stairwell of a high-rise building or in horizontal exits. If the door can limit the transmission of heat for a period of time, people can safely pass below the floor of fire origin in a burning building. These doors are built with a core that is specifically

designed to restrict the transmission of heat and are referred to as temperature rise doors.

In addition to the hourly rating, the fire door label will also state the temperature rise rating of the door. Temperature rise ratings are 250°F, 450°F, and 650°F, and indicate the maximum rise in temperature above ambient temperature measured on the unexposed surface (non-fire side) of the door during the first 30 minutes of the standard fire test. The 250°F temperature rise designation is the most stringent rating of the three, since it requires the most limiting rise in temperature. A 250°F temperature rise door meets the requirements of specifications calling for a 450°F or 650°F temperature rise rating.

5 Louvers

Listed louvers are permitted in 1-½-hour and ¾-hour fire doors and the louver must be installed in accordance with the manufacturer’s listing. Louvers may not be used in ⅓-hour (20-minute) rated doors, or doors of other hourly ratings that may be part of a smoke and draft assembly. Doors with glass lights, or doors equipped with fire exit devices may not have louvers unless permitted by local building codes.

6 Fire door frames

Where a frame bears a recognized label qualifying it as a fire door frame without an indicated rating, it may support a 3-hour, a 1-½-hour, 1-hour, a ¾-hour, ⅓-hour, or a 20 minute door. Some state and local building codes may require hourly ratings to be indicated on the certification label. Frames used in masonry walls may be used with a maximum 3-hour fire door, while frames used in drywall stud walls are intended to be used with a maximum 1-½-hour fire door. Consult with individual fire door frame manufacturers listings for fire door frames that can be used in drywall stud walls with a maximum 3-hour rating. Unless otherwise stated in the manufacturer’s certification, grout or any other filler material is not required for fire rated frames installed in either drywall or masonry walls at any hourly rating.

7 Transom and sidelight assemblies

Labeled door frames are available with transom areas, sidelight areas, or a combination of both. The transom and sidelight areas can be assembled with listed panel assemblies or

listed glazing material. Frames with solid transom panel and/or side panels may be used in openings rated up to and including 3 hours. Transom and sidelight frames with labeled glazing material may be used in openings rated up to 1-½ hours. The maximum hourly rating, overall frame size, panel construction, and individual glazing material exposed areas for frame and glazing manufacturers may be obtained through the listing agencies as indicated in Section 3.

The overall size of transom and sidelight frames is limited to the maximum size that a manufacturer has successfully fire tested. Since the size may vary, it is important to consult the manufacturer when writing specifications.

Some testing agencies require that the label applied to transom or sidelight assemblies shall state whether panels or glazing materials are to be used in the frame. If the frame contains both panels and glazing materials, the label for the glazing materials is used since it is the most limiting rating.

8 Fire window frames (borrowed light)

Fire window frames are labeled hollow metal glass light frames that are not attached to a door frame and are tested in accordance with NFPA 257 or UL 9 and shall be provided in accordance with the manufacturer's listing. Individual glazing material exposed areas are not to exceed 1296 square inches and the dimension for width or height shall not exceed 54 inches unless otherwise tested. The maximum hourly rating, overall window size, and individual glazing material exposed areas for frame and glazing manufacturers may be obtained through the listing agencies as indicated in Section 3. Fire window frames are typically used in corridor walls and may be provided for masonry or drywall construction. Consult the frame manufacturer as to the ability to supply fire window frames for drywall walls. Unless otherwise stated in the manufacturer's certification, grout or any other filler material is not required for fire rated frames installed in either drywall or masonry walls at any hourly rating.

9 Fire doors with Builders Hardware

Fire doors with Builder's Hardware serve four main purposes:

1) To function as a door at all times; 2) to provide ready egress; 3) to keep fire from spreading throughout the building; and 4) to protect life and property.

To adequately perform these functions, a fire door must be equipped with labeled hardware for dependable operation. Proper hardware selections can be verified by consulting the current editions of the "Fire Resistance Directory" published by Underwriters Laboratories Inc. and "Directory of Listed Products" published by Intertek Testing. These directories identify hardware and other products that may be used in fire-rated assemblies. The information can also be accessed at the following links:

Underwriters Laboratories

<http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm> (link valid as of 6/1/2017)

Use UL Category Codes GXHX or GYJT.

Intertek Testing Services (Warnock Hersey)

https://bpdirectory.intertek.com/Pages/DLP_Search.aspx (link valid as of 6/1/2017)

NFPA 80 provides guidance for installing fire doors, frames, and hardware in the building openings.

9.1 Hinges

A labeled fire door must be hung on steel ball-bearing-type or listed hinges. NFPA 80 allows the use of steel hinges with steel ball-bearings without a listing. Steel hinges that meet the criteria of NFPA 80 have been proven to be adequate during a fire. There are certain hinge designs made of non-ferrous metals which may be used on fire doors in accordance with the listing information for the particular hinge but may result in a lower fire rating.

Hinges with ball bearings are required in order to provide smooth operation and to minimize wear throughout the lifetime of the opening. Remember, a fire door must close in the event of a fire. Worn hinges will cause the door to sag, effectively preventing the door from closing. Exception: Some manufacturers may provide doors with hinges that use other antifriction bearing surfaces if they meet the requirements of ANSI/BHMA A156.1.

NFPA 80 allows the use of standard weight (0.134 inch leaf thickness) 4-½" steel hinges

as a minimum on 1- $\frac{3}{4}$ " doors up to 4'-0" in width and 8'-0" in height. Doors over 8'-0" in height shall have heavy weight (.180 inch leaf thickness) 4- $\frac{1}{2}$ " hinges as a minimum. Some manufacturers have the capability of providing lighter weight hinges on doors over 8'-0" in height as part of a listed assembly. (Consideration should be given to larger hinge sizes for frequently used or heavy doors.)

9.2 Latching devices

Every swinging fire door must have a labeled self-latching device. Dead bolts may be provided in addition to the latch bolt, except on doors in a means of egress, in which case interconnected locks may be used which retract the dead bolt with the latch bolt. Dead bolts may not be used in place of latch bolts.

When selecting latching devices, it is important to use the correct length of latch bolt, a requirement that can vary with the door construction and the manufacturer's fire testing program. It is common for a pair of doors to require a longer latch bolt throw than a single door. The minimum latch bolt length that must be used for any given door is indicated on the fire door label.

An exception to latching for fire rated openings is allowed by the IBC for double egress doors in corridors that are in a smoke barrier. The omission of positive latching devices must be included in the door manufacturer's listing. State and local building code authorities may also allow latching to be omitted in certain openings. Consult individual manufacturers for labeling capabilities.

9.3 Fire exit hardware

Fire exit hardware devices may be used on labeled doors provided the door labeling specifically states "Fire Door To Be Equipped With Fire Exit Hardware." This label indicates that the door has been properly reinforced for fire exit devices. Fire exit hardware used on doors that bear this label must pass a panic loading test in accordance with UL 305 and ANSI/BHMA A156.3 in addition to the standard fire test. The panic load test measures the structural capability of the door to allow the hardware to operate in a panic situation.

Care must be taken when selecting exit devices for use on fire-rated doors, as some devices

have been tested for panic loading only, and not fire tested. In addition, exit devices have size and hourly rating restrictions, and must be properly labeled and identified as fire exit hardware.

9.4 Closing devices

A properly sized closing device is the last of the "basic" fire door hardware requirements. A fire door must be in a closed and latched position to serve as a protective barrier in the event of a fire. For this reason, either listed spring hinges or a listed door closer is required to ensure that the door will close properly.

Note: Per NFPA 80, the authority having jurisdiction may allow the closer to be omitted from the inactive leaf of a pair of doors for equipment rooms to allow the movement of equipment.

9.5 Hold open devices

Tests and investigations have proven that smoke and toxic gases are the main cause of death in fires. Listed closers with closer arms that are equipped with a fusible link or a listed combination closer/holder shall be used. Mechanical hold-open only devices and hold-open only arms are not permitted on self-closing doors. Doors with surface closers equipped with a listed hold open device (e.g. electromagnetic release) also prevent the passage of the toxic gases and smoke. These devices are activated by electronic detectors that sense smoke and/or the products of combustion.

10 Hardware – pairs of doors

Pairs of doors for rated openings have some unique hardware requirements.

10.1 Hinges and closing devices

Pairs of doors for labeled openings require steel, ball-bearing-type hinges or a listed continuous hinge. Closing devices are required on both leaves of a pair of doors except on mechanical equipment rooms where the closing device may be omitted from the inactive leaf, if acceptable with the authority having jurisdiction.

10.2 Latching hardware

10.2.1 Active leaf of pairs of doors

An active leaf of a pair of doors may require labeled fire-exit hardware, or any labeled latch that shall be opened by one obvious operation from the egress side.

10.2.2 Inactive leaf of pairs of doors

Local codes may allow manual flush or surface mounted bolts to be used to secure the inactive leaf of pairs of doors being used as entrances to equipment rooms or similar situations. The IBC requires that the inactive leaf have no knob or other visible hardware that implies means of egress.

Labeled fire exit devices are mandatory for exits unless local authorities give specific approval for the use of labeled self-unlatching and latching devices, such as automatic flush bolts on the inactive leaf. The self-unlatching feature must work only when the active leaf is opened.

10.3 Double egress pairs

Double egress pairs of doors should only be provided with vertical rod fire-exit hardware devices on both leaves. The vertical rod devices may be either surface mounted or concealed.

10.4 Astragals

The application of astragals on pairs of doors depend upon the individual door manufacturer's published listings. Pairs of doors that do require an astragal shall have at least one that projects a minimum of $\frac{3}{4}$ -inch beyond the edge of the door to which the astragal is attached. Pairs of doors that are in a required means of egress may not be equipped with an astragal that inhibits the free use of either leaf. An overlapping astragal may not be used on pairs of doors swinging in the same direction with vertical rod exit devices on both leaves of the pair.

In some situations a coordinator may be needed to allow the inactive leaf to close before the active leaf. This ensures proper latching of pairs of doors. Some manufacturers are able to supply labeled pairs of doors with an open-back strike without an astragal, which eliminates the need for a coordinator.

11 Product labeling

There are several materials and attachment methods for fire labels that are approved by recognized labeling agencies. These include steel, brass, aluminum, and non-metallic materials such as foil and mylar. Metal labels are attached with welds, rivets, drive screws, or adhesive. Non-metallic labels are either die-slit or tamper proof with an adhesive back. Once

applied, if any attempt is made to remove the label it will tear apart indicating tampering. Embossed metal labels and embossments directly applied to doors and frames may be painted as long as the listing agency mark and all listing information is legible.

The mark of a labeling agency shall be provided on all labels applied to fire-rated doors and frames. The agency mark or manufacturer isn't required to be the same on the door, frame, and hardware. Labels are located on the edge of a door between the top and middle hinges. Labels are located on the frame rabbet between the top and middle hinges. Labels may be located on the top of the door or head of the frame if there is interference with hardware (e.g. electric power transfer, continuous hinge, smoke seals) that would obscure the label.

Fire labels on doors and frames are not intended to survive a fire. The label is there to indicate that the opening is protected by a properly constructed steel door and frame.

12 Fire test methods

There are two primary fire test methods that are used to establish the fire ratings of doors. The first is ANSI/UL 10B and is referred to as neutral pressure; the second is ANSI/UL 10C, and is referred to as positive pressure.

The difference between the two test methods concerns the location of a neutral pressure plane in the test furnace. In the late 1990's, the test method required in building codes changed to a positive pressure test method. This change was adopted by the International Building Code (IBC) for swinging-type fire doors.

Fire doors required to be tested to either method may be specified by calling out the test method or by indicating that the product must meet a specific section of a model building code.

13 Smoke and draft control

Doors that open into corridors that are used for a means of egress may be required to have a smoke and draft control rating. Smoke and draft control assemblies are tested for air leakage per UL 1784 and NFPA 105 and fire protection ratings as previously discussed.

13.1 Gaskets

Gaskets are required for doors to pass a smoke and draft control test. The requirement for a gasket also includes the meeting edges of a pair of doors. The gaskets used in a smoke and draft control assembly must be fire rated and be listed for use in a smoke and draft control assembly. A bottom seal is not required for smoke and draft control assemblies.

13.2 Marking

The IBC requires smoke and draft control assemblies to have an identification mark of “S” which appears on the door label following the hourly rating. The frame doesn’t require the “S” mark.

14 Smoke barrier doors

The IBC includes a requirement for smoke barrier doors. These doors need to provide smoke and fire protection as previously described in this document. The IBC includes an exception for double egress doors that require that these doors have the same characteristics of a fire door except a fire protection rating and self latching are not required. Double egress doors used in a smoke barrier are used in cross corridor applications.

15 Field modifications

Clarifications for field modifications were added to NFPA 80 in 2007. If the product or component requires a field modification, the agency that the product or component was listed with shall be provided with the description of the modification. The agency will not have to conduct a field inspection if they determine that the modification does not affect the integrity and fire protection capabilities of the opening.

16 Fire door inspections

NFPA 80 incorporated a requirement for annual fire door inspections in the 2007 version of the standard. Building owners are required to inspect all components of the opening and document the results. Adjustments and component replacement are required if the opening does not comply with the code requirements.

17 References

ANSI/BHMA A156.1-2016 *Butts and Hinges*

ANSI/BHMA A156.3-2014 *American National Standard for Exit Devices*

ASTM E119-18ce1 *Standard Test Methods for Fire Tests of Building Construction and Materials*

NFPA 80-2019 *Standard for Fire Doors and Other Opening Protectives*

NFPA 105-2019, *Standard for Smoke Door Assemblies and Other Opening Protectives*

NFPA 252-2017 *Standard Methods of Fire Tests of Door Assemblies*

NFPA 257-2017 *Standard Methods of Fire Tests of Window and Glass Block Assemblies*

Underwriters Laboratories Standard for Safety ANSI/UL 9 *Standard for Fire Tests of Window Assemblies*, 8th Edition, July 2, 2009, revisions up to and including February 13, 2015

Underwriters Laboratories Standard for Safety ANSI/UL 10B *Standard for Fire Tests of Door Assemblies*, 10th Edition, February 7, 2008, revisions up to and including February 16, 2015

Underwriters Laboratories Standard for Safety ANSI/UL 10C *Standard for Positive Pressure Fire Tests of Door Assemblies*, 3rd Edition, June 9, 2016

Underwriters Laboratories Standard for Safety ANSI/UL 263, *Fire Tests of Building Construction and Materials*, 14th Edition, June 21, 2011, revisions up to and including March 2, 2018

Underwriters Laboratories Standard for Safety ANSI/UL 305, *Standard for Panic Hardware*, 6th Edition, July 12, 2012, revisions up to and including March 22, 2017

Underwriters Laboratories Standard for Safety ANSI/UL 1784, *Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives*, 4th Edition, February 17, 2015

International Building Code, 2015

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AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

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Installation Troubleshooting Guide for Standard Steel Doors and Frames



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FOREWORD

The material contained in this document has been developed under the auspices of the Technical Committee of the Steel Door Institute.

The Steel Door Institute does not condone or encourage repair methods which would adversely affect product performance or violate and/or void product warranties.

The user of this document assumes all responsibility associated with but not limited to product performance and violation of product warranties for any product associated with the installation and suggested repair methods in this document.

PURPOSE

The intent of this document is to cover field installation problems most commonly experienced with standard steel door and frame installations. It should be understood that most problems encountered are because of inappropriate application of the products and/or improper installation.

The suggested method of repairs requires only basic hand tools and relatively little time. It should be understood that more complex problems or compound problems could exist which warrant extensive field repairs and modification to products. These types of field installation problems are not intended to be covered in this document and should not be made without first consulting the manufacturer.

Modifications made to fire-rated-labeled doors and frames shall be made in compliance with NFPA 80.

SDI-122

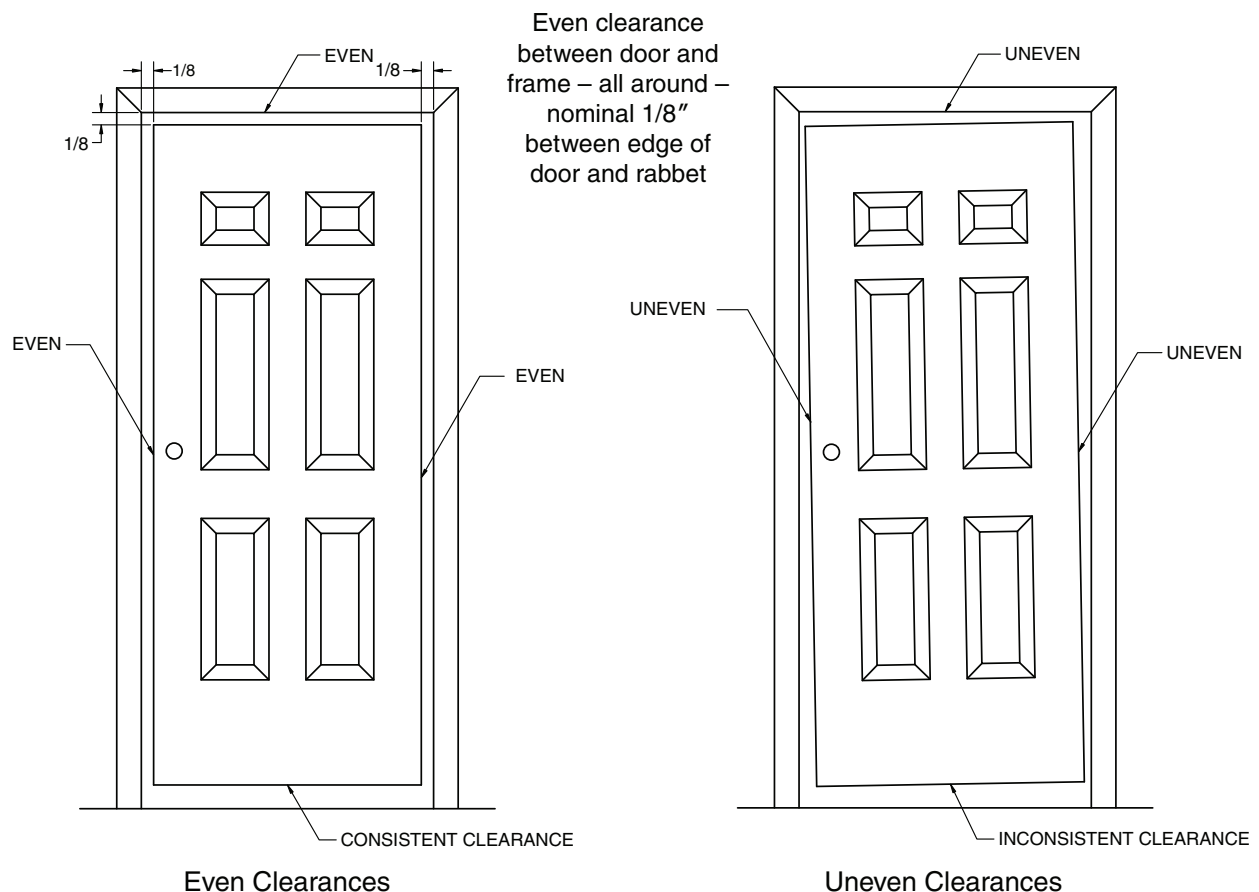
Installation Troubleshooting Guide for Standard Steel Doors and Frames

IMPROPER DOOR / FRAME CLEARANCE

To ensure proper door and frame function, the clearance between the door and frame must be properly maintained. All standard steel door and frame manufacturers closely hold tolerances that result in a nominal clearance between the door and frame of 1/8 inch. If this clearance is not maintained, interference and hardware misalignment may occur.

Proper installation is extremely important in establishing clearances and preventing a multitude of potential problems.

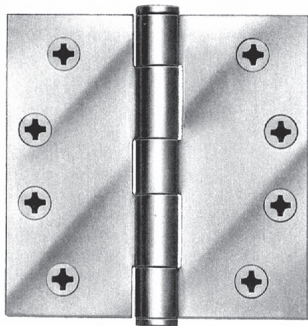
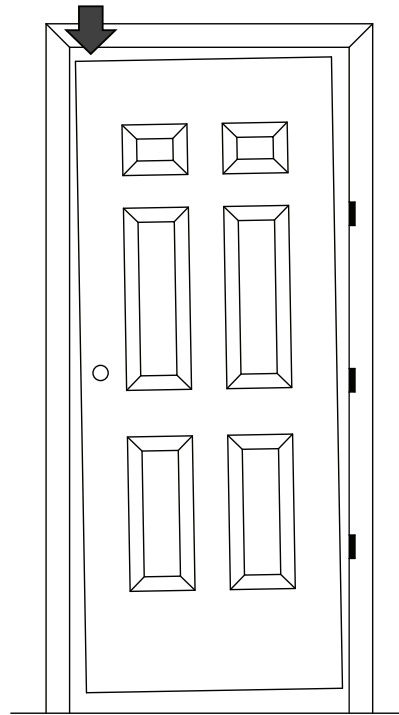
The Steel Door Institute has many publications which were developed to establish industry standards and assist in specifying as well as installing standard steel doors and frames. One publication, ANSI/SDI 250.11, *Recommended Erection Instructions for Steel Frames*, will be of assistance regarding the erection and installation of standard steel frames.



IMPROPER DOOR / FRAME CLEARANCE *(continued)*

Is door sagging?

Uneven clearances frequently result from improper installation of frames and frame anchors. The condition, characterized by lock edge clearances narrow at the top and wide at the bottom, is called "door sag". The following suggested adjustments may correct the condition



Are hinges loose?

If hinge screw does not remain tight, the screw can be held in place by the use of a "locktite" type product which prevents the screw from loosening. Additionally, "Nyloc" type fasteners can be used to replace the normal machine screws.

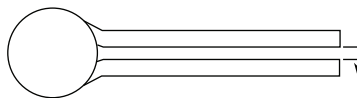
Are hinges worn?

If excessive wear has occurred on hinge knuckles, the door will not be held tightly. Replace hinges.

Are hinges properly swaged?

The hinge manufacturer's specifications should be checked to determine what the proper hinge swage should be.

Swaging is a slight offset of the hinge leaf at the barrel which permits the leaves to come together.

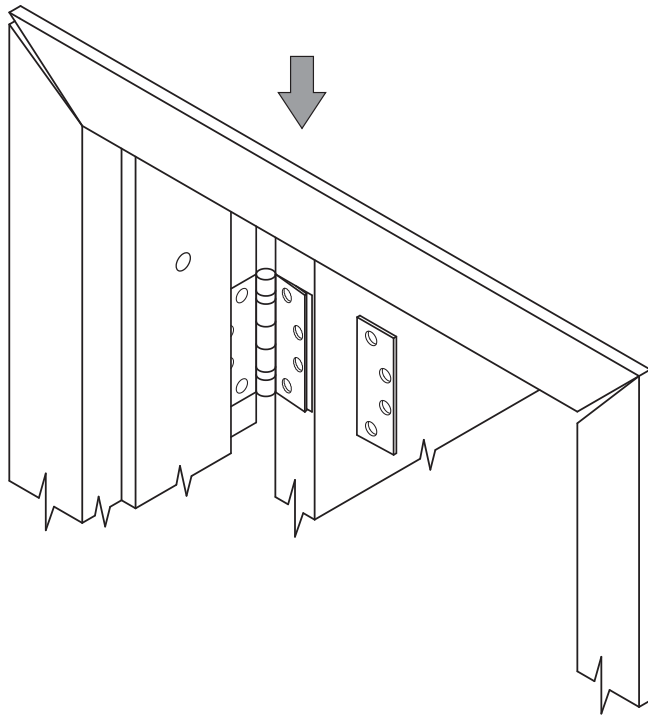
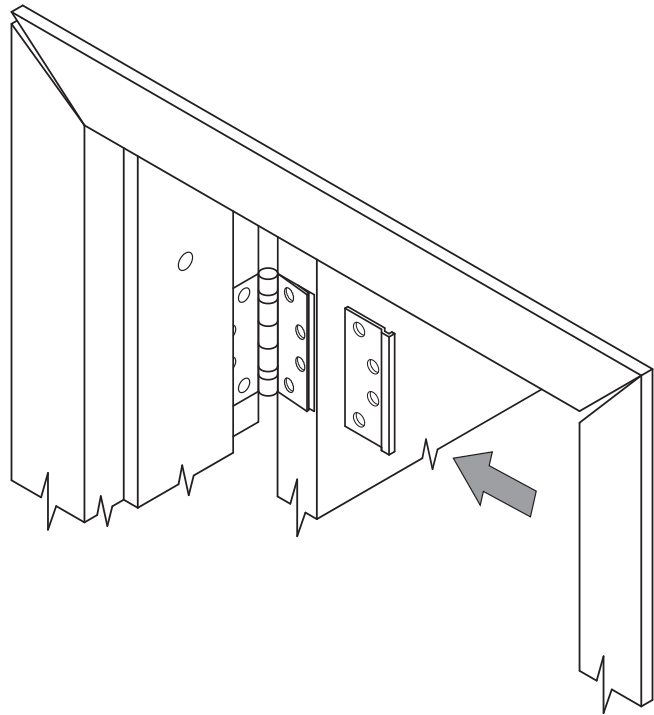


Standard swaging of standard-weight and heavy-weight full mortise hinges, when closed to the parallel position, provides a $\frac{1}{16}$ " clearance between leaves.

IMPROPER DOOR / FRAME CLEARANCE *(continued)*

Remove top hinge filler for non-handed doors

The improper clearance condition may be improved by removing the top hinge leaf attached to the door and taking out the filler (hinge filler) from behind the leaf. Once completed, reattach hinge leaf to door. A hinge filler is used on all non-handed doors.

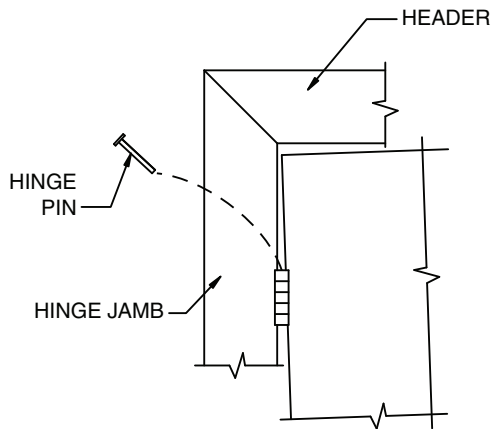


Add shims to bottom and/or middle hinge

On handed or non-handed doors, the lower half of the door can be shifted upward and toward the strike jamb. Remove the screws which attach the middle and/or bottom hinge(s) to the door. Insert shims between the hinge leaf and door. Reattach hinge leaf to door.

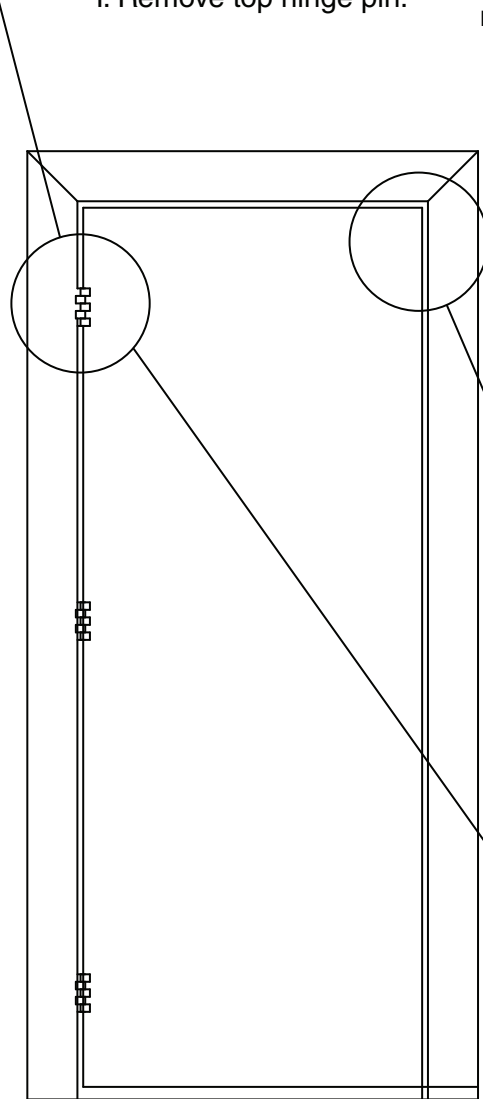
Standard-weight to heavy-weight hinge modifications

Although styles and types vary, many manufacturers offer built-in features that allow hinge pockets on doors and frames to be modified from standard-weight to heavy-weight. Examples of the different methods are: grinding or flattening down raised embossments in shim plates or reinforcements; removing or breaking off hinge filler shim plates; adjusting set screws; and removing wire shims. These options all involve removing material from the pocket to allow for heavy-weight depth to be achieved. As always, check with individual manufacturers to determine the type of modifications offered.

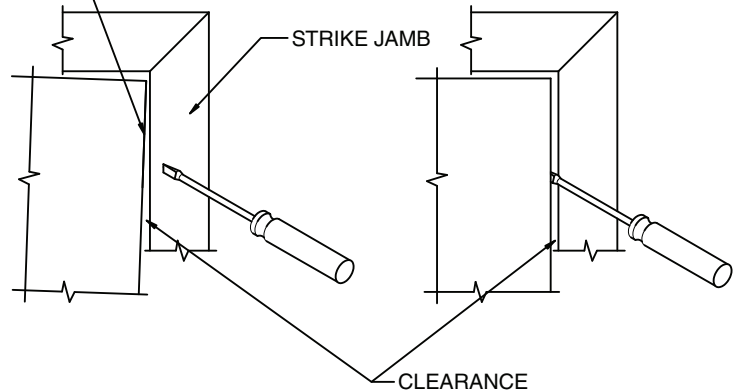
IMPROPER DOOR / FRAME CLEARANCE *(continued)***Reswaging hinges**

The following example shows how a hinge leaf can be reswaged to correct minor improper door/frame clearances. This particular method allows the reswaging to be accomplished while the door remains in the opening and the hinge leaves remain on the door and frame. The example shows a top hinge reswaged to correct a sag-type condition. However, any of the hinges can be reswaged in this manner to compensate for conditions opposite to that of a sag condition.

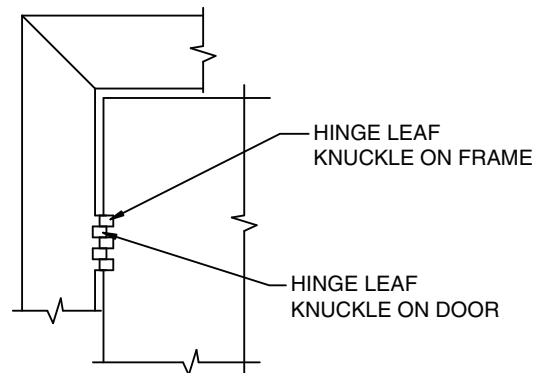
1. Remove top hinge pin.



DOOR LOCK
EDGE



2. Use a screwdriver to set the clearance between the lock edge of the door and strike jamb.

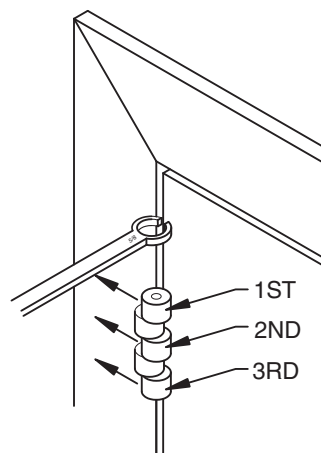


3. Hinge knuckle will now be misaligned.

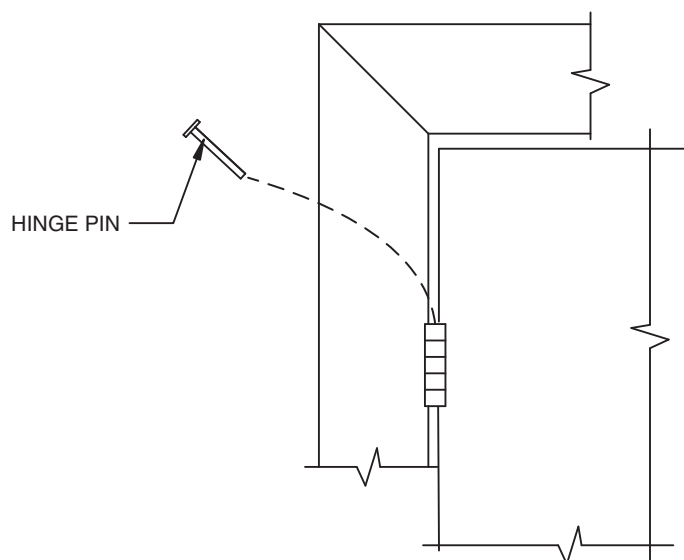
IMPROPER DOOR / FRAME CLEARANCE *(continued)*

Reswaging hinges *(continued)*

As shown, the hinge leaf knuckles on the door move to a new location once the clearance at the strike jamb is set. The hinge leaf knuckles on the frame must now be reswaged (bent) to align with the new location of the hinge leaf knuckles on the door. The simplest way to do this is to use a $\frac{5}{8}$ " – $1\frac{1}{16}$ " tube wrench (a crescent wrench will do as a second choice). Simply slip the tube wrench down around the 1st knuckle and align it with the new location. Once the first knuckle has been aligned, the wrench will now slip down to the 2nd knuckle for alignment. Repeat the process on the third knuckle.



4. Reswage and align hinge knuckles.



5. Re-insert the hinge pin and remove the screwdriver.

NOTE: As always, caution should be exercised when the hinge leaves are not removed. **Excessive** pressure could damage doors/frames. As an alternate reswaging method, the hinge can be removed and clamped in a vise for reswaging.

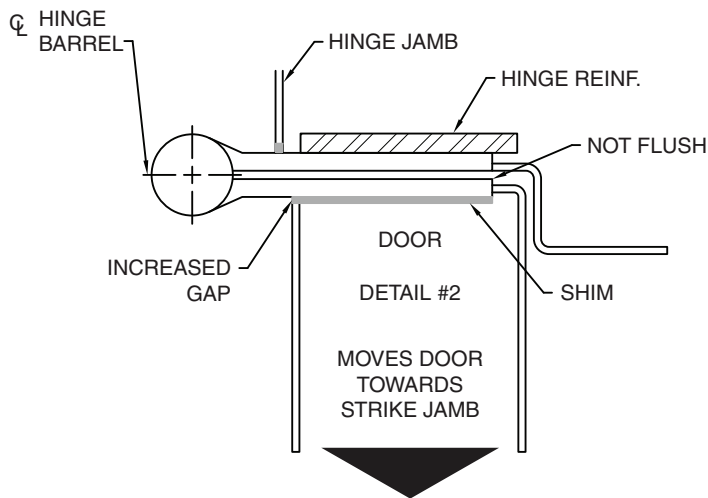
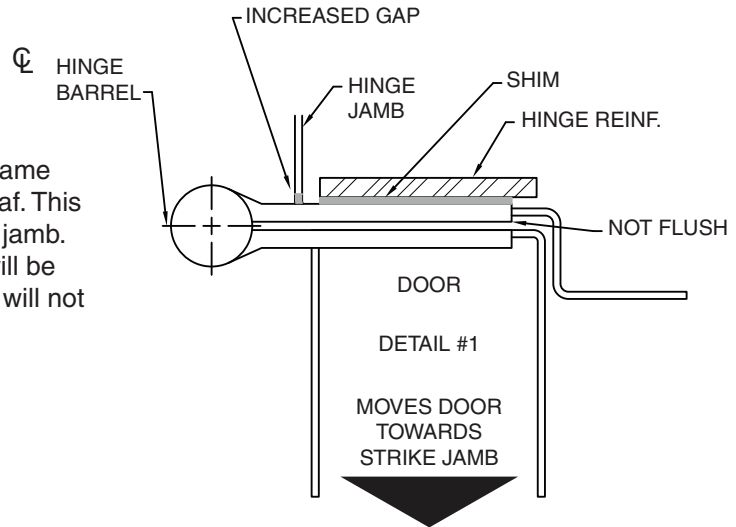
Is the door binding?

Frames which are out of plumb will likely cause improper operation of locksets and binding of bolts in the strike. Check carefully the installation of the frame prior to making hardware adjustments.

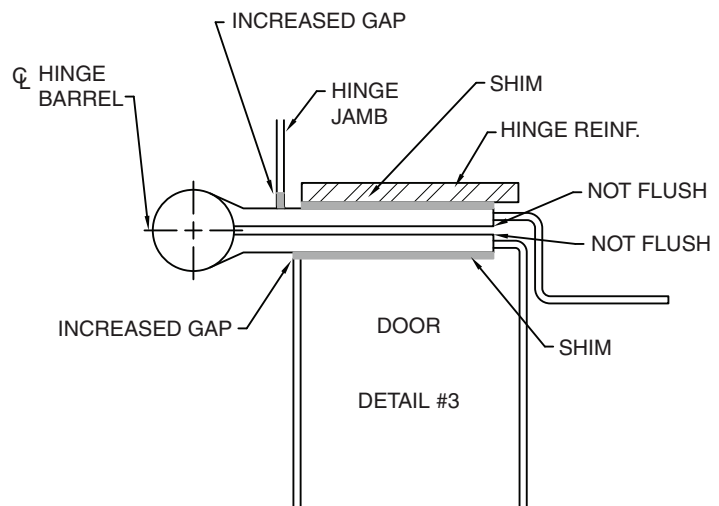
HINGE BIND AGAINST RABBET

Normally, hinge bind is found between the door and rabbet. There are several ways of shimming which will move the door in different directions. The following guidelines should be used in shim applications.

1. A shim can be placed between the frame hinge reinforcement and the hinge leaf. This will move the door towards the strike jamb. However, the hinge notch face gap will be increased and the hinge leaf surface will not be flush with the rabbet surface.



2. A shim can be placed between the door and the hinge leaf. This will also move the door towards the strike jamb. However, an increased gap will be created by the shim and the hinge leaf surface will not be flush with the backset surface on the door.



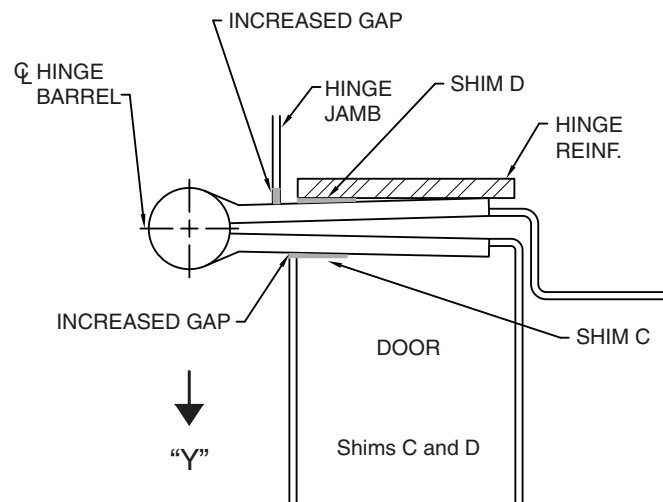
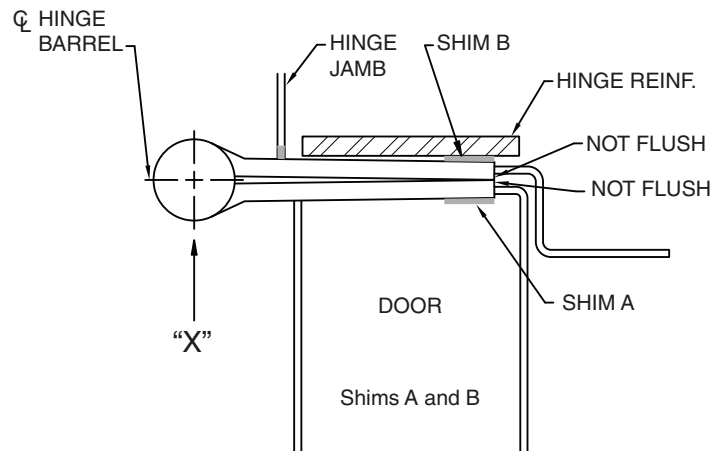
3. To minimize the gaps and the allow the hinge leaf surfaces to remain flush with the rabbet and backset surfaces, two shims, each half the thickness of those used above, could be used.

HINGE BIND AGAINST STOPS

Hinge bind against the frame stops is possible field condition. There are several ways of shimming which will move the door in the desired direction. The following guideline should be used in shim application.

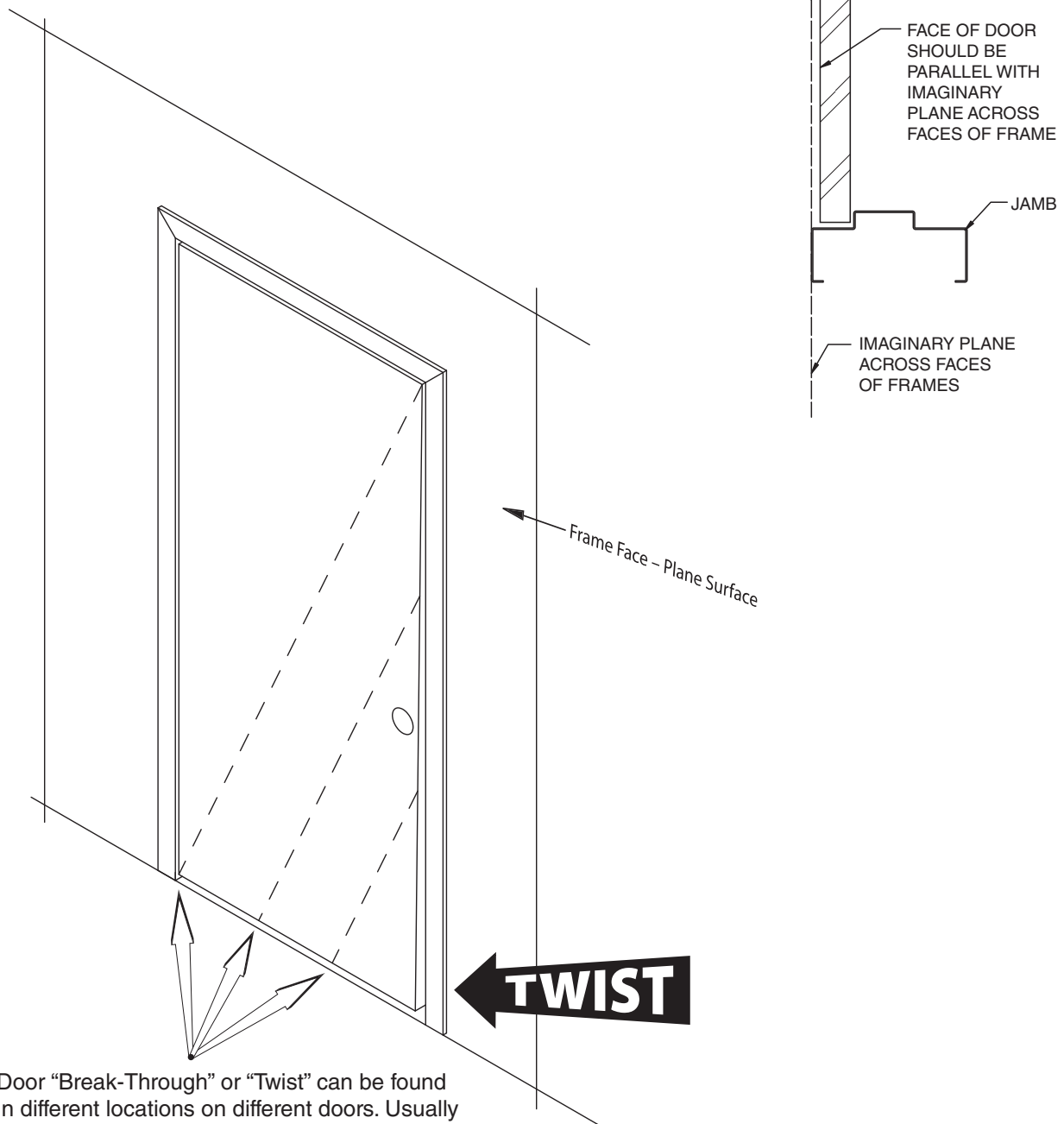
Adjustment of Clearance Between the Door and the Frame May be Accomplished by the Following:

1. Using Shim "A" only, door will be relocated in direction of Arrow "X".
2. Using Shim "B" only, will move both door and centerline of hinge barrel in direction of Arrow "X".
3. Using both Shims "A" and "B" will relocate the door in direction of Arrow "X" by a greater amount than by using Shim "B" alone.
4. Using Shim "C" only, door will be relocated in direction of Arrow "Y".
5. Using Shim "D" only, both door and centerline of hinge barrel will move in direction of Arrow "Y".
6. Using both Shims "C" and "D" will relocate the door in direction of Arrow "Y" by a greater amount than by using either "C" or "D" alone. The centerline of hinge barrel will be relocated the same as by using Shim "D" alone.



TWISTED DOOR

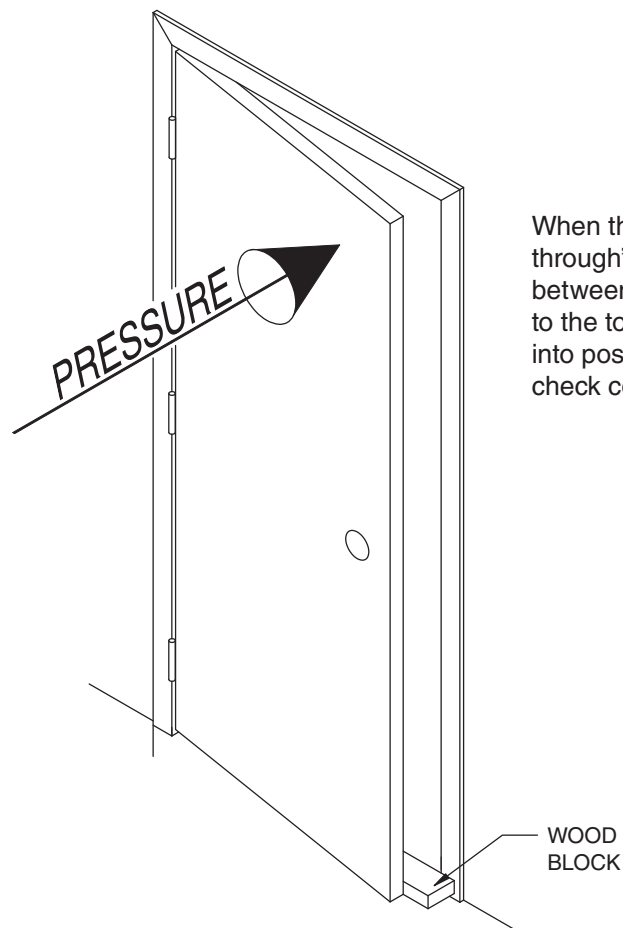
Normal installation results in the plane of the door face being parallel with the plane of the frame face. If the frame is square and plumb, all face surfaces of the frame will be in the same plane. A twisted door will “break through” the frame’s face plane surface. **BE SURE** the frame is square and plumb. If it is not, the problem is probably with the frame installation and **NOT** the door.



Door “Break-Through” or “Twist” can be found in different locations on different doors. Usually it is found diagonally between opposite lower and upper corners.

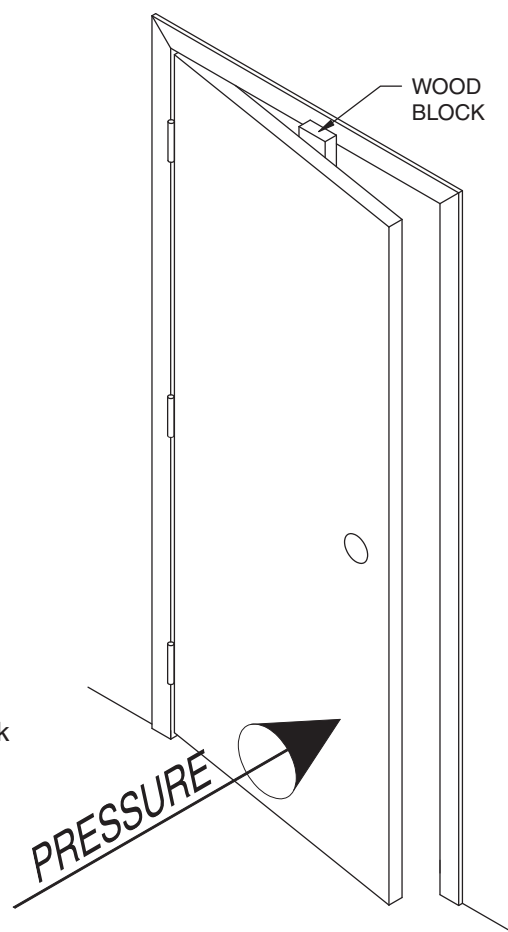
TWISTED DOOR ADJUSTMENTS

When required, it is possible to “spring” the door back to (or much closer to) its ideal position of being parallel with the plane across the faces of the frame. This can usually be done with the door remaining in the frame. A piece of wood blocking must be placed between the door and frame. Pressure is then applied at the twisted area to “spring” the door. However, caution should be exercised on drywall installations since the frame could possibly work loose from the wall, particularly with slip-on drywall type frames.



Twisted at Top

When the top lock area of a door is “breaking-through” the plane, place a wood block on floor, between door and frame as shown. Apply pressure to the top lock area as shown to “spring” door back into position. Remove wood block, close door and check condition. Repeat if necessary.

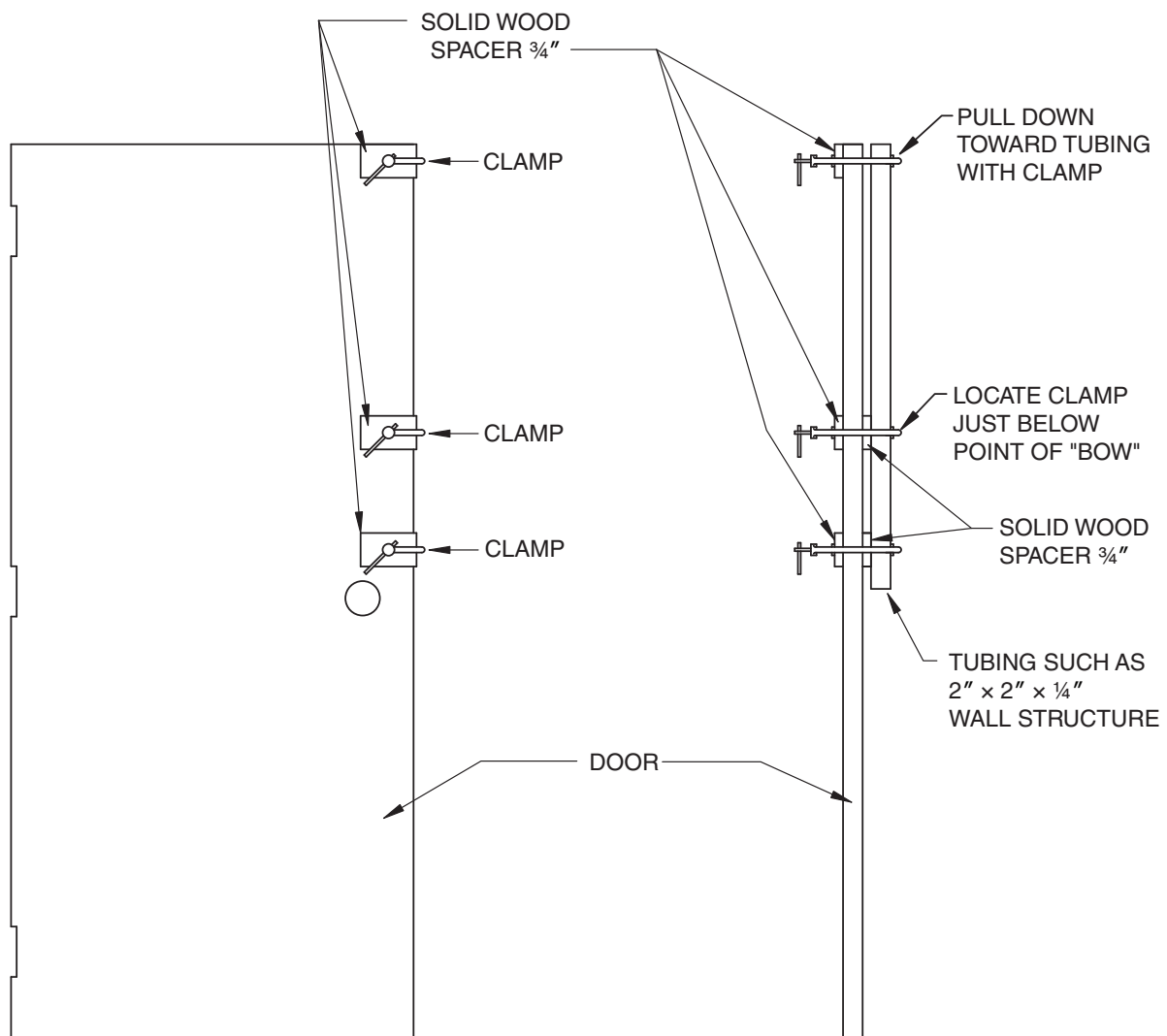


Twisted at Bottom

When the bottom lock area of door is “breaking-through” the plane, place a wood block between frame head and door as shown. Apply pressure to the bottom lock area as shown to “spring” door back into position. Remove wood, close door and check condition. Repeat if necessary.

TWISTED DOOR ADJUSTMENTS *(continued)*

An alternate method can also be used which will allow the door to remain in the opening. This method might be appropriate in drywall installations as previously mentioned. Although the example shown deflects the top half of the door, this method could be used on the bottom half of the door as well.

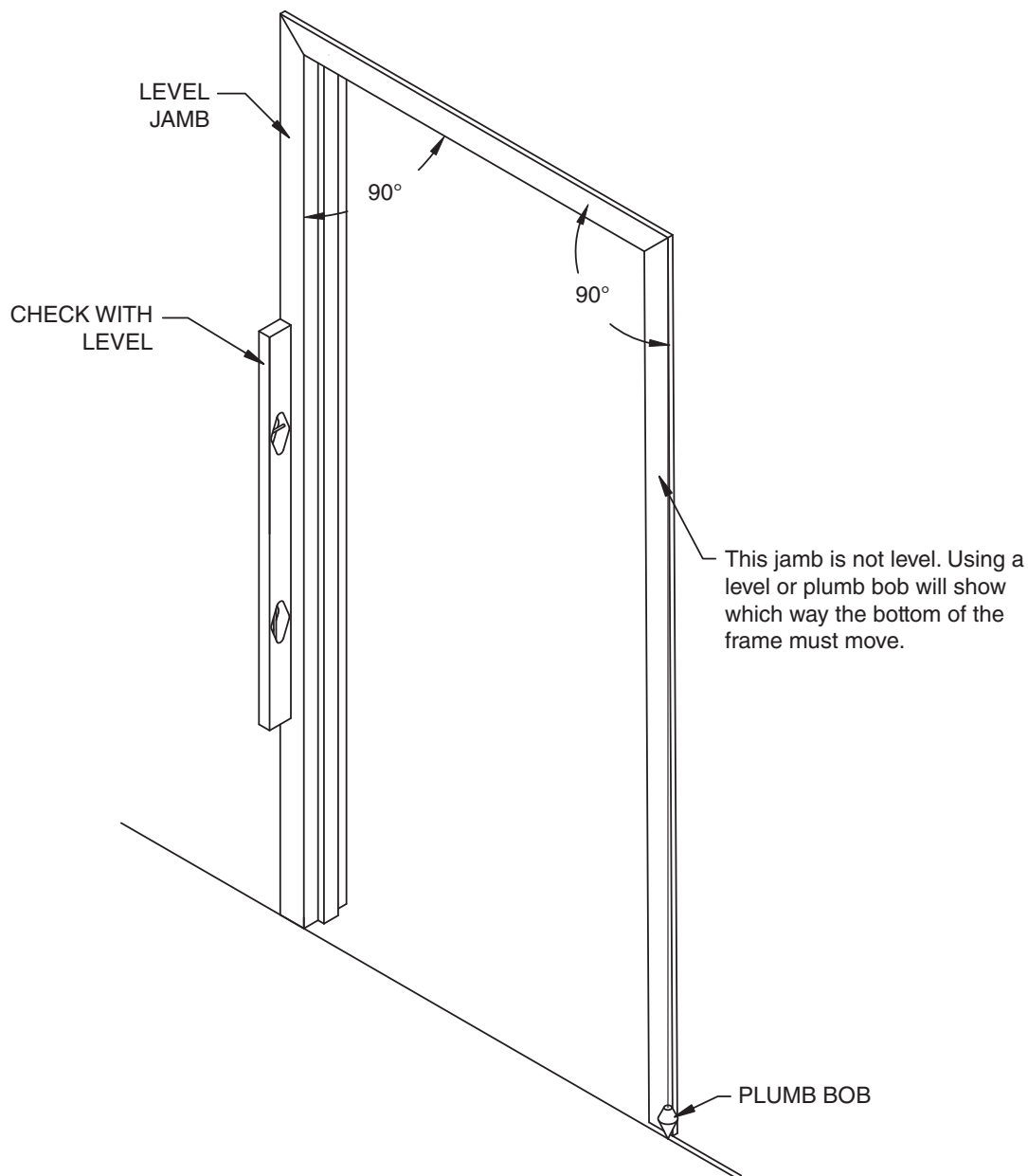


TWISTED FRAME

Wall conditions and anchoring methods can cause the frame to be “twisted” in the opening. The two jamb (hinge and strike) faces are not in the same plane as discussed in the twisted door section. This can be checked by using a level and/or plumb bob. Frames do not have adjustments when it comes to “twist.”

The “twist” condition is generally caused by the wall conditions. The frame jamb faces are prevented from being set in the same plane because the walls are out of plane to begin with.

The options available to correct this problem depend, to a large extent, on the wall construction.

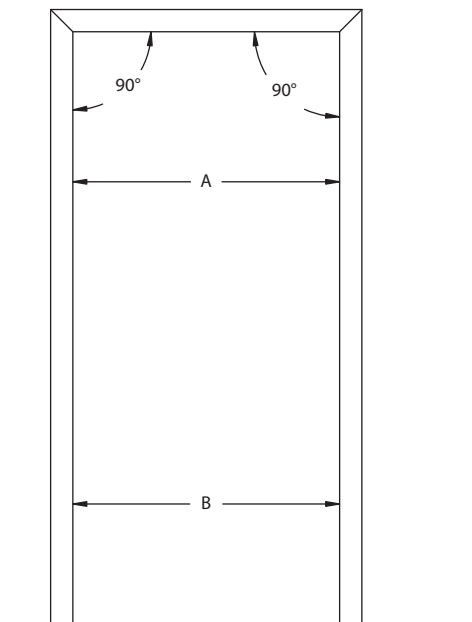


FRAME SET OUT OF SQUARE

Proper frame installation cannot be overemphasized. In the majority of wall constructions, ("slip-on" drywall type frames being the major exception) "quick" or "easy" field fixes are limited. Improperly set frames that are drastically out of square will cause severe door and hardware problems. These types of situations would require extensive field repair and may result in having to remove frames from walls.

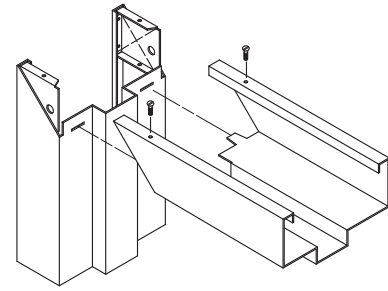
If the "out of square" condition is slight, some adjustment can be made by shimming and/or adjusting anchors, particularly if the frame being worked on is a slip-on drywall type.

The most versatile frame to work with in correcting these types of conditions is the "slip-on" drywall frame. The manufacturers' instructions should be referenced, but generally most "slip-on" drywall frames have a sill anchor at the bottom of the jamb and a compression anchor between the top hinge and the header. Also, most jambs have corner clips that have a hole to accept a screw. The corner clip and hole align with a hole in the header. The adjustment of slip-on drywall frames can be made using these anchors or corner clips.

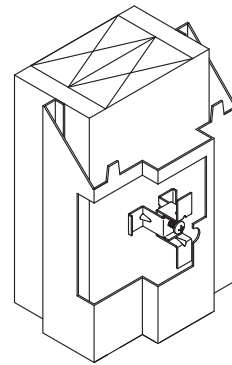


PROPERLY SET FRAME

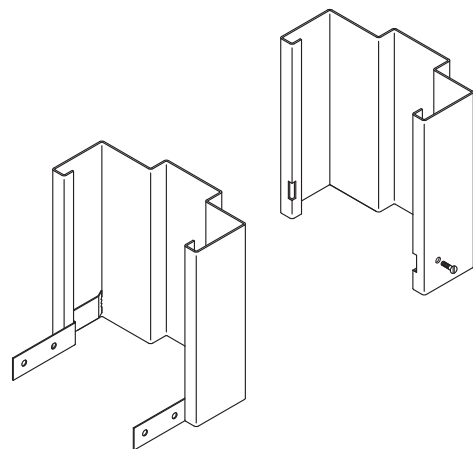
All corners are 90°. The dimension taken at Point "A" is equal to the dimension checked at Point "B." Both hinge and strike jambs are plumb and level.



**Corner Clip
Header to jamb connection**



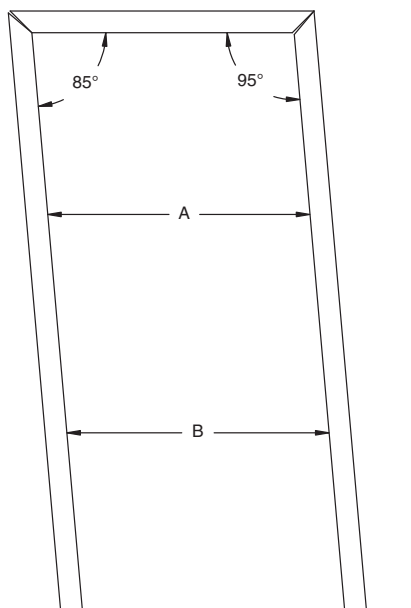
**Compression Anchor
(Cut-away view)**



**Sill Anchors
Snap-in type or screw type**

FRAME SET OUT OF SQUARE *(continued)*

The following examples illustrate how a frame can be set out of square.

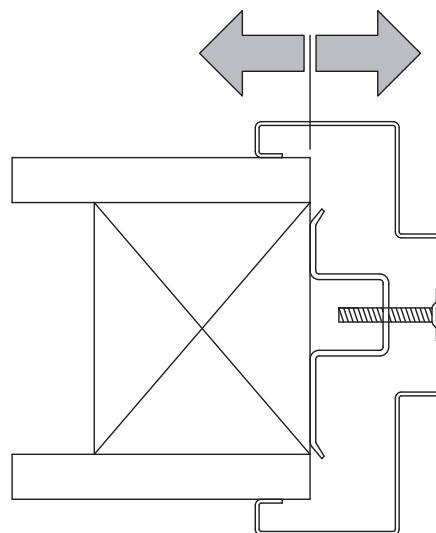
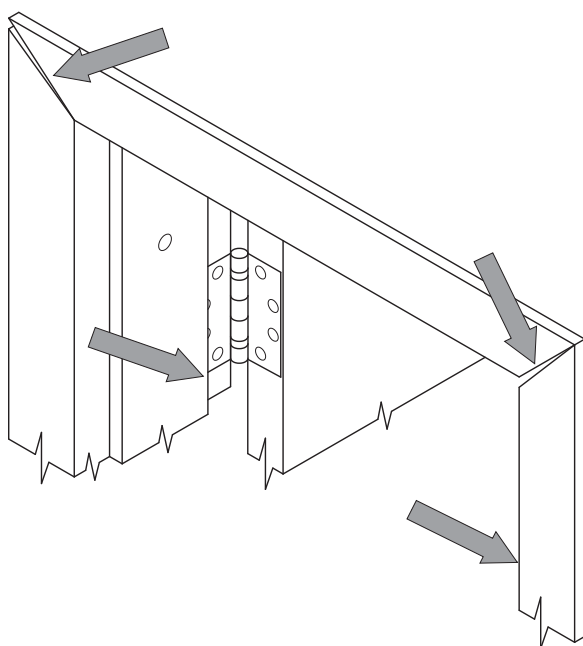
**IMPROPERLY SET FRAME (A)**

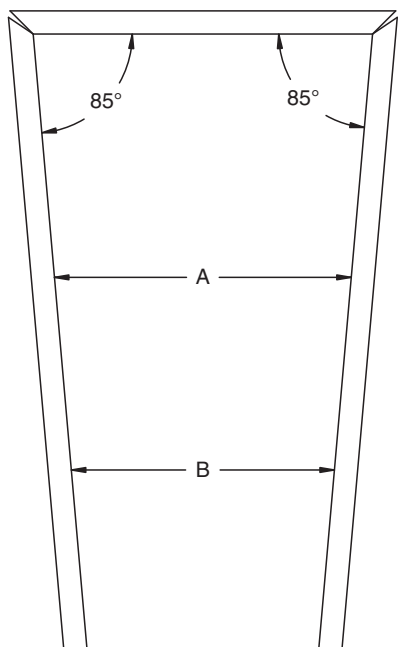
One corner is greater than 90° and one corner is less than 90°. The miters do not properly align with one another and “gaps” are created in the miters which are opposites of one another. The dimension taken at point “A” would remain the same when checked at point “B” if the 90° corners are out of square an equal number of degrees.

This condition can be corrected by adjusting the compression anchors in and/or out of each jamb as required. Loosen the corner clip screws if the frame is so equipped before making adjustments; retighten when finished. The compression anchors must be adjusted (turned) in opposite directions to allow the jambs to move.

For the illustration shown, the strike jamb compression anchor screw must be turned counterclockwise to retract the compression anchor and give room for the frame to be adjusted back into position using the hinge jamb compression anchor. The hinge jamb compression anchor screw is then turned clockwise to advance the anchor and push the frame towards the room made at the

strike jamb. The frame should be brought into square with the header and the hinge jamb compression anchor. Once this is done, the strike jamb compression anchor screw can be turned clockwise, advancing the anchor snug against the stud. The corner slip screws should then be retightened.



FRAME SET OUT OF SQUARE *(continued)***Jambs Toed In at Sill**

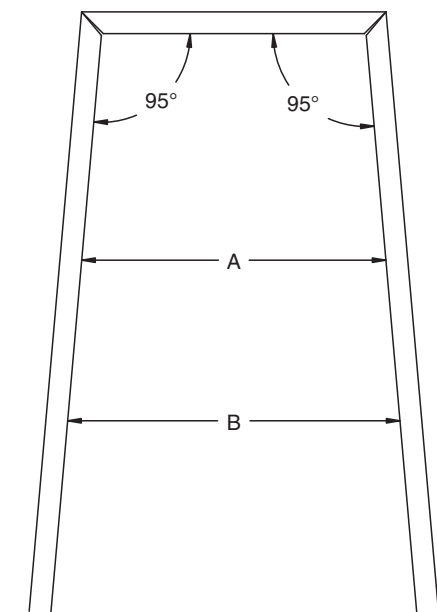
To correct this condition, the sill anchors must be loosened to allow the bottom of each jamb to be moved in and/or out. In the case of the snap-in type sill anchor, the baseboard trim might have to be removed to gain access to the anchors. This type of anchor is generally used because it can be hidden by covering it with the baseboard trim.

If the jambs are toed in at the sills, the compression anchors might have to be retracted slightly so the sill (base) of the jambs can be pushed out. The jambs should be plumbed, squared with the header and leveled as they are pushed out into their proper position. The sill anchors should be reset, the compression anchors adjusted and retightened. The baseboard trim should be reattached to the wall if it had been removed.

A similar procedure should be used if the jambs are toed out at the sills. The sill (base) of the jambs should be pushed in towards the opening. The jambs should be plumbed, squared with the header and leveled as they are pushed into their proper position. The sill anchors should be reset, the compression anchors adjusted (extended) and retightened. The baseboard trim should be reattached to the wall if it had been removed.

IMPROPERLY SET FRAME (B)

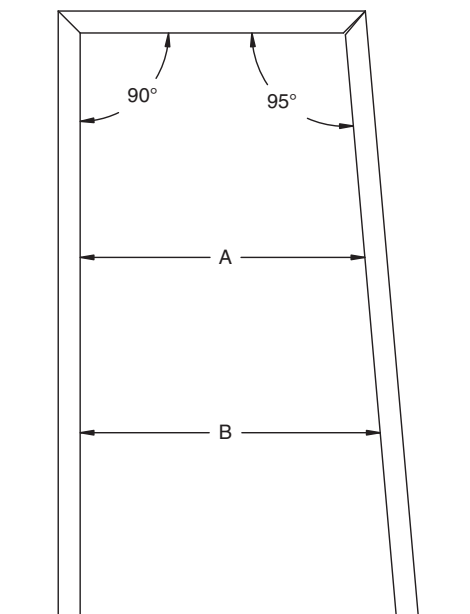
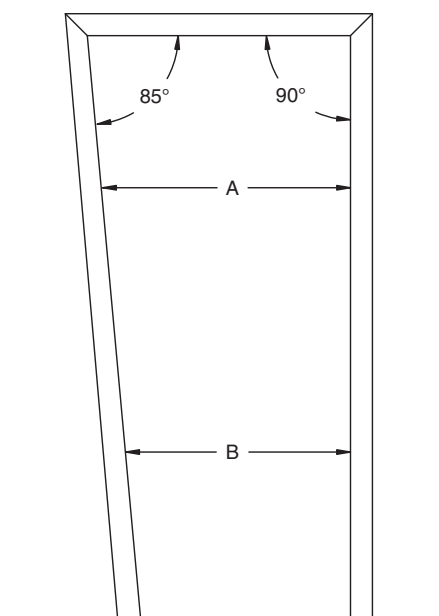
The corners are both greater than or less than 90°. The miters do not properly align with one another. When the corner is less than 90° the miter will have a gap which increases as it goes towards the return. When the corner is greater than 90° the miter will have a gap, which increases as it goes towards the rabbet. Dimensions taken at point "A" and "B" will not be equal. This condition will always result in dimension "B" being either greater than or less than the nominal opening dimension which would be obtained if checked between jambs along the header.

**Jambs Toed Out at Sill**

FRAME SET OUT OF SQUARE *(continued)***IMPROPERLY SET FRAME (C)**

One corner is properly set at 90° while the other corner is greater or less than 90°. The dimension taken at point "A" will constantly change when checked at various points going towards point "B." The corner miter will not properly align between the header and jamb which is not set at 90°

The jamb which is not 90° to the header must be moved. To correct this condition, the sill anchor must be loosened to allow the bottom of the jamb to be moved in or out as required. In the case of the snap-in type sill anchor, the baseboard trim may have to be removed to gain access to the anchor. This type of anchor is generally used because it can be hidden by covering it with the baseboard trim.

**One Jamb Toed Out****One Jamb Toed In**

If the jamb is toed in at the sill, the compression anchor may have to be retracted slightly so the sill (base) of the jamb can be pushed out. The jamb should be plumbed, squared with the header and leveled as it is being pushed out into its proper position. The sill anchor should be reset, the compression anchor adjusted and retightened. The baseboard trim should be reattached to the wall if it had been removed.

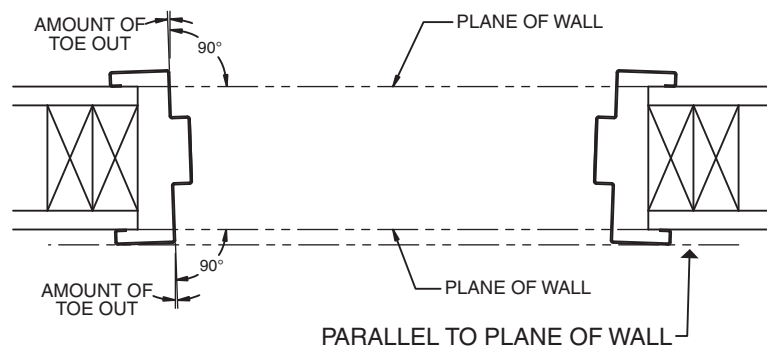
A similar procedure should be used when the jamb is toed out at the sill. The sill (base) of the jamb should be pushed in towards the opening. The jamb should be plumbed, squared with the header and leveled as it is pushed into its proper position. The sill anchor should be reset, the compression anchor adjusted (fastened) and retightened. The baseboard trim should be reattached to the wall if it had been removed.

FRAME WITH RABBETS TOED IN OR OUT

The importance of proper initial frame installation is evident in this condition. In the majority of wall constructions, except for the “slip-on” drywall type frames, “quick,” “easy” field fixes are limited. Improperly set frames which have the rabbets drastically toed in or out would require extensive field repair and in most cases require that the wall be entered to gain access to frame anchoring.

The toed in or out condition is worse near the floor. The header prevents the upper portion of the jambs from toeing in or out but as you move away from the header towards the floor, the jambs have greater potential to be toed in or out during installation.

The only frame with this condition which can be corrected with little difficulty is the “slip-on” drywall frame. Since the “slip-on” drywall frame uses only compression anchors near the head and sill anchors near the bottom of the jambs, this condition is easily corrected.



Note that the rabbet surfaces are not 90° to the plane of the wall. This can be checked by placing a straight edge across the face of both jambs.

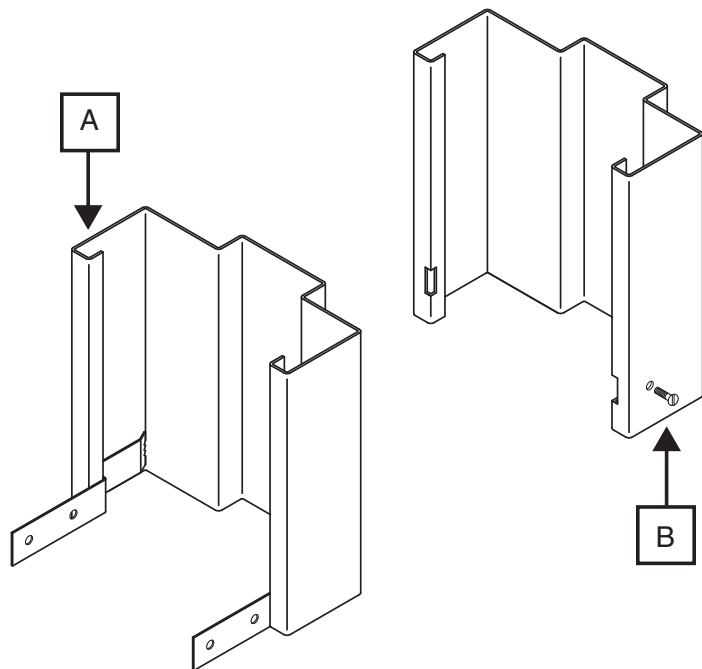
The straight edge should set flat across both faces at the same time. If the jambs are twisted, a “gap” will be created as shown in the figure to the left.

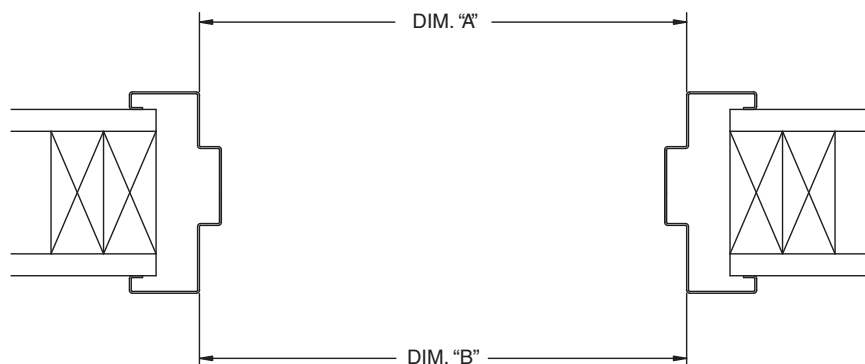
Typical toed-in or out condition

The figures to the right show the two typical types of sill anchors used on the “slip-on” drywall frame.

“A” shows an anchor which will be covered up by the baseboard trim. To gain access to this anchor the baseboard trim must first be removed. Next, the nails or screws holding the anchors to the wall must be removed. This will loosen the jamb and allow it to be squared in the opening.

“B” illustrates a screw going through the face of the frame into the wall. This holds the sill of the frame in position. This screw is exposed and is readily accessible. Removing the screw will loosen the jamb and allow it to be “squared-up” in the opening. If both jambs are toed in/out, they both should be “squared-up.” This can be checked by taking measurements as shown below. Both the “A” and “B” dimensions will be the same when the frames are properly set. However, the frame jambs must be plumb, level, and square with the head of the frame.

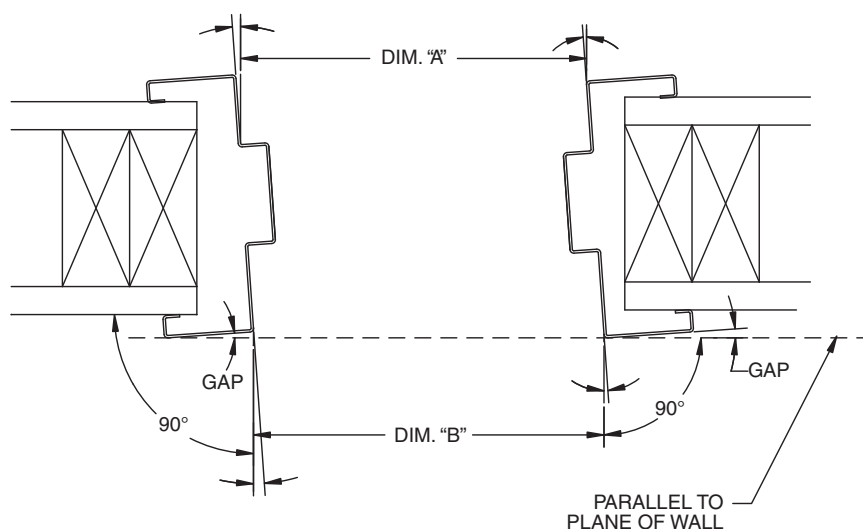


FRAME WITH RABBETS TOED IN OR OUT *(continued)*

If both jambs are toed in/out, they both should be “squared-up.” This can be checked by taking measurements as shown above. Both the “A” and “B” dimensions will be the same when the frames are properly set.

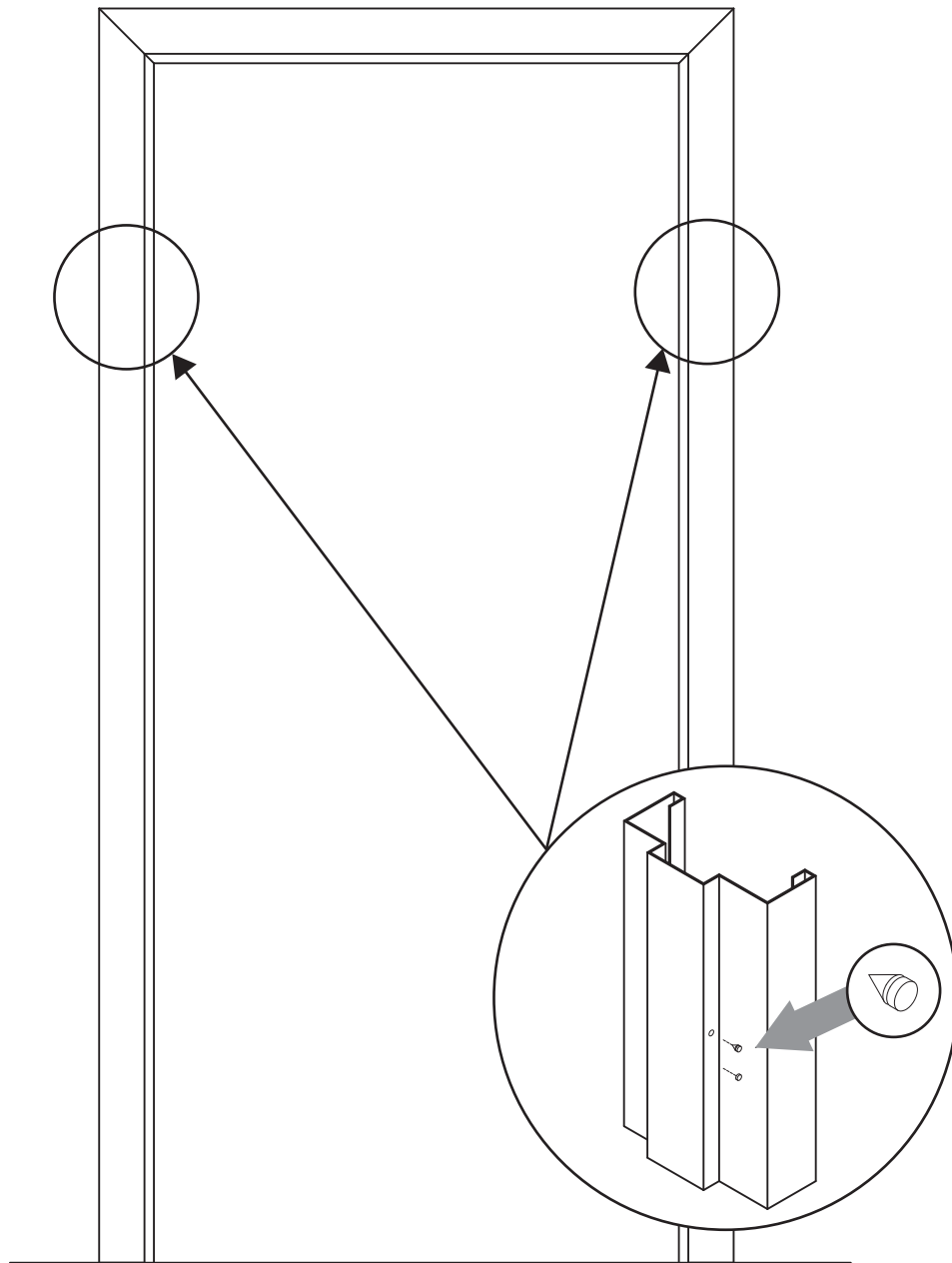
The below figure shows a condition which can give the impression that the frame is properly installed. Both dimensions “A” and “B” will be equal but the frame will not be square in the opening. Both jambs can be twisted to create a parallelogram. This can be checked by placing a straight edge across the face of both jambs (the straight edge is represented by the dotted line shown below). The straight edge should set flat across both faces at the same time. If the jambs are twisted, a “gap” will be created as shown in the illustration. The “gaps” will be to the same side if a parallelogram was created. The gaps could also be to opposite sides as shown in the Typical Toed In or Out Condition figure on the previous page.

This condition can be corrected as outlined for the other “toe out” or “toe in” examples.



SILENCERS

Some manufacturers provide a silencer hole in the frame stop to accept a push-in silencer. A “stick-on” silencer is also available for application to frames without the silencer hole. The silencer acts as a “rubber bumper” which evenly holds the door off the stop at a constant distance. If the door is held off of the stop rather than being allowed to move slightly towards the stop, the latch tube will fit tighter into the strike. Three silencers are placed on the strike jamb, one toward the top of the jamb (nearer the header) and one toward the bottom of the jamb (nearer the sill) and the third near the strike preparation.

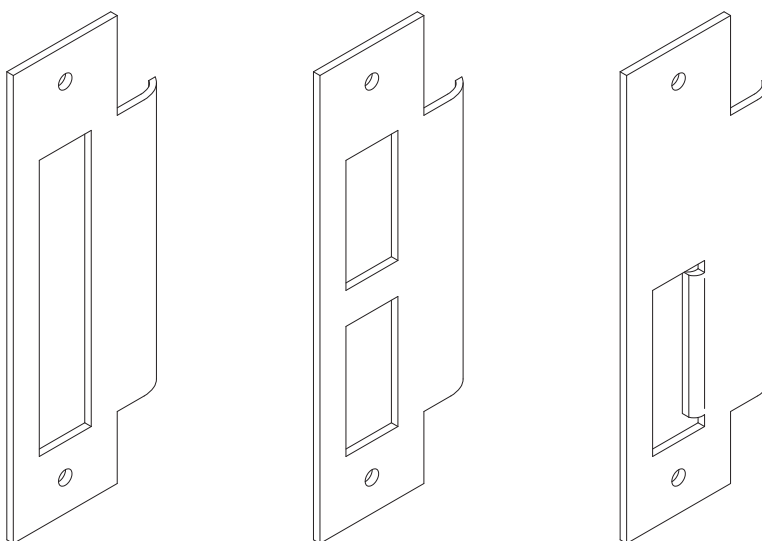


LOCK FITS LOOSE ON STRIKE

This condition cannot be caused by an improperly set door and/or frame. If the lockset on the door was not properly aligned with the strike on the frame, interference would occur or the latch bolt would bind in the strike. Since this is not the case; the cause is something other than improper installation. The following should be checked:

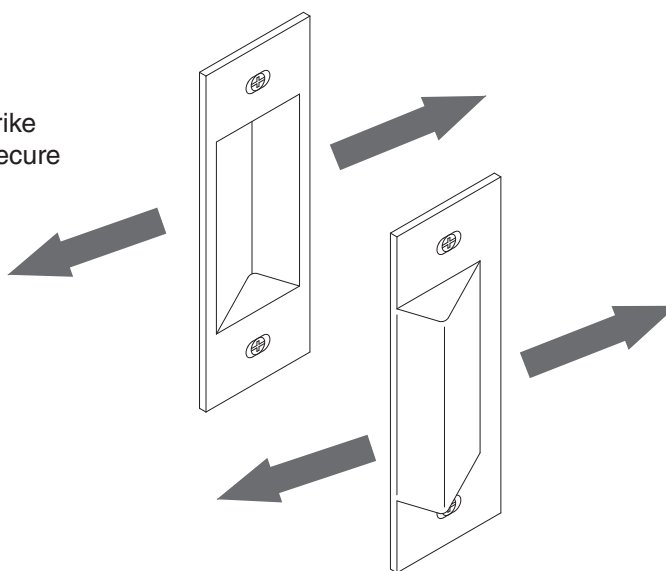
PROPER STRIKE

Is the proper strike plate attached to the frame?



RIM EXIT DEVICES

An adjustable strike plate is provided. Is the strike plate properly adjusted to provide positive and secure latching?



LOCK FITS TOO TIGHT IN STRIKE

Proper installation of the door and frame are essential. If the door and frame are not properly aligned, the latch bolt could bind in the strike. The following items should be checked:

IMPROPER CLEARANCE/DOOR SAG

For various conditions, refer to page 2.

HINGE BIND

For various conditions of hinge bind, refer to page 6.

TWISTED DOOR

For various conditions of twisted doors, refer to page 8.

TWISTED FRAMES

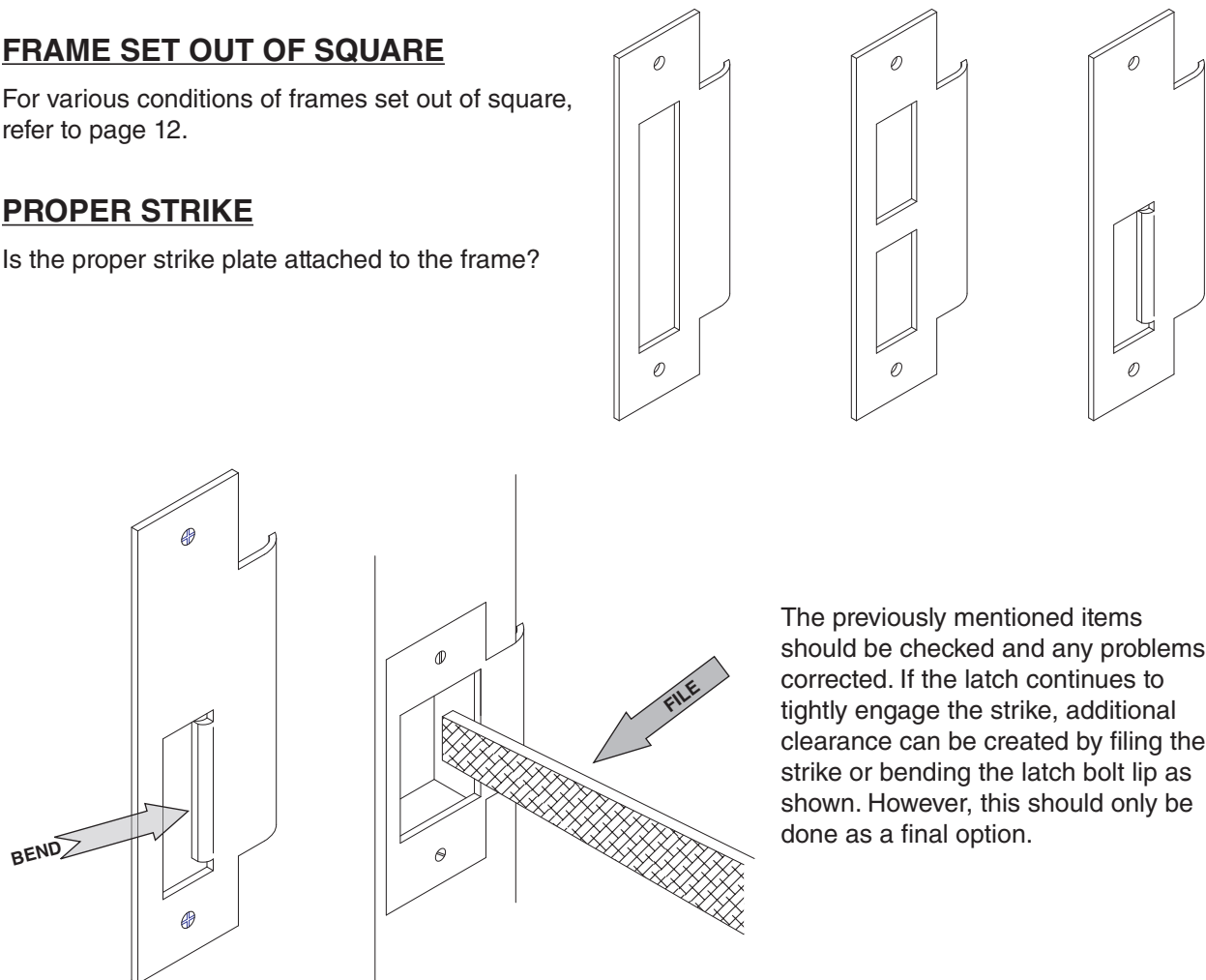
For various conditions of twisted frames, refer to page 11.

FRAME SET OUT OF SQUARE

For various conditions of frames set out of square, refer to page 12.

PROPER STRIKE

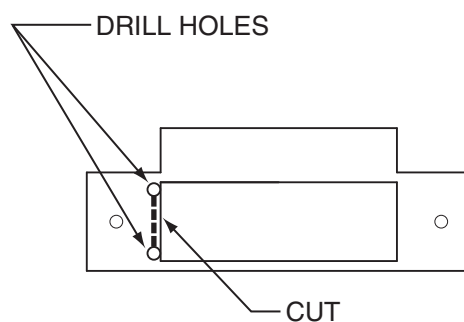
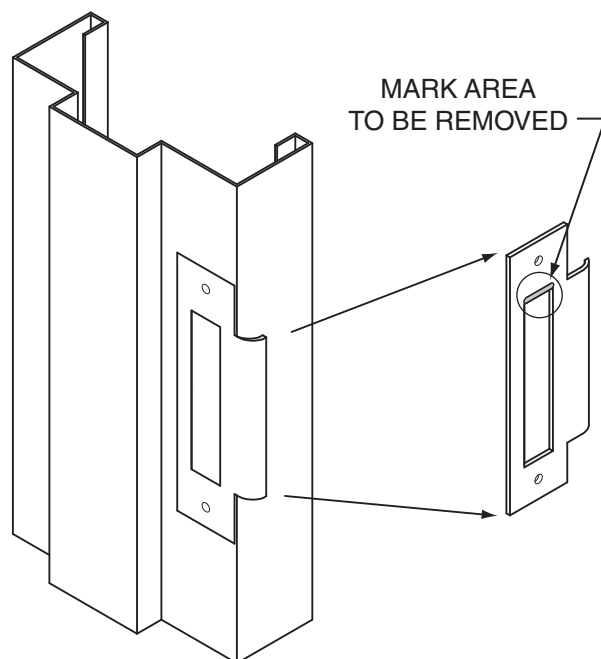
Is the proper strike plate attached to the frame?



LOCKSET OFF LOCATION ON DOOR OR STRIKE OFF LOCATION IN FRAME IN WALL

Minor location adjustments usually can be accomplished by altering the strike plate. The strike plate alteration would “extend” the opening to allow the latch tube to properly engage the strike. This is similar to the section “Lock Fits Too Tight in Strike” except that the amount of material removed from the strike is greater. This could compensate for minor mislocation of the strike plate on the frame and/or location of the lockset on the door. These general steps should be followed for modifying the strike plate.

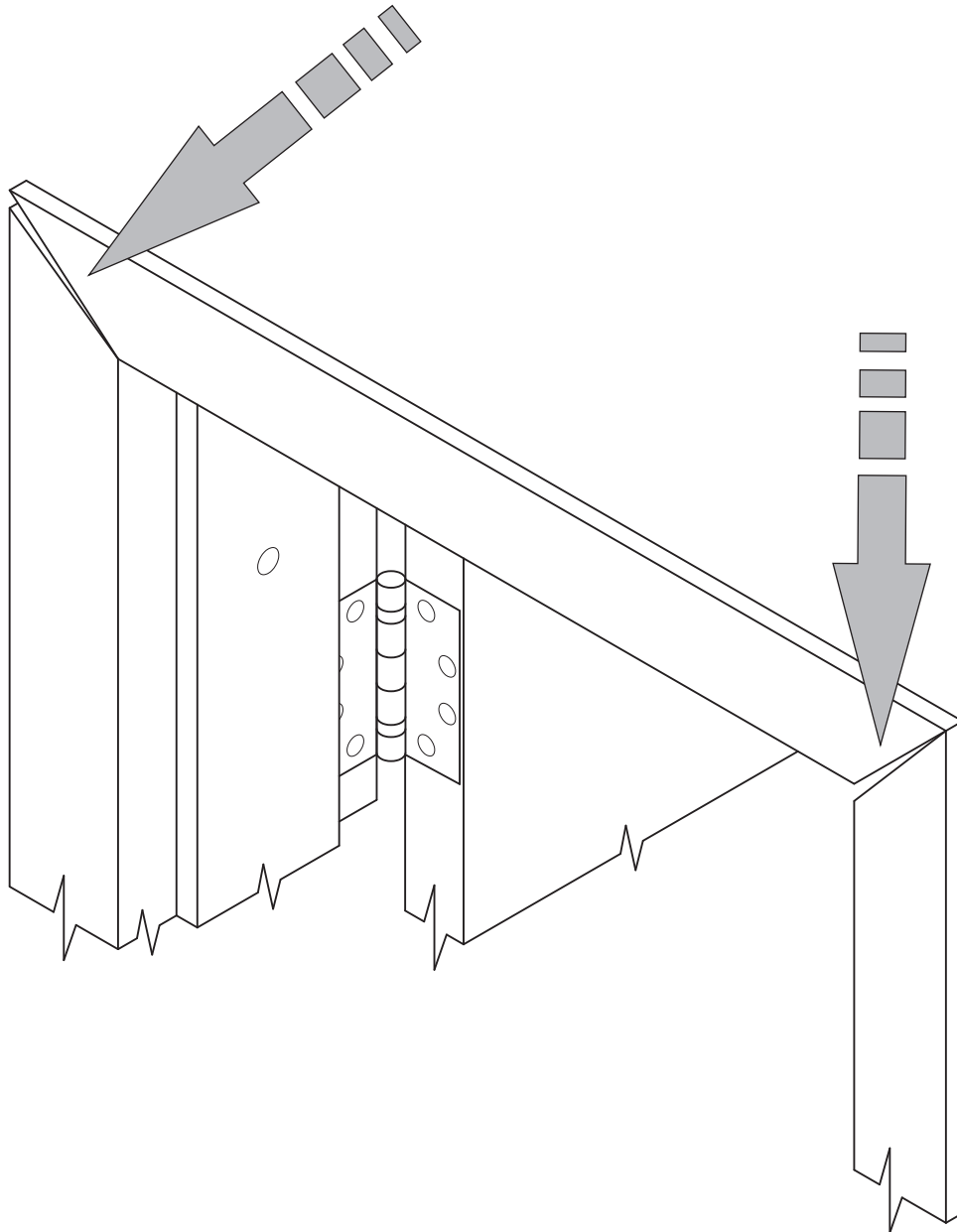
- Mark the area on the strike plate which must be removed.
- Remove strike plate from frame.
- Center punch corners of area to be removed and drill a $\frac{1}{8}$ " diameter hole in each corner.
- Use a saber saw and cut from the existing opening up to the $\frac{1}{8}$ " diameter holes. The remaining material between the two $\frac{1}{8}$ " holes should be filed away.
- Dress off all rough edges and corners with a file. This must be done since any irregular edges or edges with burrs could cause the latch tube to “drag” or “hang up” in the strike plate.
- Reassemble strike plate to frame and check alignment with lockset on door as well as latch tube function in and out of strike plate.



MITER NOT CLOSED ON FRAME

The major cause of miters not properly lining up and “closing” is incorrect installation. The effects of improper installation on miter seams are covered under the previous section of “Frame Set Out of Square.” This section should be referenced for detailed explanations of conditions which could occur, and solutions for correcting the problems.

This condition could also be caused by conditions as explained in the “Frame Loose on Drywall” section—figures on page 28.



CLEARANCE AT BOTTOM OF DOOR TOO SMALL

The available options for correcting this problem are limited. Frames which are permanently anchored to the wall construction (such as masonry or steel stud) leave few alternatives. The only available “fix” is to trim the bottom of the door, if the door’s construction will permit trimming. As shown in the figure below, the nominal “sill clearance” should be $\frac{3}{4}$ of an inch. The sill clearance is the dimension from the bottom of the door to the bottom of the frame jambs, and $\frac{3}{4}$ ” is a standard industry dimension.

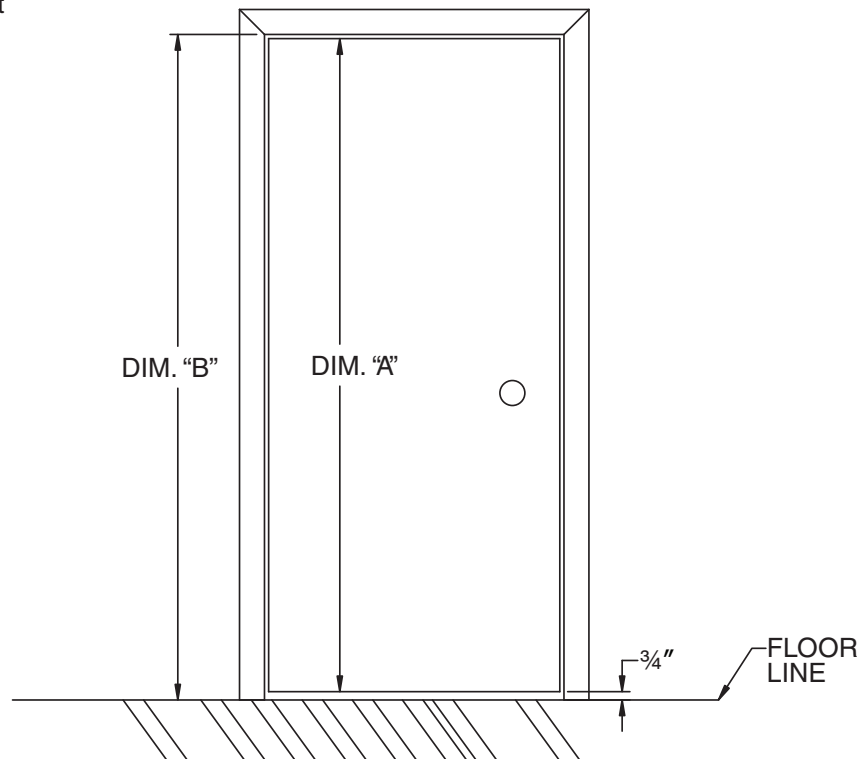
The frame jambs should be set at floor level which then results in $\frac{3}{4}$ of an inch between the bottom of the door and floor.

The $\frac{3}{4}$ ” also provides enough room to allow the installation of a “raised sill” which is a type of flat threshold. If a raised sill is used, the $\frac{3}{4}$ inch clearance is decreased.

Before any alterations are made the door height dimensions should be checked.

The door height is determined by taking a measurement represented by dimension “A” in the figure. If the door height is “oversize” the clearance at the bottom will be too small.

The frame jamb height (which is the same as the opening height) is determined by taking a measurement represented by dimension “B”. If the jamb height is “undersize,” the clearance at the bottom will be too small.



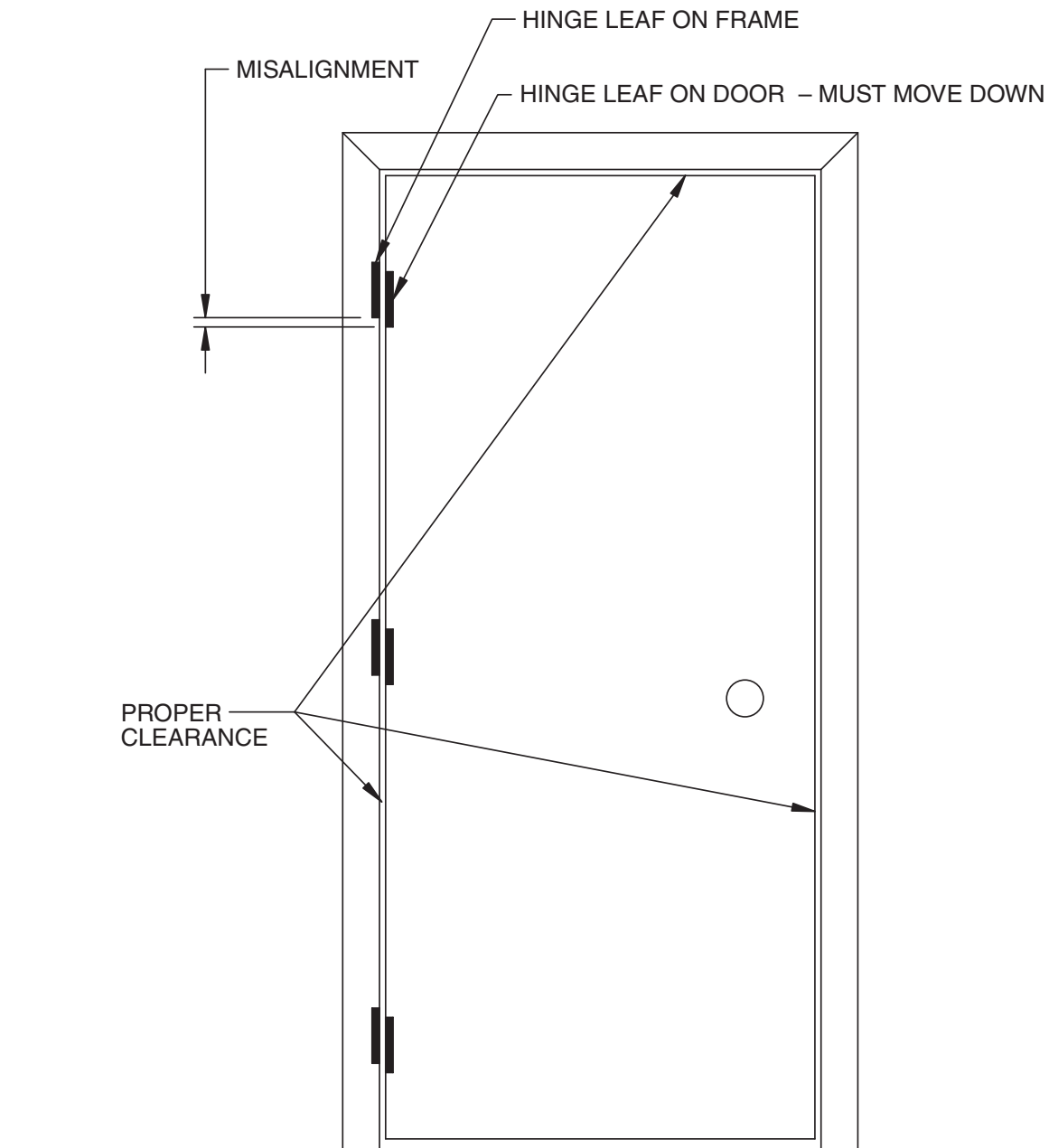
The bottom of the frame jambs should be set “on” the floor not “in” the floor. In some special cases the jambs can be set “in” the floor but this requires special design consideration and adjustments in door height and jamb heights. If this was not compensated for in the designed heights, the clearance at the bottom could be too small.

By taking these basic dimensions, you can confirm what element of the opening is in error. If trimming the bottom of the door is considered, you must make sure that the door’s design will allow such a modification to be made. It is best to contact the distributor or the manufacturer to determine if and how much the door can be trimmed. These types of trimming modifications can be relatively simple or more extensive depending on door design.

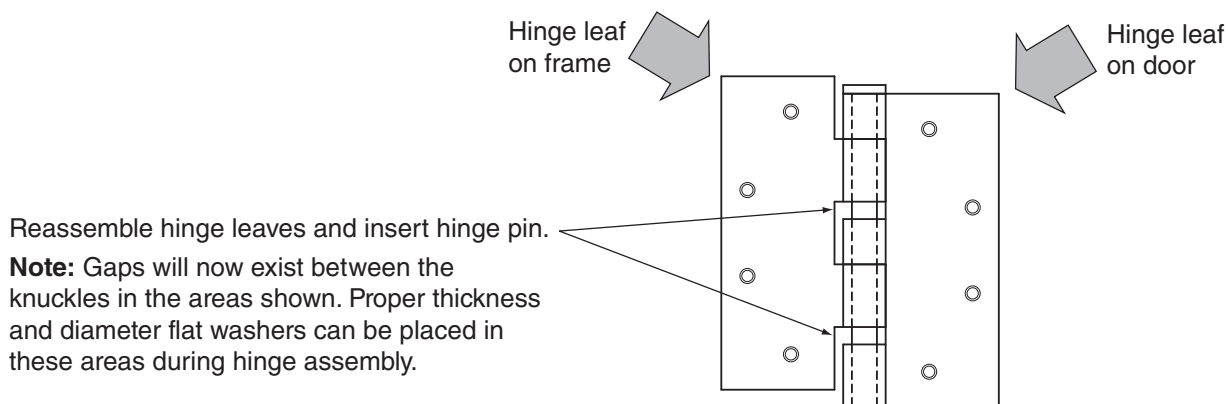
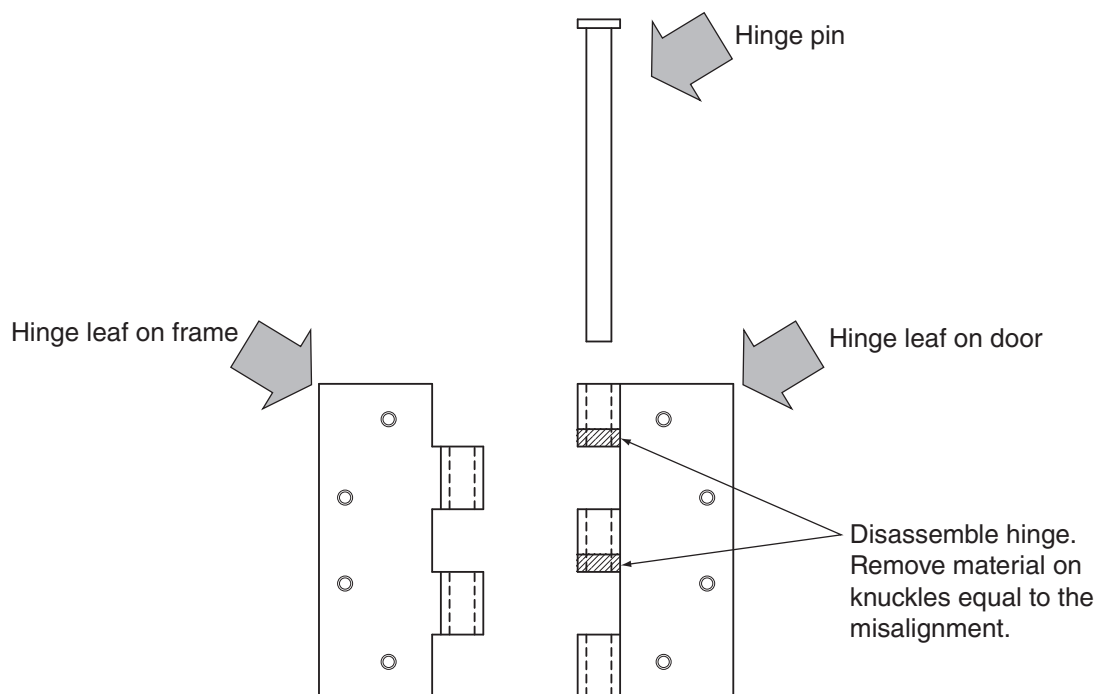
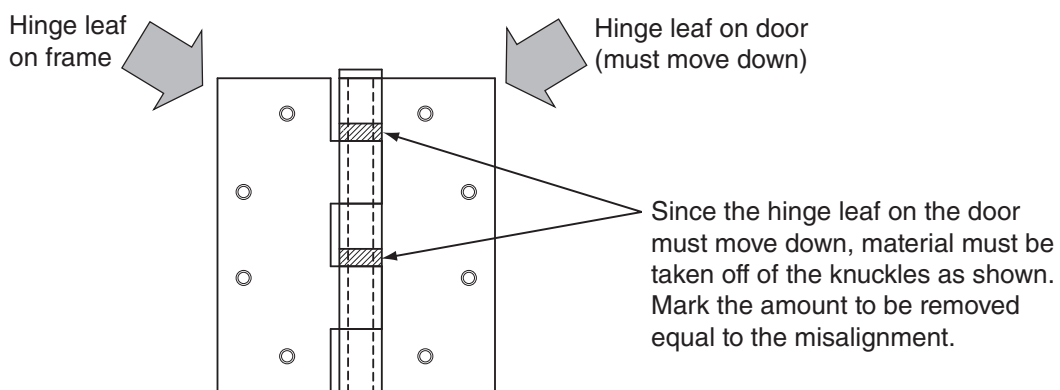
FRAME AND DOOR HINGE MISALIGNMENT

Frame and door hinge misalignment can cause a variety of problems. When misalignment occurs, either the door's hinge locations or frame's hinge locations are slightly off. This can apply to retrofitting existing openings where either the door or frame is being replaced, but not both. When new doors and frames are provided from a single manufacturer, this problem does not exist.

The example shown on the following page reflects the dropping of the hinge leaf which attaches to the door from its relationship to the hinge leaf on the frame. However, by removing material from the opposite end of the knuckles, the door hinge leaf could be raised as well. The frame hinge leaf can also be relocated in similar fashion.



FRAME AND DOOR HINGE MISALIGNMENT *(continued)*



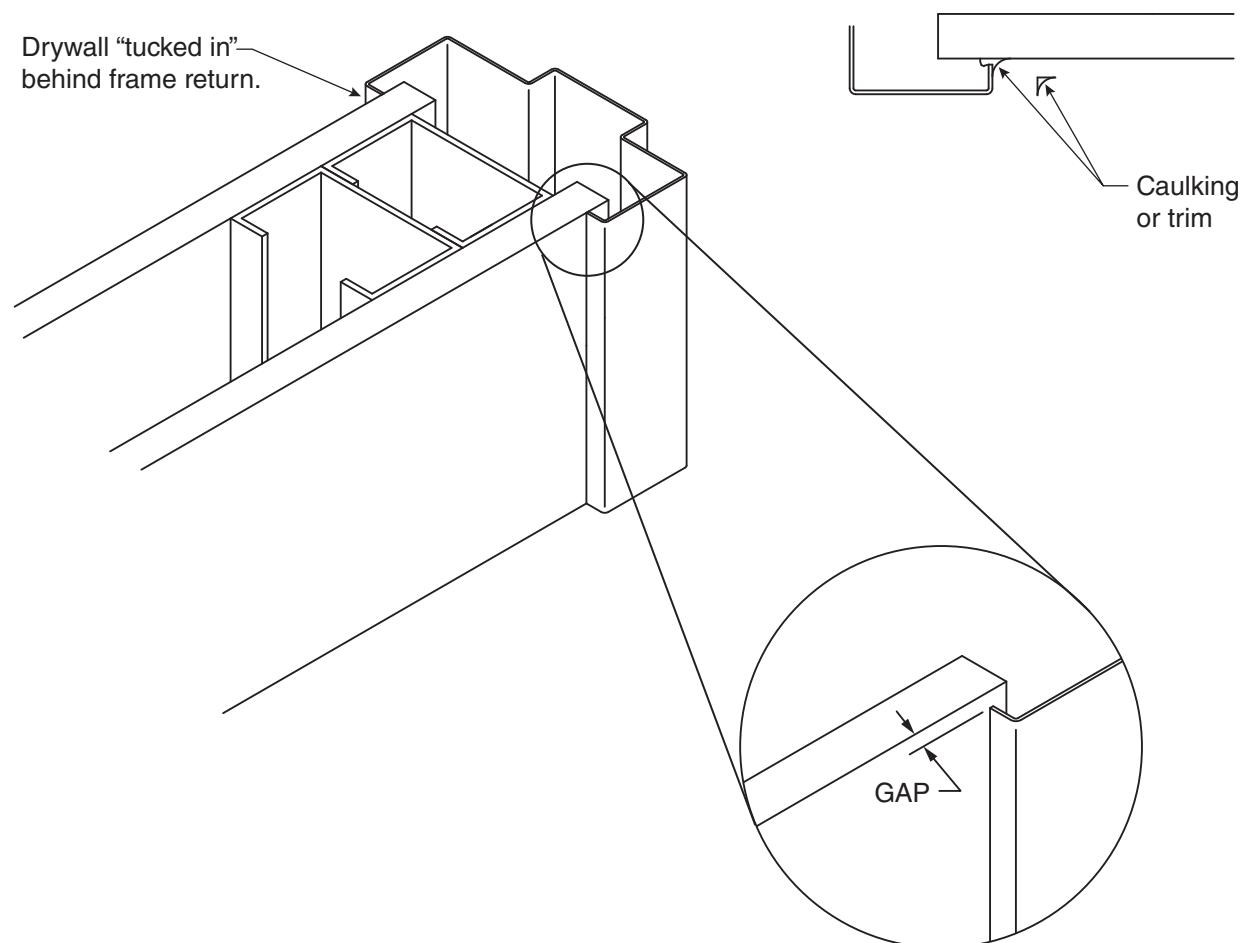
FRAME LOOSE ON DRYWALL

Frame manufacturers closely control the dimensions to which their frames are manufactured. Since automated equipment is used these dimensions are easily repeated from piece to piece. The majority of cases where frames are loose on drywall will reveal that the overall wall thickness has not been properly maintained. Wall thickness conditions can vary from undersize to oversize. The thickness should be checked, if possible, to verify the wall's compliance with the job specification.

Frames installed in drywall walls can use two different anchoring methods:

WELDED/SNAP-IN STEEL, OR WOOD STUD ANCHORS

Some frames use welded or snapped-in steel or wood stud anchors. These frames are installed prior to the drywall material being attached to the studs. The drywall can either be “butted-up” against the return of the frame or be “tucked in” behind the return of the frame. Only in the installation where the drywall is “tucked in” behind the return can there be a condition where the frame is loose on the drywall. This gap could be uniform along the entire length (height) of the jamb or could be only in certain areas. Since the frame cannot be removed, the only available options are to caulk the gap or cover it with trim.

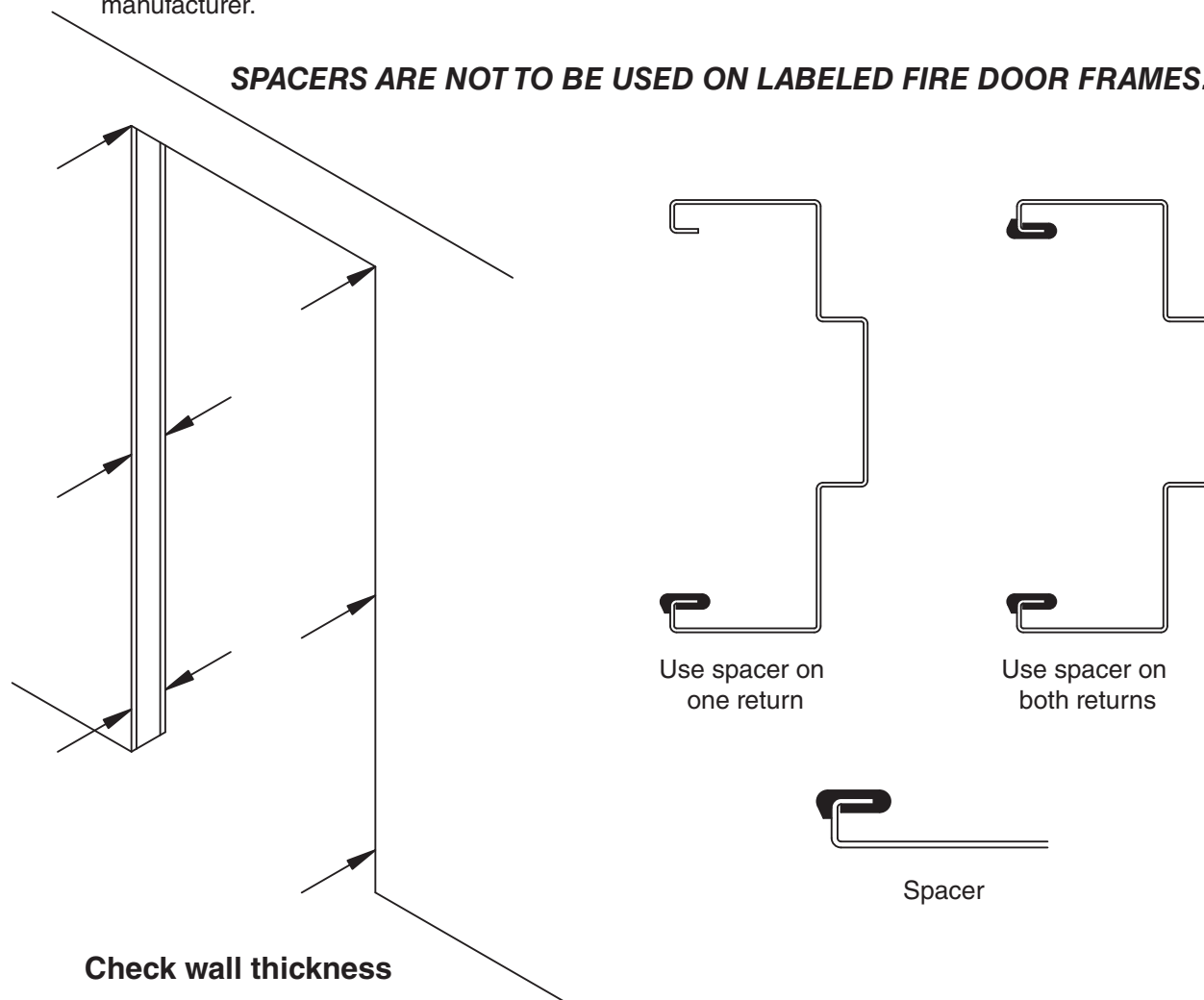


FRAME LOOSE ON DRYWALL *(continued)***DRYWALL FRAMES WITH COMPRESSION ANCHORS**

These frames are intended to be installed after the wall construction is complete. The anchoring methods that this type of frame uses allows the removal of the frame if so desired. The manufacturers' installation instructions should be followed anytime the frame is removed and reinstalled. Three conditions could exist for drywall slip-on frames which are "loose on the wall."

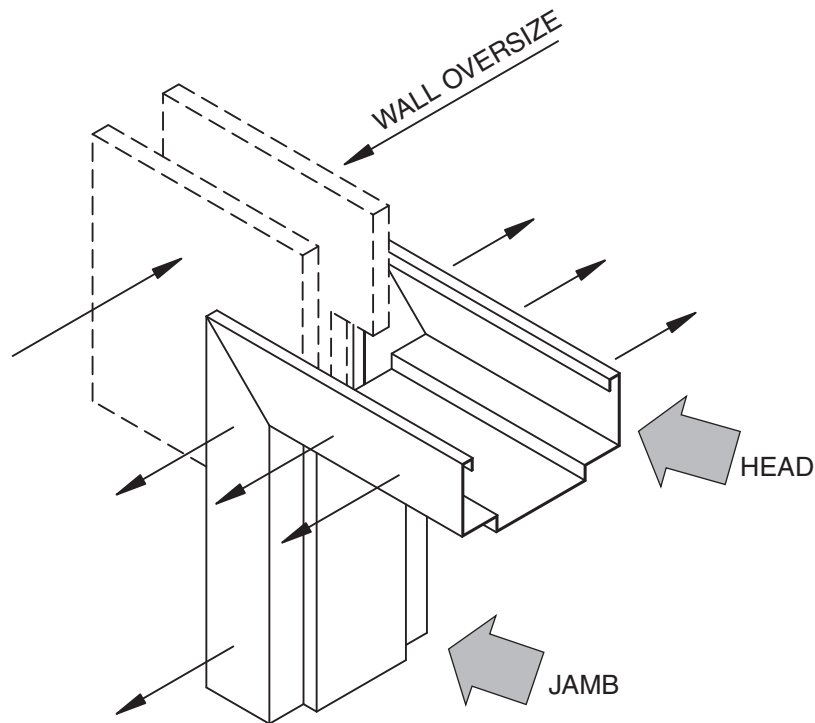
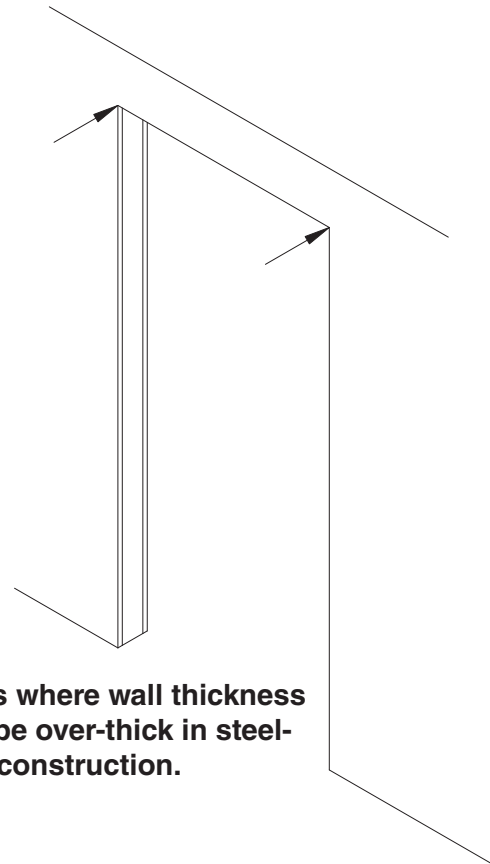
- 1) The first condition is a uniform gap along the entire length (height) of the frame jambs. The frame should be removed from the opening and the wall thickness checked at numerous places around the opening. These measurements should be compared to the job specifications. If the wall thickness is undersize, two options are available.
 - a) If the gap is relatively small, the use of caulking or trim can be considered to cover the gap when the frame is installed.
 - b) If the gap is larger, the use of "spacers" can offset the lacking wall thickness. The use of spacers requires that the frame be removed from the opening, the spacer(s) attached, and the frame reinstalled. The spacers can be used on either one or both of the frame returns which would result in spacers on either one side or both sides of the wall. Spacers are available from the frame manufacturer.

SPACERS ARE NOT TO BE USED ON LABELED FIRE DOOR FRAMES.



FRAME LOOSE ON DRYWALL *(continued)*

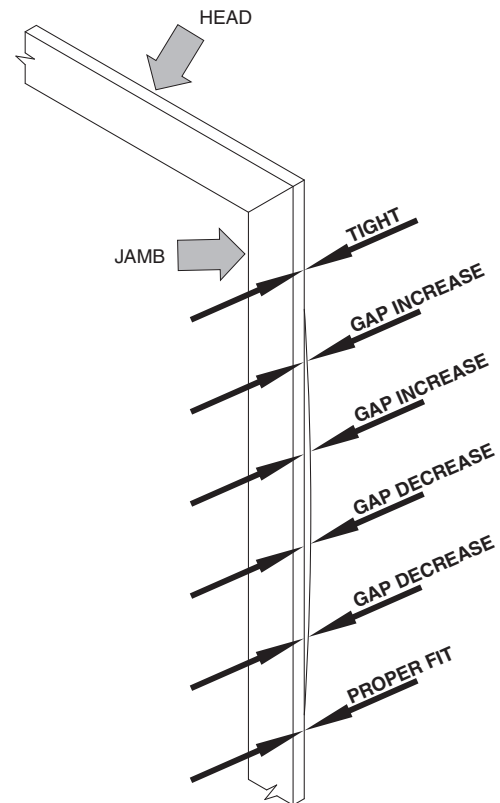
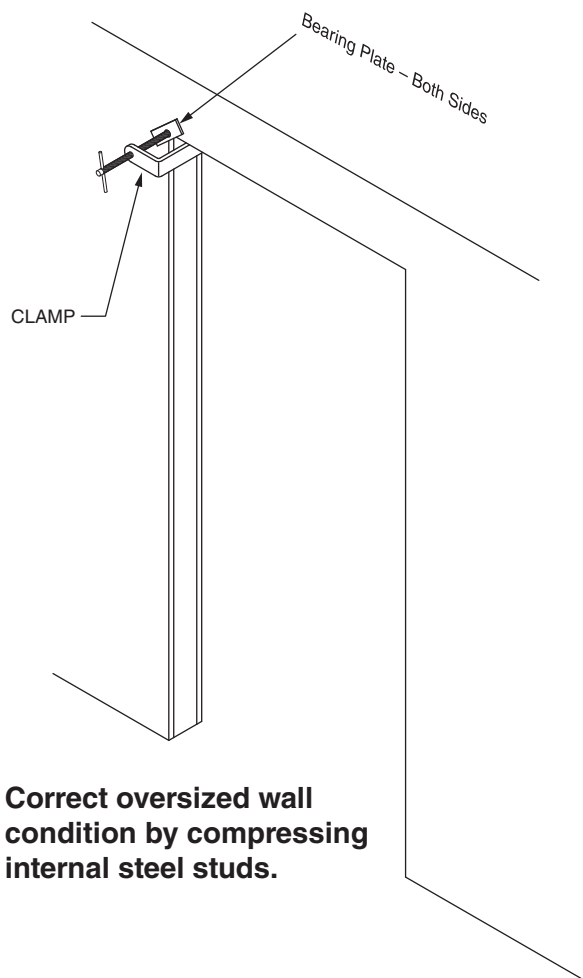
- 2) The second condition would be a gap that changes along the length (height) of the jamb. This condition is generally found in steel stud construction and results in “over thick” walls in the upper corners of the opening, refer to Figure 5. This is usually a direct result of how the steel stud headers were attached to the vertical steel studs to form the opening. When the wall is oversize (in this area) it will force the header and jamb miters to spread apart and actually open up the throat dimensions to accept the oversize wall. This will cause the corners of the frame to be extremely tight on the wall and as you progress down the jamb, a gap will begin to develop and then gradually disappear closer to the floor, see figure on following page.



Frame spreads apart with oversize wall.

FRAME LOOSE ON DRYWALL *(continued)*

This condition should be reported to the appropriate jobsite personnel. The condition can be corrected by putting a bearing plate on each side of the corner and compressing the internal steel studs with a clamp. However, the responsibility for correcting this condition belongs to the sub-contractor responsible for the actual wall construction.



Gap produced by oversized wall.

- 3) The third condition is different from the first two which address the "fit" of the frame over the wall thickness. The cause of this condition is compression anchors which have not been tightened. The drywall frame would then be loose across the width of the opening and move from side to side against the rough opening.

The frame should be plumbed, squared and secured in the opening by properly adjusting the compression anchors following the manufacturers' instructions.

GLAZED WINDOW UNITS

Hollow metal borrowed light, transom, and combination sidelight frames are an excellent choice for exterior openings due to their design flexibility, thermal performance, and security. These types of frames are not factory sealed to prevent water infiltration; the contractor/installer must seal all joints that are exposed to the elements after the frame assembly is installed.

Whenever possible it is strongly recommended that the glass and glazing be installed on the exterior rabbet of the frame. This will act as a deterrent to water penetration.

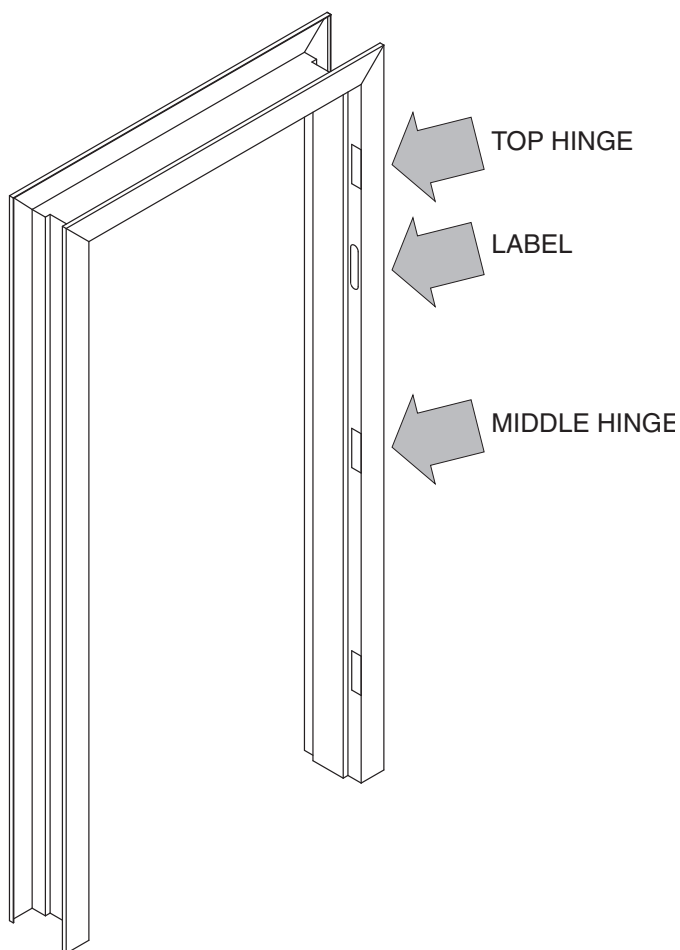
Manufacturers cannot control the workmanship associated with the installation of these types of frames, therefore, this work must be specified in the installation/glazing/caulking section of specifications.

LABEL MISSING FROM FIRE-RATED FRAME

Like doors, fire-rated frames are an important element of compliance with building codes and fire protection standards. Consequently, proper control of the labels which are attached to the frame is top priority for the manufacturer, code official and labeling agency. Once the product is in the field, whether it is installed or not, no one, including the manufacturer is permitted to attach labels unless a representative of the manufacturer's labeling agency has inspected the product for compliance with the manufacturer's procedures. Only authorized individuals can be in possession of and attach labels to fire rated products in the field.

All labels on fire rated frames are located on the hinge jamb between the top and middle hinge (see figure below). It should be noted that some frames have an embossed label, rather than a surface-attached label. The embossed label is stamped into the frame rabbet and can be painted over.

If the label or embossment is not present, the frame distributor should be contacted.



Special Notes:

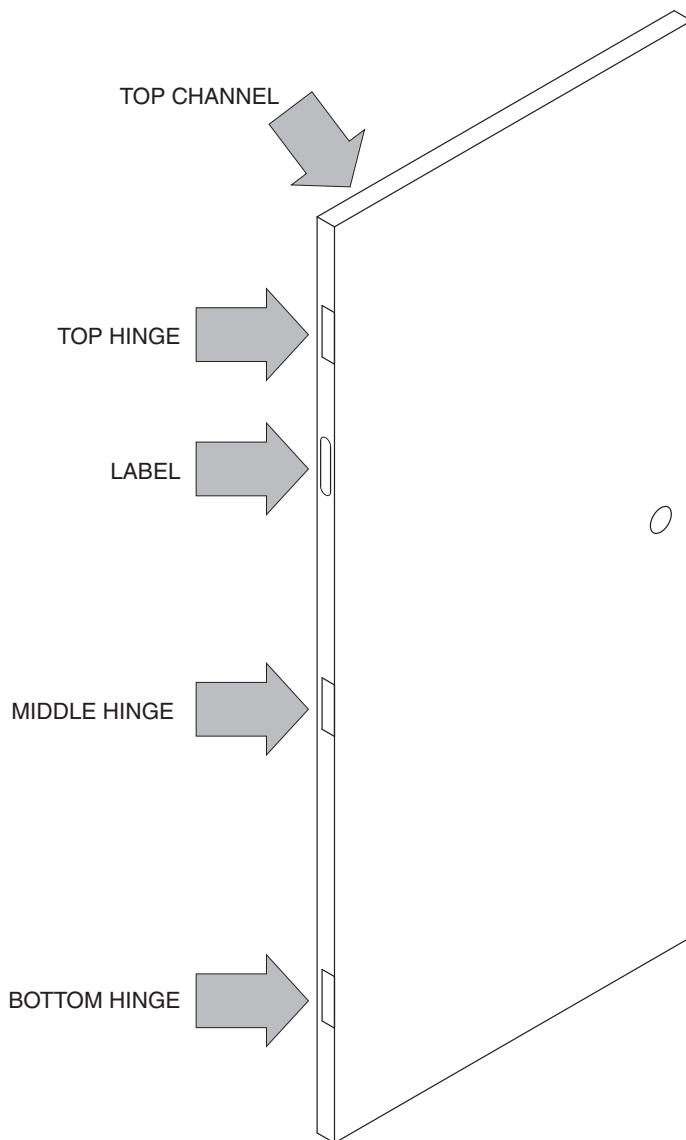
- Borrowed light frames may have labels applied to soffit of frame due to glass and glazing bead location.
- Frames incorporating continuous hinges may have labels applied to soffit or frame head.
- See manufacturer's procedures.

LABEL MISSING FROM FIRE-RATED DOOR

Fire-rated doors are an important element of compliance with building codes and fire protection standards. Consequently, proper control of the labels is top priority for the manufacturer, code official and labeling agency. (The manufacturer must account for every label used and the label can only be applied at the manufacturer's facility or at an authorized labeling distributor of the manufacturer.) Once the product is in the field, whether it's installed or not, no one, including the manufacturer is permitted to attach labels unless a representative of the manufacturer's labeling agency has inspected the product for compliance with the manufacturer's labeling procedures. Only authorized individuals may be in possession of and attach labels to fire rated products in the field.

Labels on fire-rated doors are located in one of two places, either between the top and middle hinge, or on the top channel (see figure). Be sure you are looking for the label in the correct location.

If the label is not present, the door distributor should be contacted.



Special Notes:

- Labeled doors incorporating continuous hinges may have labels placed on the top channel of the door. Check with the individual manufacturer to determine location of label.
- Labeled hollow metal transom panels may need to be removed to verify labeling if fully enclosed by a fixed hollow metal frame.
- See manufacturer's procedures.

PAINT PROBLEMS

PAINT PEELING TO BARE METAL

Two conditions exist that must be considered when evaluating paint peeling to bare metal.

1. Prime Paint Only

If the product is only prime painted, and peeling has occurred, then poor adhesion between the primer and bare metal has occurred. This can usually be attributed to inadequate surface preparation before prime painting. The bare metal must be adequately prepared to ensure good prime paint adhesion.

The door should be completely sanded, washed with solvent and re-primed. The sanding and washing operations provide an adequate surface to assure good primer adhesion.

2. Prime Paint and Top (Finish) Coat

The failure could be caused by either poor surface preparation before prime painting or the use of a non-compatible finish paint that has reacted with the primer and lifted all paint from bare metal. In either case the corrective measure would be the same. The door should be completely sanded and washed with an appropriate solvent. The door should then be re-primed. Lightly sand the prime coat, wipe and finish-paint with a compatible top coat.

Whenever the door is being prepared for top or finish-coat painting the surface should be cleaned. Use the same solvent that will be used to thin the topcoat paint and thoroughly clean all surfaces to be painted.

PAINT IN TAPPED HOLES

Both hollow metal doors and frames have various holes that are drilled and tapped. These holes are in various components such as reinforcements. All of the components are brought together as an assembly prior to the painting operation.

There are a variety of painting methods manufacturers can use. Some of these methods can result in paint build-up in the tapped holes of the reinforcements. This build-up can make installation of screws difficult. The build-up should be removed to make screw installation easier and assure that the screws are properly seated.

The best method of cleaning the tapped holes is to use an actual thread tap which matches the screw thread. The tap will easily cut through and clean paint build-up and by running it in and out of the hole. If the build-up is not as great and extra screws are available (or can be obtained) a screw can be run in and out of the hole to clean minor build-up prior to final screw installation.

WATER STAIN DAMAGE

Water stain damage is a direct result of improper storage. If the product is still in prime paint (no finish coat has been applied) the condition is easily detectable as follows:

- Initially, the water stain appears as a discoloration or variance in sheen or gloss in the primer. Damaged areas will look and possibly feel different from the rest of the product.
- If the water stain has existed for a considerable length of time and was caused by large amounts of water, rust will start to appear through the discolored areas.

If the product has had a finish coat of paint applied, water stain damage can cause failure of the finish coat as well:

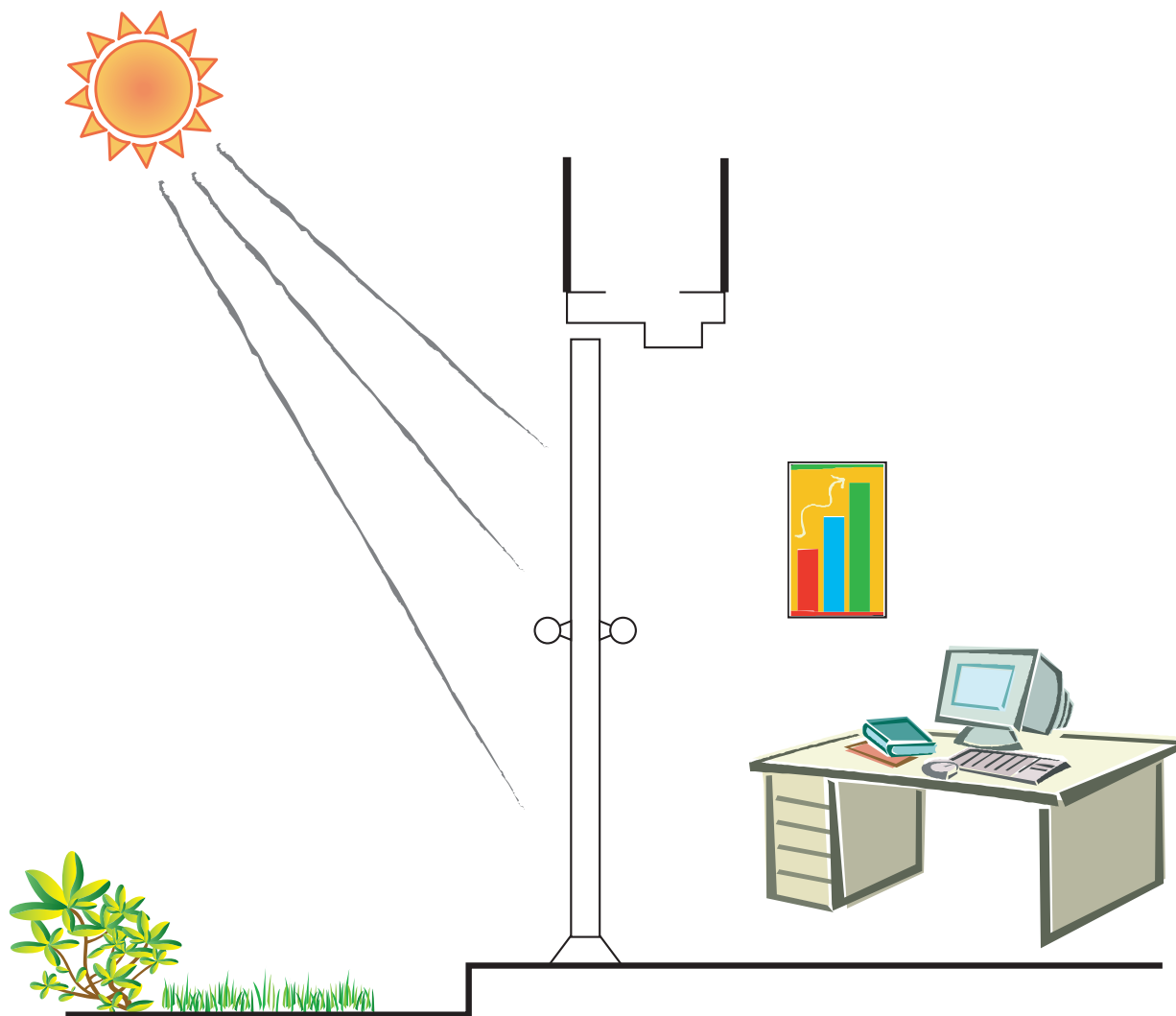
- Water stain damage can be detected by random areas of finish paint failure on the door as well as the appearance of uniform rust development on those areas. In some cases the finish paint will show good adhesion in water damaged areas but will also show a uniform layer of rust developing through the finish paint.

To correct water stain damage, use the following guidelines:

- For products that are prime painted only, the affected areas should be adequately sanded. If necessary, the area should be sanded to bare metal. The entire door/frame surface should then be lightly sanded and “feathered” into any heavily sanded areas. The entire surface should then be re-prime painted.
- For products that are finish painted, the affected areas should be adequately sanded. If necessary the area should be sanded to bare metal. The entire remaining finish-painted area should then be lightly sanded and “feathered” into any heavily sanded areas. If bare metal is showing, these areas should be re-prime painted and lightly sanded to “feather” into the lightly sanded finish-painted areas. The product should then be re-finish painted.
- When the door is being prepared for top or finish coat painting, the surface should first be cleaned. Use the same solvent that will be used to thin the topcoat paint and thoroughly clean all surfaces to be painted.

THERMAL BOW

Installers need to be aware of a condition known as Thermal Bow. Thermal Bow is a temporary condition which may occur in metal doors due to the inside-outside temperature differential. This is more common when the direct rays of the sun are on a door surface. This condition is temporary, and to a great extent depends on the door color, door construction, length of exposure, temperature, etc. This condition can often be alleviated by painting the exposed surface a light color. Thermal bow can occur in reverse under extremely cold conditions. Typical symptoms of thermal bow are hardware latching difficulty and door clearance issues.



AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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- SDI-111** Recommended Details for Standard Details Steel Doors, Frames, Accessories and Related Components
- SDI-122** Installation Troubleshooting Guide for Standard Steel Doors & Frames

Miscellaneous Documents

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- SDI-130** Electrified Hinge Preparations
- SDI-134** Nomenclature for Standard Steel Doors & Steel Frames

AUDIO-VISUAL PROGRAMS ALSO AVAILABLE

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Maintenance
of
Standard Steel Doors
and Frames



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Maintenance of Standard Steel Doors and Frames

1 Introduction

This document is intended to serve as a general outline of maintenance activities needed for standard steel doors and frames. However, it should be noted that the door and frame are virtually maintenance free. Maintenance will be, for the most part, associated with the accessories and hardware attached to the door and frame.

Maintenance of any product is important and necessary to obtain the maximum benefits of product service and longevity. Steel door and frame assemblies are not different. In fact, in some cases where the door and frame assembly is used as a “fire rated” barrier or a “leakage rated” smoke barrier, proper maintenance is crucial. Basic maintenance to ensure the proper functioning of the assembly is imperative and well worth the effort to provide for human life safety.

2 Areas to be inspected

The following items should be periodically checked. The frequency with which these checks are performed must be established at the discretion of the building owner, insurance company, labeling authority (as applicable), and maintenance service. Since doors in different areas of a building access service different traffic, the frequency of periodic inspections would occur respectively.

Hinges

Check all hinges for loose attaching screws, hinge pin wear or other notable defects. Service the hinges or remove defective parts and replace per the manufacturer’s recommendations. The door should always swing freely and smoothly without obstruction from the opened to latched (when latching device is used) position.

Locksets, panic devices, fire exit hardware

Check all locksets for loose attaching screws, latch wear or other notable defects. Service the lockset or remove defective parts and replace per the manufacturer’s recommendations. The door should always latch

freely and smoothly without obstruction. Self latching devices should always function freely and smoothly as the door swings into the closed position. Additional force should not be needed to achieve latching. Silencers (mutes) should be replaced when latch operation is compromised by wear.

Strike plate

The strike plate should be firmly attached to the frame or inactive leaf of a pair of doors. Check for loose screws and/or other notable defects. Service or remove and replace per the manufacturer’s instructions.

Closing devices

Check all closing devices for loose attaching screws, linkage arm and pin wear, **fluid leakage** or other notable defects. Service the device or remove defective parts and replace following the manufacturer’s recommendations. The primary and secondary closing speed adjustments should also be set and maintained in accordance with the manufacturer’s recommendations. The device should allow the door to operate freely and smoothly throughout its entire swing range and positively latch (if so equipped) or remain in the closed position.

Flush bolts

Check all flush bolts for loose attaching screws, rod bolt adjustment and strike plate (on both door and frame if so equipped) attachment. Service the devices or remove defective parts and replace following the manufacturer’s recommendations. The rod bolts should retract, extend and engage the strike or keeper hole freely and smoothly for both manual and/or automatic flush bolts.

Glass lights

The glazing material should be checked for cracks and/or missing pieces of glazing. The glazing mounting frame should be checked to assure all attaching screws (if used) are tight and the unit is securely attached to the door. Service the glass light or remove defective parts and replace by following the manufacturer’s rec-

ommendations. Also be sure to use approved safety glass in appropriate applications/locations, **or fire rated glass and glazing in fire doors, windows or lights.**

Door and frame finish

A general visual inspection of the door and frame finish should be periodically conducted. Any excessive finish defects should be repaired and repainted. Adequate protection is needed to help prevent the product from rusting prematurely and shortening its service life.

Unobstructed operation

Fire rated and/or smoke control assemblies are specified and installed to meet “safety to life code requirements.” It is imperative that these assemblies receive regularly scheduled maintenance checks for all of the above items. Additionally, for the assembly to serve its purpose of stopping fire and/or smoke propagation it must function freely with the ability to positively latch in the closed position. Therefore, propping or blocking these doors in an open position is in violation of intended use and purpose as established in building

codes. These doors must not be obstructed in any fashion preventing them from functioning as intended.

Gasketing/weatherstripping

A visual and operational inspection is periodically necessary for gasketed or weatherstripped areas such as perimeter seals, threshold seals, door bottoms, etc. Inspect for signs of deterioration such as splitting, cracking or deforming of flexible components. Install replacement components as needed.

Inspect operational integrity by the following method:

Gasketing should be positioned to create proper contact along the door’s entire perimeter. The test for proper contact is usually done with common paper. The paper should be firmly held in place by inserting it between the door and gasket and then closing the door. If the paper is not firmly held in place, the seal is inadequate. The paper test should be conducted along the entire perimeter.

Related Documents:

- NFPA 80 Standard for Fire Doors and Other Opening Protectives, Chapter 5
- SDI-122 Installation and Troubleshooting Guide for Standard Steel Doors and Frames

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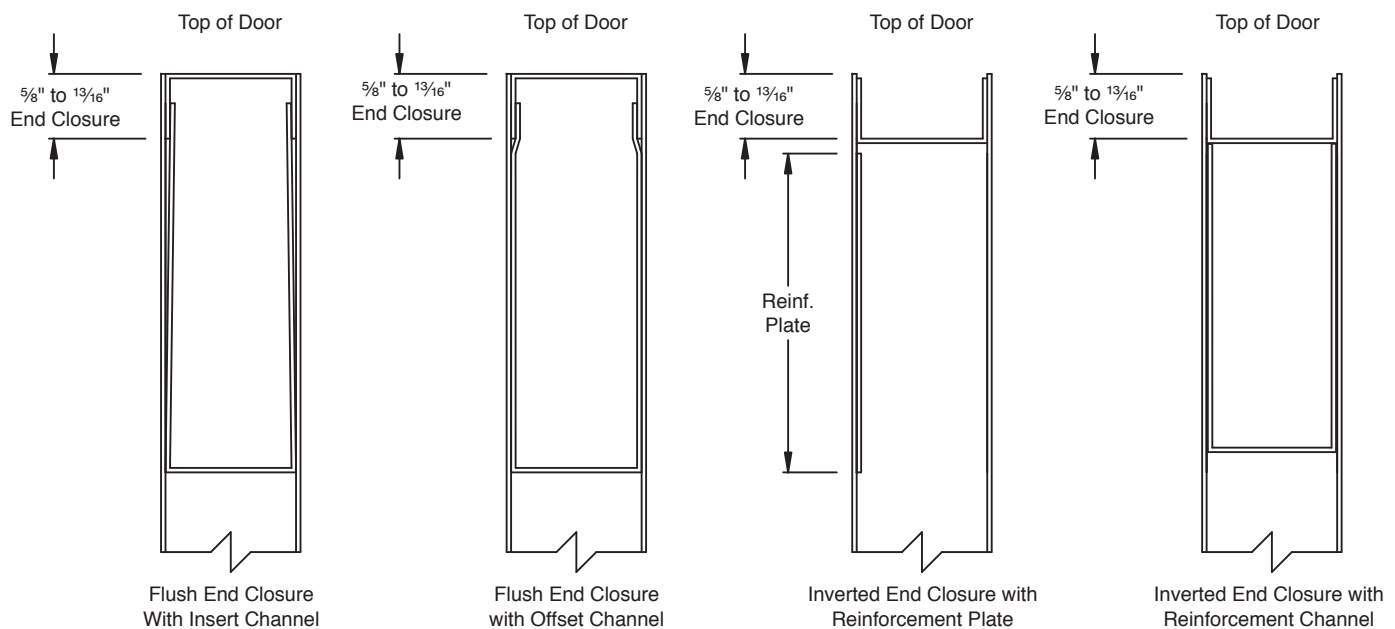
End Closure Location

The steel door industry utilizes a variety of end closure designs in standard doors. The most common are flush type end closures or inverted end closures. The inverted (legs upward) end closures in many cases may create a necessity to reposition the mounting holes for regular arm closures or surface overhead stops/holders. To avoid interference with the "web" of the top end closure channel, mounting screws must be slightly repositioned.

A similar (but less serious) situation could occur when channel-shaped closer reinforcements are inserted into flush type end closures. The additional layers of material or the joint itself could cause "creeping" of the drill bit or tap.

Illustrated below is the consensus of the Steel Door Institute members showing the location of these channel conditions on standard steel doors.

It is suggested that the hardware manufacturer and/or hardware consultant be contacted for resolution of such a conflict.



Refer to ANSI A250.8 for Material Thickness

Door Edge Cutouts

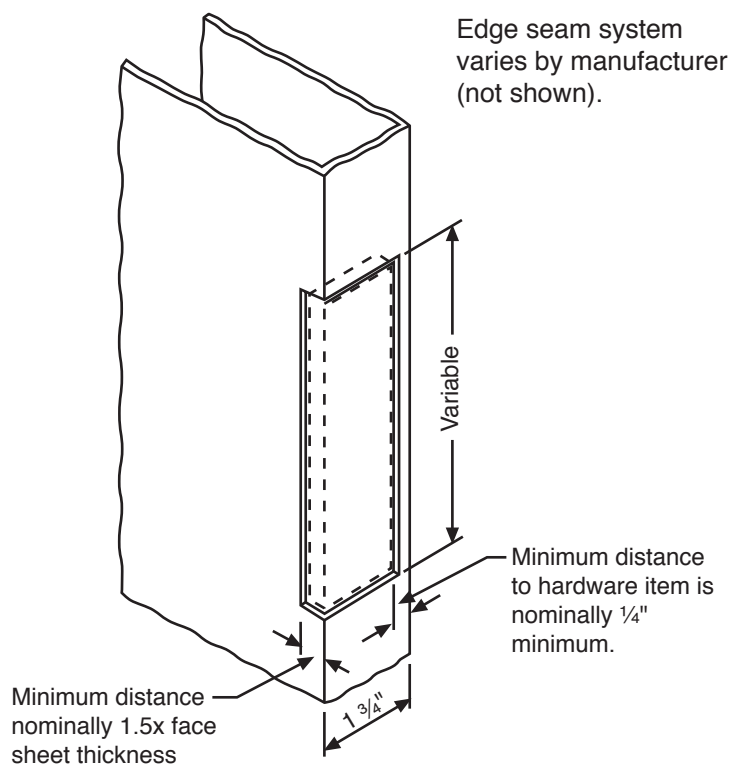
The ability to form a crisp aesthetic cutout in the edge of a steel door, especially in the vicinity of a bend line is directly influenced by the steel thickness and the proximity of the cutout to the bend line. A cutout too close to the bend line will result in a flare-out of the cutout area due to unevenly distributed stress along the brake die or rollform rollers.

The following illustrations are intended to convey dimensional limitations of the hardware items to be mortised into the edge of 1 3/4" thick standard steel doors.

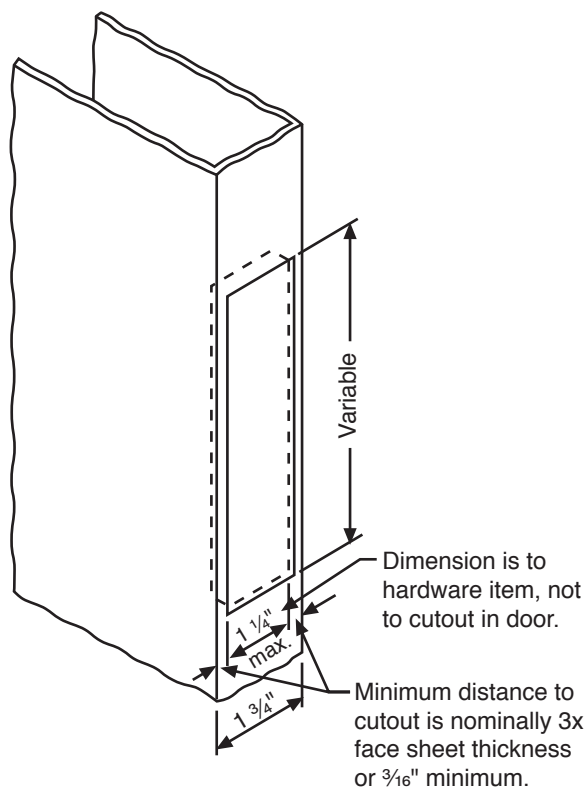
Certain lock fronts, concealed hinges, strikes, or electrical devices do not comply with these limitations. The resulting potential for inaccuracy or lack of aesthetics is inherent in the manufacturing processes and is not to be considered a defect.

Notes: Tolerances – All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

Gauge vs. Thickness – While the term 'gauge' is no longer common for defining material thickness it is still used to specify doors and frames for ordering purposes. The term 'thickness' is used when defining the actual dimension of an item, and the term 'gauge' is used in the context of specifying a particular door or frame.



Cutout Limits
Cutout Around Corner



Cutout Limits
Cutout On Edge



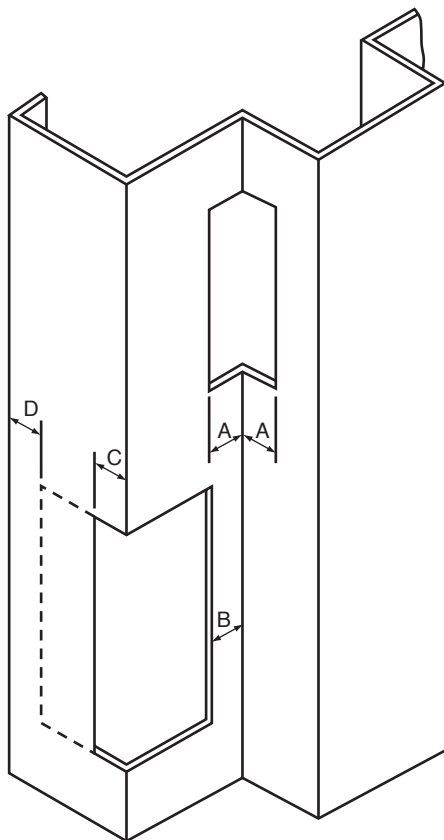
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Frame Cutout Limits

The ability to form a crisp aesthetic cutout in steel frames, especially in the vicinity of a bend line is directly influenced by the steel thickness and the proximity of the cutout to the bend line. A cutout too close to the bend line will result in a flare-out of the cutout area due to unevenly distributed stress along the brake die or rollform rollers.

The following illustration is intended to convey dimensional limitations of the hardware items to be mortised into the face, rabbet or stop of steel frames. Certain concealed hinges, strikes, or electrical devices do not comply with these limitations. The resulting potential for inaccuracy or lack of aesthetics is inherent in the manufacturing processes and is not to be considered a defect.



Notes: Tolerances – All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

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Gage	Min. Thickness	Inside Bends	Backset	Outside Bends	
		A Min.	B Min.	C Min.	D Min.
18	0.042"	$5/64$ "	$7/32$ "	$5/64$ "	$7/32$ "
16	0.053"	$3/32$ "	$7/32$ "	$3/32$ "	$7/32$ "
14	0.067"	$7/64$ "	$7/32$ "	$7/64$ "	$7/32$ "



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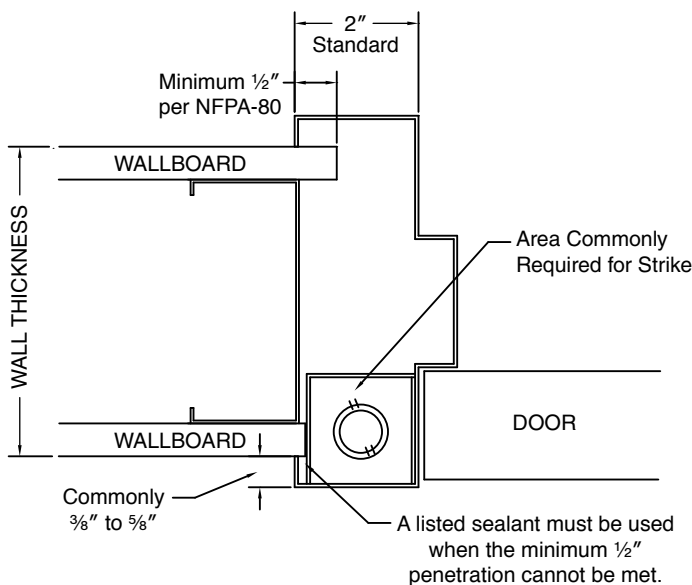
Electric Strikes & Electric Hinges in Stud Walls

Steel or wood stud drywall constructions methods and frame anchorage could result in interference between the stud and the electric strike or hinge. Notching the stud could result in compromising the stability of the frame and invalidating the fire rating of the opening.

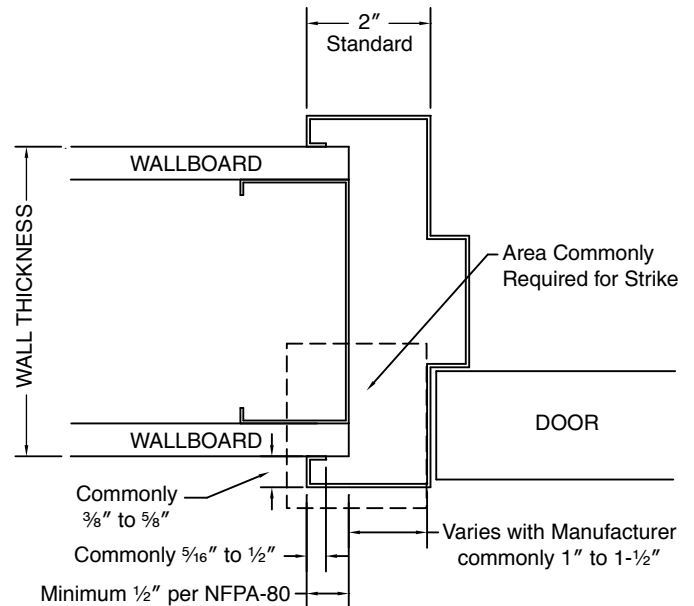
Dependent on the dimensions of the strike, the cutouts may extend beyond the frame face or the returns, thus leaving critical strike parts or wiring exposed.

Consideration should be given to specifying a strike suitably sized to fit the confines of a standard 2" face frame or specify an alternate frame profile with larger frame faces that will accommodate it.

Situations exist where the preparation for an electric strike or hinge does not allow the drywall to penetrate the throat of a fire rated frame the required 1/2-inch in the immediate area of the hardware. When this occurs, a penetration or joint seal (e.g. intumescent caulk) listed for gypsum wall assemblies must be applied to the affected area; thereby, sealing any potential gap and ensuring the continuity of the fire barrier.



Typical Frame Profile



Slip-on Drywall Frame



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Prime Painted Materials Alert

Prime Painted Doors, Frames, and Accessories (where applicable) shall comply with the acceptance criteria specified in ANSI A250.10-2011. Doors and frames are cleaned and treated prior to painting to ensure maximum paint adhesion. All exposed surfaces are then given a factory-applied coat of rust inhibiting “direct to metal” type primer. The primer is then baked, air dried, or otherwise cured as appropriate for the primer.

This process is intended to protect the steel surfaces for a period of time under reasonable weather exposure conditions. Factory applied primer coatings may be somewhat porous in order to accept finish coatings. The primer coating may therefore be susceptible to the action of moisture or ambient moisture condensation during shipping or storage. For example, transportation of materials in unprotected “open” trucks during inclement weather (rain or snow) or on roadways where salt or other snow melting agents are used will deteriorate the primer. Extended exposure to such conditions may result in rusted or water stained areas. ANSI A250.8-2017 (SDI-100) paragraph 4.1 presents Industry recommended jobsite storage requirements.

Should the primer become scratched, abraded, rusted or stained, the affected areas may rust unless sanded and reprimed with a suitable “direct to metal” primer containing rust inhibitors.

Prior to application of finish coats, the substrate shall be inspected by the Painting Contractor. All Architectural Specification requirements along with all requirements of the paint manufacturer shall be followed. These will generally include scuff sanding of the substrate to remove foreign materials, scratches or abrasions from construction processes, along with any special or mandatory requirements for primer touch-up or additional primers required by the paint system.

MOST IMPORTANTLY, the field applied primer and finish paint “systems” must be designed for direct to metal applications and contain rust inhibiting properties.

IF COATING COMPATIBILITY IS AN ISSUE, contact the SDI Manufacturers or their local distributors who can provide information or “sample” materials for the painting contractor’s use.



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Butted Frames Rough Opening Sizes

The variety of existing wall anchors available from SDI Members allow Standard Steel Door Frames to be a reliable option for existing wall, structural steel wall framing or retrofit installations utilizing a butted to wall application. In order to make the installation successful, careful consideration shall be given to all tolerances involved and that sufficient clearance is figured to allow for them.

It has been “customary” to allow clearance around the frame perimeter when establishing rough opening sizes or when figuring non-standard overall frame sizes. This clearance is necessary to compensate for any allowable manufacturing tolerances, installation tolerances, or substrate conditions. Tolerances and clearances are referenced both pictorially and verbally in a number of Industry documents such as:

- SDI-110-18 (butted frames)
- SDI-111F-07 (existing wall anchors)
- SDI-117-19 (manufacturing tolerances)
- ANSI A250.8-2012
- ANSI/SDI A250.11-2012
- ANSI/NAAMM HMMA 840-17
- ANSI/NAAMM HMMA 841-13

Frames will “fit and function” if made to these dimensional tolerances and installed within tolerances. There is, however, relatively no assurance that the substrate (walls) will be of suitable size or alignment.

We therefore recommend that the rough openings for these cases be no less than $\frac{3}{16}$ " larger on all 3 sides than the “intended” overall frame size. (Example: 3070 standard frame = 3'-4 $\frac{3}{8}$ " x 7'-2 $\frac{3}{16}$ "). The installer carries the responsibility for shimming and aligning as necessary. Gaps are normally sealed as part of the installation or caulking/painting process. Architectural Specifications are to be consulted to determine the appropriate sealant material to be used at fire door or smoke control frames.

Frame Installation in Cast-in-Place Concrete Walls: While the use of hollow metal frames in cast-in-place concrete walls is a common construction practice, the SDI does not recommend the inclusion of the frame as part of the process of pouring the wall. Instead, a rough-opening should be blocked out no less than $\frac{3}{16}$ " (4.8 mm) larger than the frame on all three sides. For example the opening for a 3'-0" x 7'-0" standard frame with 2" faces would be 3'-4 $\frac{3}{8}$ " x 7'-2 $\frac{3}{16}$ " minimum. The installer is responsible for anchoring the frame per the manufacturer's installation instructions, shimming and aligning as necessary.

Note: All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm \frac{1}{16}$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.



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Environmental Considerations Relating to Factory Painted Steel Doors and Frames

There is an Industry need for a comprehensive revision of specifications, practices and procedures that will allow compliance with existing and future regulations. The Member Companies of the Steel Door Institute have taken the steps needed to eliminate from their primers, those elements identified by Regulatory Authorities as hazardous to human health and the environment. This is not only a moral responsibility toward society, but also a survival responsibility toward the business. The SDI encourages specification writers to look at these issues very carefully when they specify coating requirements.

Federal and State Laws have regulated the management of hazardous waste so as to not pose a threat to the environment or human health. Environmental Protection Agencies are very strict in regulations that affect coating applications, by limiting the emission to the atmosphere of the amount of VOC (Volatile Organic Compound), which has curtailed the use of solvent base paints.

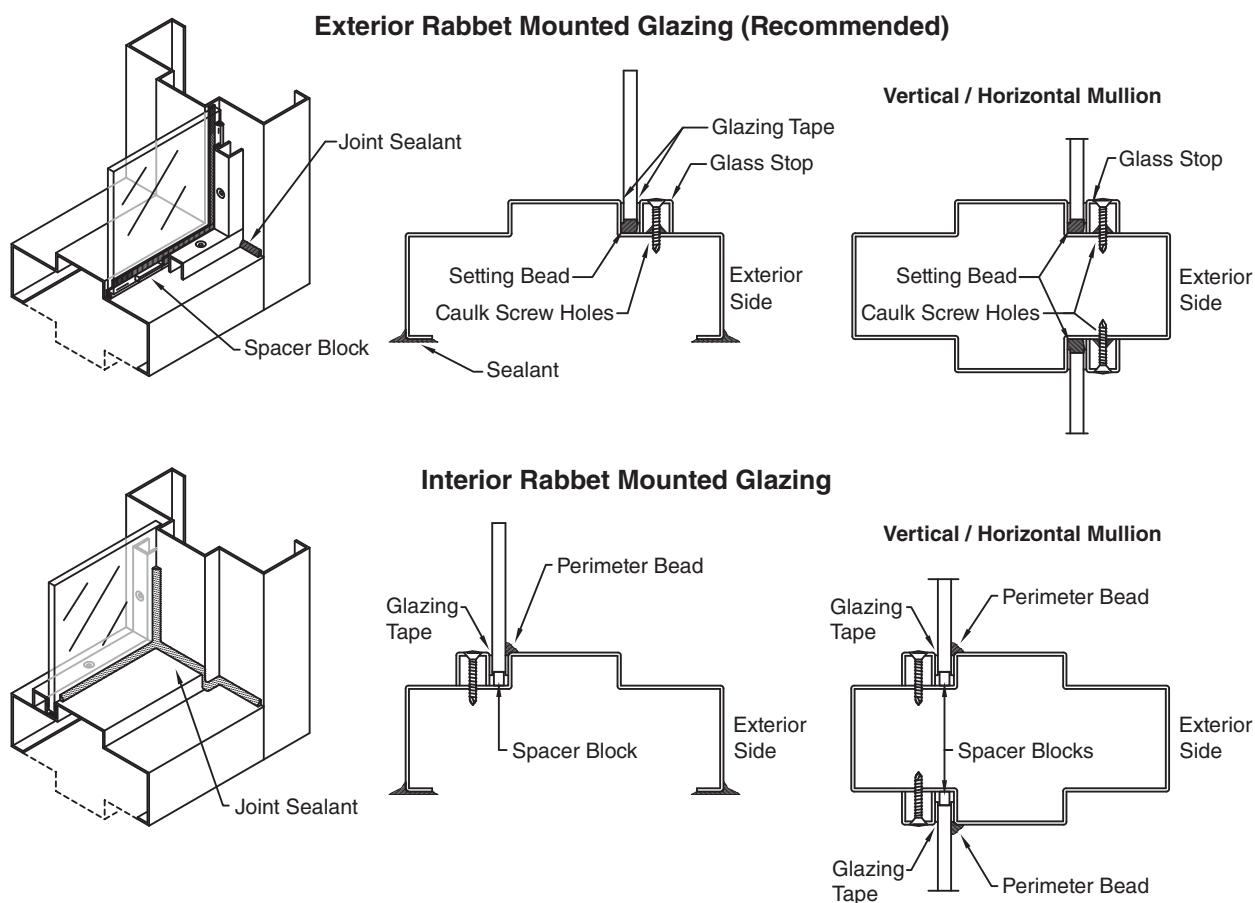
Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III) sets up the reporting requirements in the metal fabricating industry for all wastes containing any listed toxic chemical, which affects the use of heavy metals (such as Zinc-Chromates) as rust inhibitors.

Water Penetration

Borrowed light assemblies, transom, sidelight, and combination transom sidelight frames are not factory sealed to prevent water penetration. In situations where water penetration is a concern, the contractor must seal all joints that are exposed to the elements after the frame assembly is installed.

Whenever possible, it is strongly recommended that glass and glazing be installed on the exterior rabbet of the frame assembly. This will help act as a deterrent to water penetration.

The member companies of the hollow metal industry can not control the workmanship associated with the frame installation; therefore, it is the responsibility of the installer to assure all steps are taken to prevent water penetration.



Grouting Frames in Drywall

Some Architectural Specifications require frames in stud and drywall partitions to be filled with grout for sound deadening or to enhance structural integrity.

The STEEL DOOR INSTITUTE is opposed to this practice for the following reasons:

- In drywall construction, this moisture has two places to go. It can soak into the drywall, potentially destroying its cohesive integrity and thus the ability to retain anchors or frame integrity, or it can leach downward where it will cause premature rusting of anchors, screws, stud connections, bottom of frames, etc.
- Grouting does not appreciably afford any additional structural rigidity to the frame. As an example, slip-on drywall frames have passed fire and hose stream tests, cycle tests, and in some cases impact tests without being grouted.
- If the intention is for sound deadening, SDI 128-19 (Section 3) should be consulted. In addition, the same insulation as used between wall studs (generally lightly packed fiberglass) will serve as a sound deadener without the potential for damage to the frame or wallboard.

Higher STC (Sound Transmission Class) products (over STC 40) may require that the frame be grouted with a cement-based grout or mortar as this was the tested condition. In these cases, the frames should be grouted and thoroughly cured prior to installation of the frame in the drywall wall.

It is therefore the opinion of the STEEL DOOR INSTITUTE that grouting should **not** be specified or used for drywall construction except as described above.

Back-Coating of Frames

Some Architectural Specifications require steel frames to be back-coated with a “bituminous” coating for corrosion protection and sound control. The term “Bituminous” is defined as an asphalt or tar material obtained as a residue from heat refined petroleum. For years it was not recommended by Steel Door Institute for frames to be factory back-coated. This procedure was to be done at the jobsite by the contractor or appropriate trade immediately prior to installation of the frame.

Modern materials available today offer manufacturers the opportunity to back-coat frames with a more user friendly and environmentally sound product. Some of these coatings are free of VOCs (Volatile Organic Compounds) and can also easily be used to touch up frames that are welded on-site.

For corrosion protection, ANSI/SDI A250.11-2012 paragraph 2.2.1 clearly states that “the contractor responsible for installation” applies corrosion resistant coatings only where specified for anti-freeze agents in the mortar. “Anti-freeze agents are accelerators (e.g. – calcium chloride) intended to increase the rate of mortar strength development not reduce the freezing point of mortar. The Steel Door Institute recommends not using any accelerating additives to the mortar used to back-fill or grout frames. ANSI/SDI A250.11, Paragraph 2.3.2 states that “grout shall be mixed to provide a 4” maximum slump”. Grout mixed to a thinner consistency has excessive moisture and requires longer cure times which increase the potential for corrosion.



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Improper Wedges as Hold-Opens

It has come to the attention of the Steel Door Institute (SDI) that cleaning or maintenance personnel have been incorrectly wedging doors to hold them open. This has been reported mainly in health care or hotel-motel installations at patient rooms, utility rooms, sleeping rooms, and even stairways.

Instead of using rubber wedges at the bottom of doors or suitable hold-open mechanisms, wedges of various materials have been inserted between the hinge edge of the door and the hinge jamb. This practice puts an abnormal stress on the hinge reinforcements, hinge knuckles, and attachment screws causing potential damage to any or all of these components.

Damage, loosening, or failure resulting from this practice shall not be construed as a door, frame, or hardware defect or warranty issue. The SDI strongly discourages the use of wedges in this manner or any methods for holding doors open that will compromise the fire or life safety integrity of the openings.

The importance of unrestricted closing and latching of door openings in fire situations is further discussed in Sections 9 through 9.5 of SDI-118 "Basic Fire Door Requirements".

Buyer Beware Steel Doors with Lead-Based Primer

Excessive lead paint in toys has been in the news a great deal lately. Just ask the toy industry about the far reaching impact of selling products that don't comply with federal regulations. U.S. manufacturers, contractors, and end users are aware of the regulations concerning the limitations of lead in paint. Although the toy industry may not have knowingly violated these regulations, it is embroiled in this issue because it didn't closely regulate the production of these toys in a country where lead in paint is an accepted practice. United States industries need to comply with applicable regulations for all products that they produce, including all components and assemblies that are outsourced to foreign manufacturers.

In light of the issues raised by the toy industry example and others, the Steel Door Institute felt it worthwhile to investigate the lead content of paint contained on steel doors imported into the United States. The investigations were conducted by independent laboratories on randomly selected doors taken from various regions throughout the United States. The results showed that all the doors tested exceed the allowable lead content for paint used in residential and other consumer products. To ensure consumer safety and, to protect the interests of its membership as well as the industry as a whole, SDI believes it is important to bring attention to this issue.

Risks of Using Lead-Based Paint

In addition to the issues associated with non-compliance with the federal statutes and regulations, there are more serious risks associated with manufacturing, importing, buying or selling products that contain lead-based paint. There are significant physical risks associated with ingesting lead by breathing or swallowing lead dust, which can affect workers during construction and installation as well as the ultimate consumers who may come into contact with the surfaces. For example, standard practice for top coat painting steel doors and frames is to rough up the primer on the face of the door with abrasive sheets to improve adhesion to the primer. This practice will release lead



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dust that could be potentially inhaled by the painter or other workers in the general vicinity. In addition, painting over lead-based paint with non-lead paint is not a long-term solution. Even though the lead-based paint may be covered by non-lead paint, the lead-based paint may continue to loosen from the surface below and create lead dust. The new paint may also partially mix with the lead-based paint, and lead dust will be released when the new paint begins to deteriorate.

Restrictions on the Use of Lead-Based Paint

There are a number of statutory restrictions on the use of lead-based or lead containing paint in the United States. The Residential Lead-Based Paint Hazard Reduction Act of 1992 (P.L. 102-550, October 28, 1992) incorporates the definition of lead-based paint contained in Section 302(C) of the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. 4831), which characterizes any paint that contains more than .5% by weight of lead as "lead-based paint."

Together, these two statutes prohibit the use of any paint with excessive lead content in new residential structures, and mandate strict disclosure requirements with respect to the lead content of paint in existing dwellings.

The lead content restrictions are even more stringent under the Consumer Product Safety Act, which reduces the threshold for characterization as lead-containing paint to .06% by weight of the total non-volatile content of the paint or the weight of the dried paint film, and prohibits the use of such paint in residences and consumer products.

This prohibition extends to any products that may be used by consumers following an initial sale, including those contained in apartment buildings, schools, hospitals, hotels, parks and any other public places or areas where consumers may have access to the painted surfaces. (Consumer Product Safety Act, 15 U.S.C. 2057, 2058; 16 C.F.R. 1303.)

Due to the significant potential risks and costs associated with those risks of importing and/or distributing doors containing lead-based paint, the Steel Door Institute feels obligated to alert the industry to the issue and to urge the general public to be aware of the products that they are associated with, so that they can monitor compliance with all applicable laws.

The Steel Door Institute does not make any assertions or conclusions other than those specifically contained herein, which are limited in scope and used for illustrative purposes only.

For more information on steel doors and frames, contact any of the following members of the Steel Door Institute

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AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

AUDIO-VISUAL PROGRAMS ALSO AVAILABLE



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Guidelines for
**Acoustical Performance
of Standard Steel Doors
and Frames**



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Guidelines for Acoustical Performance of Standard Steel Doors and Frames

1 General

1.1 Scope

This document shall provide guidelines for the specifying, installing, and adjusting of standard steel doors and frames in applications where sound control is a consideration.

1.2 Definitions

1.2.1 Sound Transmission Class

A single number rating that indicates the sound transmission loss over a defined range of frequencies of a door assembly between adjacent closed rooms, abbreviated STC. Higher values equate to better sound reduction performance.

1.2.2 Outdoor-Indoor Transmission Class

A single number rating used to compare door assemblies when subjected to exterior sounds, such as ground or air transportation noise, is abbreviated OITC.

1.2.3 Sound transmission loss – TL

The reduction in sound level at specific frequency levels when sound passes through a door assembly.

1.2.4 Frequency

The number of cycles per second of a sound wave, measured in units of Hertz and abbreviated Hz.

1.2.5 Decibel – dB

A unit used to express the intensity of a sound wave, equal to 20 times the common logarithm of the ratio of the pressure produced by the sound wave to a reference pressure, usually 0.0002 microbar.

1.2.6 Sound Control Door Assembly

An assembly consisting of a door, frame, hardware, threshold, and gasketing, capable of reducing the transmission of sound.

2 Gauge vs. Thickness

While the term 'gauge' is no longer common for defining material thickness it is still used to specify doors and frames for ordering purposes. The term 'thickness' is used when defining the actual dimension of an item, and the term 'gauge' is used in the context of specifying a particular door or frame.

3 Testing

3.1 Test Specimen

Unless otherwise specified, the test specimen shall be a nominal 36" (914 mm) wide, by 84" (2133 mm) high for single doors and 72" (1,829 mm wide, by 84" (2133 mm) high for pairs of doors. All doors shall be 1 3/4" (44 mm) in thickness. All doors shall be fully operable. A detailed description of the test assembly shall be included in the test report.

Ratings derived from non-operable assemblies shall only be used for experimental purposes and are not part of this document.

3.2 Test Method

The door assemblies shall be tested in accordance with ASTM E 90. The STC and OITC ratings shall be calculated in accordance with ASTM E 413 and E 1332, respectively. The latest editions of the standards shall be used in determining the STC and OITC ratings. Testing shall be performed at laboratories that are accredited under the National Voluntary Laboratory Accreditation Program (NVLAP)

3.3 Test Results and Report

The test report shall be prepared by the test laboratory and shall contain the information identified in Section 13 of ASTM E 90 or Section 8 of ASTM E 1425.

4 Design Criteria

4.1 Performance Considerations

The proper function of acoustical doors relies on a combination of factors that are under the control of various firms, trades, specifiers, suppliers, and designers. Without the cooperation of all concerned, the installed opening may not function as intended. Proper seal installation and adjustment are critical to the performance of the opening. The installation guidelines shall be provided by the manufacturer.

Consideration must be given to correctly specifying the door capability for the project condition. Some doors, although rated higher in overall STC or OITC ratings may not perform as well as lower rated doors at certain frequencies. The test reports should be reviewed to establish the best TL values at the frequencies under consideration for a given project.

Room design should create a full enclosure equal to or greater than the door's TL capabilities. For example, walls that do not run full height to a similar rated overhead structure will allow sound leakage through ceilings, louvers, pipe chases, access doors, etc.

Carpeting, although considered a good source of sound absorption, should not be used underneath acoustical doors. Door bottom gaskets must compress against a solid object to affect a proper seal. Carpeting by its nature does not provide that type of surface.

Walls, in addition to their STC rating, should be designed to support the additional weight of acoustical doors. A wall that moves or flexes each time the door is operated cannot ensure that the gasket alignment will be maintained.

The manufacturer's literature should be consulted to determine the weight of acoustical doors; especially, those that have higher acoustical ratings.

4.2 Field Testing

Results obtained from field-testing may vary from those obtained under laboratory conditions. Atmospheric conditions, room volumes, wall type and design, sound diffusion, test equipment, etc. may affect the results obtained when testing in the field.

4.3 Hardware Considerations

Hardware should be specified giving special consideration to the fact that it will be used on acoustical doors. Any type of hardware that may be the source of sound leakage should be avoided. Since all acoustical doors depend on a tight perimeter seal, some types of hardware will become difficult to operate due to the compression required to seal the opening.

AVAILABLE PUBLICATIONS

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Hinge and Strike Spacing



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Cautionary Statement

The hinge and strike spacings presented in this brochure are intended as a reference to inform the reader of the standard locations used in the manufacture of steel doors and frames by SDI member companies for the opening sizes shown.

The user must be aware that these spacings shall not be relied upon when retrofitting doors or frames to an existing installation. Field verification of hinge and strike spacings in this situation is necessary.

Dimensions listed are valid at the time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.

The Steel Door Institute and its member companies shall not be held liable for products manufactured using the information published here.

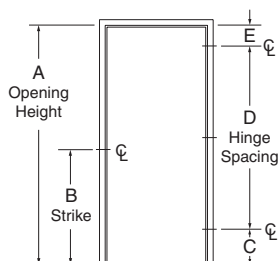
Notes

Tolerances – All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

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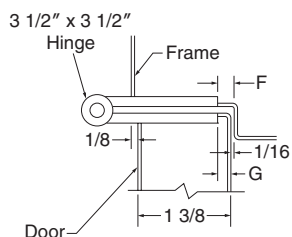
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Ceco Door



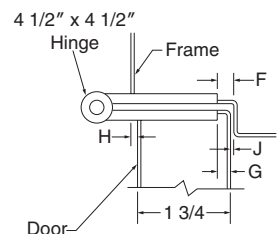
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.

Note: On 3 1/2" hinge preparation for 1 3/8" doors, the standard for 6'-8" non-fire rated frames is two (2) hinges.



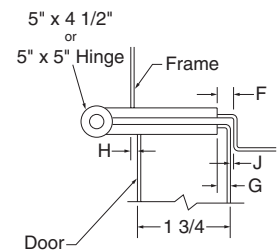
3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors

A	B	C	D	E	F	G
6'-8"			2 @ 29-15/16"			
7'-0"	40-5/16"	10-3/8"	2 @ 31-15/16"	9-3/4"	5/16"	1/4"
7'-2"			2 @ 32-15/16"			



4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors

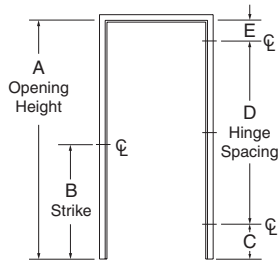
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 31"					
6'-10"			2 @ 32"					
7'-0"			2 @ 33"					
7'-2"			2 @ 34"					
7'-4"			2 @ 35"					
7'-6"	41-13/16"	9"	2 @ 36"	9"	5/16"	1/4"	1/8"	1/16"
7'-8"			3 @ 24-21/32"					
7'-10"			3 @ 25-21/64"					
8'-0"			3 @ 26"					
9'-0"			3 @ 30"					
10'-0"			3 @ 34"					



5" Hinge & Strike Comparison for 1-3/4" Thick Doors

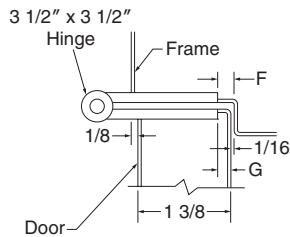
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 31"					
6'-10"			2 @ 32"					
7'-0"			2 @ 33"					
7'-2"			2 @ 34"					
7'-4"			2 @ 35"					
7'-6"	41-13/16"	9"	2 @ 36"	9"	5/16"	1/4"	1/8"	1/16"
7'-8"			3 @ 24-21/32"					
7'-10"			3 @ 25-21/64"					
8'-0"			3 @ 26"					
9'-0"			3 @ 30"					
10'-0"			3 @ 34"					

Curries

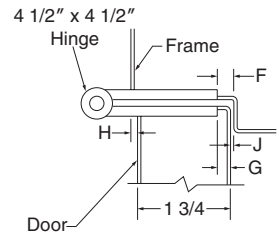


Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.

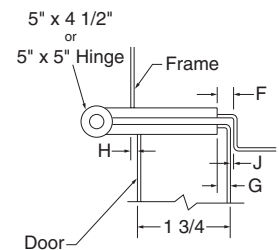
Note: On 3 1/2" hinge preparation for 1 3/8" doors, the standard for non-fire rated frames is two (2) hinges.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"		10-3/8"	2 @ 29-15/16"			
7'-0"	40-5/16"	10-3/8"	2 @ 31-15/16"	9-3/4"	5/16"	1/4"
7'-2"		10-3/8"	2 @ 32-15/16"			

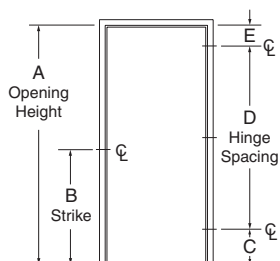


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		12-1/4"	2 @ 30-1/4"					
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"	40"	12-1/4"	2 @ 35-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
7'-8"		12-3/8"	3 @ 24-1/8"					
7'-10"		12-1/8"	3 @ 24-7/8"					
8'-0"		12-1/4"	3 @ 25-1/2"					
9'-0"		12-1/4"	3 @ 29-1/2"					
10'-0"		12-1/4"	3 @ 33-1/2"					

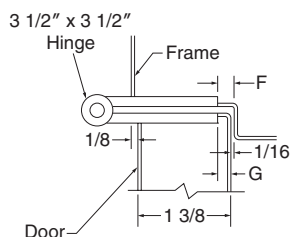


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		12-1/4"	2 @ 30-1/4"					
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"	40"	12-1/4"	2 @ 35-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
7'-8"		12-3/8"	3 @ 24-1/8"					
7'-10"		12-1/8"	3 @ 24-7/8"					
8'-0"		12-1/4"	3 @ 25-1/2"					
9'-0"		12-1/4"	3 @ 29-1/2"					
10'-0"		12-1/4"	3 @ 33-1/2"					

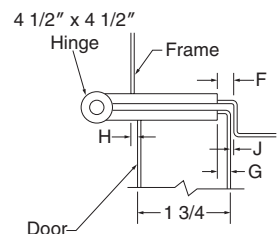
Deansteel Manufacturing Co.



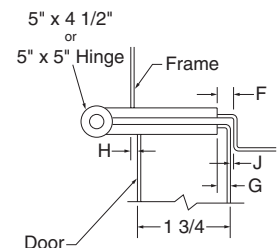
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"			61-1/2"			
7'-0"	40-5/16"	11-3/4"	2 @ 32-3/4"	6-3/4"	5/16"	1/4"
7'-2"			2 @ 33-3/4"			

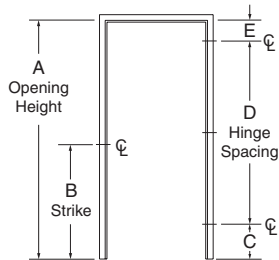


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30-1/4"					
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"			2 @ 34-1/4"					
7'-6"	40-5/16"	12-1/4"	2 @ 35-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
7'-8"			24-1/8", 24-1/4", 24-1/8"					
7'-10"			24-7/8", 24-3/4", 24-7/8"					
8'-0"			3 @ 25-1/2"					
9'-0"			3 @ 29-1/2"					
10'-0"			3 @ 33-1/2"					

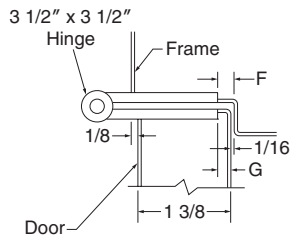


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		12-1/2"	2 @ 30"					
6'-10"		12-1/2"	2 @ 31"					
7'-0"		12-1/2"	2 @ 32"					
7'-2"		12-1/2"	2 @ 33"					
7'-4"		12-1/2"	2 @ 34"					
7'-6"	40-5/16"	12-1/2"	2 @ 35"	7-1/2"	5/16"	1/4"	1/8"	1/16"
7'-8"		12-1/2"	3 @ 24"					
7'-10"		12-1/2"	24-5/8", 24-3/4", 24-5/8"					
8'-0"		12-1/2"	25-3/8", 25-1/4", 25-3/8"					
9'-0"		12-9/16"	3 @ 29-5/16"					
10'-0"		12-9/16"	3 @ 33-5/16"					

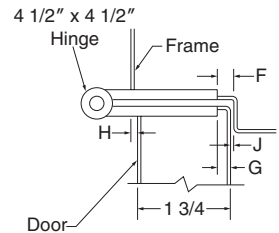
Door Components Inc.



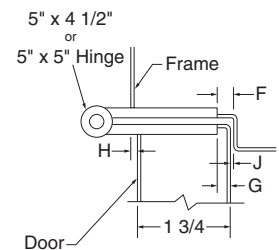
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"			2 @ 29-15/16"			
7'-0"	40-5/16"	10-3/8"	2 @ 31-15/16"	9-3/4"	5/16"	1/4"
7'-2"			2 @ 32-15/16"			

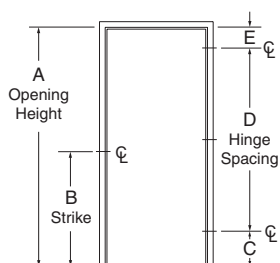


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 29-15/16"					
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"	40-5/16"	10-3/8"	2 @ 34-15/16"	9-3/4"	5/16"	1/4"	1/8"	1/16"
7'-8"			23-15/16", 24", 23-15/16"					
7'-10"			3 @ 24-5/8"					
8'-0"			25-5/16", 25-1/4", 25-5/16"					
9'-0"			29-5/16", 29-1/4", 29-5/16"					
10'-0"			33-5/16", 33-1/4", 33-5/16"					

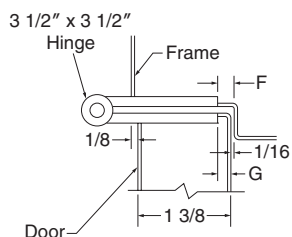


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 29-15/16"					
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"	40-5/16"	10-3/8"	2 @ 34-15/16"	9-3/4"	5/16"	1/4"	1/8"	1/16"
7'-8"			23-15/16", 24", 23-15/16"					
7'-10"			3 @ 24-5/8"					
8'-0"			25-5/16", 25-1/4", 25-5/16"					
9'-0"			29-5/16", 29-1/4", 29-5/16"					
10'-0"			33-5/16", 33-1/4", 33-5/16"					

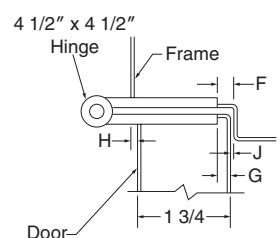
Hollow Metal Xpress



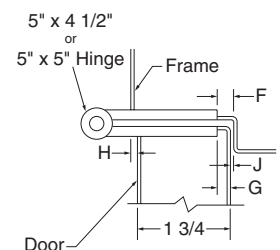
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
—	—	—	—	—	—	—

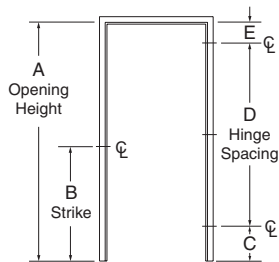


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	3/8"	1/4"	1/16"	1/8"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"					
7'-10"			3 @ 24-5/8"					
8'-0"			3 @ 25-19/64"					
9'-0"			3 @ 29-19/64"					
10'-0"			3 @ 33-19/64"					

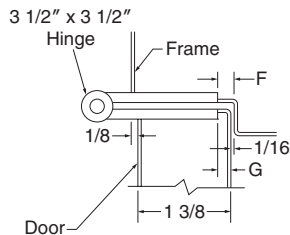


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	3/8"	1/4"	1/16"	1/8"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"					
7'-10"			3 @ 24-5/8"					
8'-0"			3 @ 25-19/64"					
9'-0"			3 @ 29-19/64"					
10'-0"			3 @ 33-19/64"					

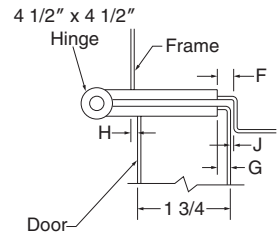
Mesker Door, Inc.



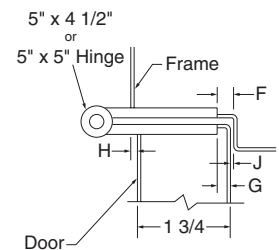
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"			61-1/2"			
7'-0"	40-5/16"	11-3/4"	2 @ 32-3/4"	6-3/4"	1/4"	3/16"
7'-2"			2 @ 33-3/4"			

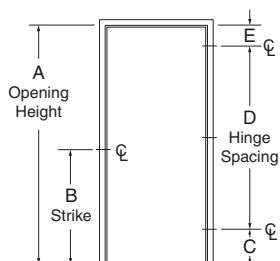


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		12-1/4"	2 @ 30-1/4"					
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"	40-5/16"	12-1/4"	2 @ 35-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
7'-8"		11-1/4"	3 @ 24-1/2"					
7'-10"		10-1/4"	3 @ 25-1/2"					
8'-0"		12-1/4"	3 @ 25-1/2"					
9'-0"		12-1/4"	3 @ 29-1/2"					
10'-0"		12-1/4"	4 @ 25-1/8"					

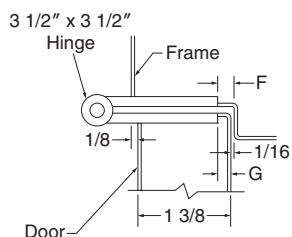


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		12-1/4"	2 @ 30-1/4"					
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"	40-5/16"	12-1/4"	2 @ 35-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
7'-8"		11-1/4"	3 @ 24-1/2"					
7'-10"		10-1/4"	3 @ 25-1/2"					
8'-0"		12-1/4"	3 @ 25-1/2"					
9'-0"		12-1/4"	3 @ 29-1/2"					
10'-0"		12-1/4"	4 @ 25-1/8"					

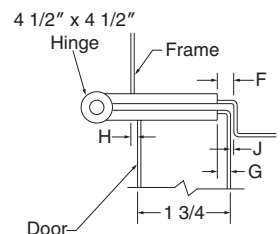
MPI



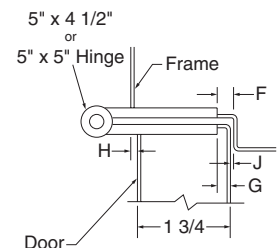
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"	40-5/16"	11-3/4"	2 @ 30-3/4"	6-3/4"	5/16"	1/4"
7'-0"			2 @ 32-3/4"			
7'-2"			2 @ 33-3/4"			

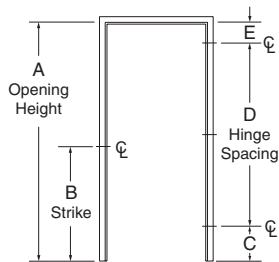


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"			2 @ 34-1/4"					
7'-6"			2 @ 35-1/4"					
7'-8"			2 @ 24-3/16", 1 @ 24-1/8"					
7'-10"			2 @ 24-13/16", 1 @ 24-7/8"					
8'-0"			3 @ 25-1/2"					
9'-0"			3 @ 29-1/2"					
10'-0"			3 @ 33-1/2"					

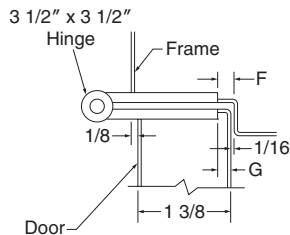


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/2"	2 @ 30	7-1/2"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 31					
7'-0"			2 @ 32					
7'-2"			2 @ 33					
7'-4"			2 @ 34					
7'-6"			2 @ 35					
7'-8"			3 @ 24					
7'-10"			2 @ 24-11/16", 1 @ 24-5/8"					
8'-0"			2 @ 25-5/16", 1 @ 25-3/8"					
9'-0"			2 @ 29-5/16", 1 @ 29-3/8"					
10'-0"			2 @ 33-5/16", 1 @ 33-3/8"					

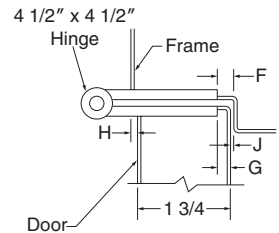
Pioneer Industries, Inc. – Standard



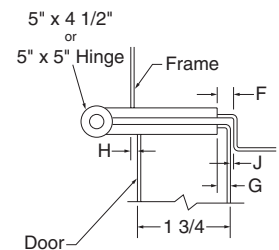
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"	38"	11-3/4"	2 @ 30-3/4"	6-3/4"	5/16"	7/32"
7'-0"			2 @ 32-3/4"			
7'-2"			2 @ 33-3/4"			

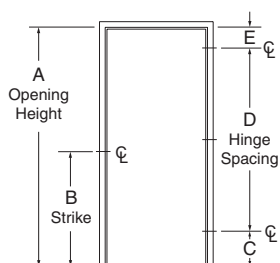


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	38"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	7/32"	3/32"	3/32"
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		12-1/4"	3 @ 23-1/2"					
7'-8"		12-3/16"	3 @ 24-3/16"					
7'-10"		12-5/16"	3 @ 24-13/16"					
8'-0"		12-1/4"	3 @ 25-1/2"					
9'-0"		12-1/4"	3 @ 29-1/2"					
10'-0"		12-1/4"	3 @ 33-1/2"					

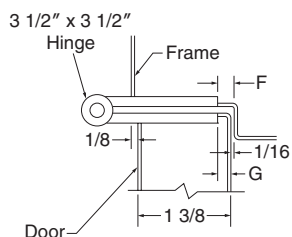


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	38"	12-1/2"	2 @ 30"	7-1/2"	5/16"	7/32"	3/32"	3/32"
6'-10"		12-1/2"	2 @ 31"					
7'-0"		12-1/2"	2 @ 32"					
7'-2"		12-1/2"	2 @ 33"					
7'-4"		12-1/2"	2 @ 34"					
7'-6"		12-9/16"	3 @ 23-5/16"					
7'-8"		12-1/2"	3 @ 24"					
7'-10"		12-5/8"	3 @ 24-5/8"					
8'-0"		12-9/16"	3 @ 25-5/16"					
9'-0"		12-9/16"	3 @ 29-5/16"					
10'-0"		12-9/16"	3 @ 33-5/16"					

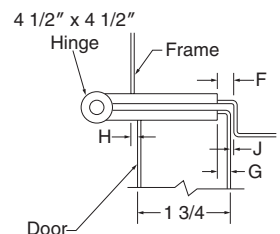
Pioneer Industries, Inc. – S-Series



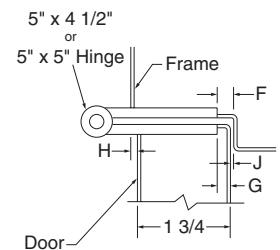
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	7/32"
7'-0"			2 @ 31-15/16"			
7'-2"			2 @ 32-15/16"			

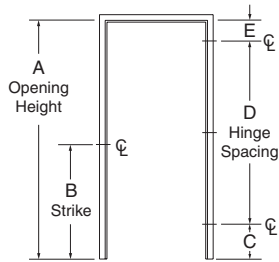


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	7/32"	3/32"	3/32"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"					
7'-10"			3 @ 24-5/8"					
8'-0"			3 @ 25-19/64"					
9'-0"			3 @ 29-19/64"					
10'-0"			3 @ 33-19/64"					

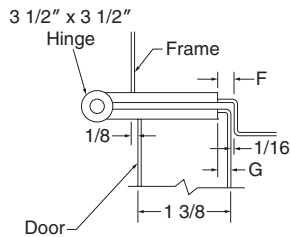


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	7/32"	3/32"	3/32"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"					
7'-10"			3 @ 24-5/8"					
8'-0"			3 @ 25-19/64"					
9'-0"			3 @ 29-19/64"					
10'-0"			3 @ 33-19/64"					

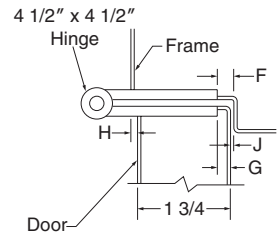
Premier Steel Doors & Frames, Inc.



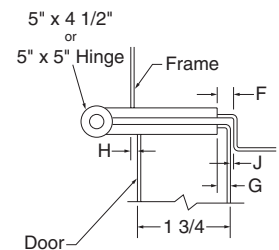
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"			1 @ 59-7/8"			
7'-0"	40-5/16"	10-3/8"	2 @ 31-15/16"	9-3/4"	1/4"	3/16"
7'-2"			2 @ 32-15/16"			

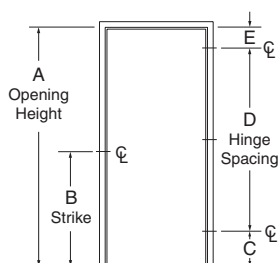


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30-1/4"					
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"	40-5/16"	12-1/4"	3 @ 22-53/64"	7-1/4"	3/8"	1/4"	1/16"	1/8"
7'-6"			3 @ 23-1/2"					
7'-8"			3 @ 24-11/64"					
7'-10"			3 @ 24-53/64"					
8'-0"			3 @ 25-1/2"					
9'-0"			3 @ 29-1/2"					

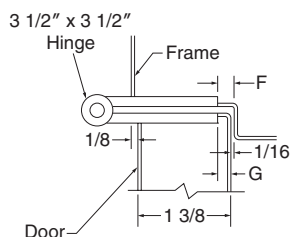


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30-1/4"					
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"	40-5/16"	12-1/4"	3 @ 22-53/64"	7-1/4"	3/8"	1/4"	1/16"	1/8"
7'-6"			3 @ 23-1/2"					
7'-8"			3 @ 24-11/64"					
7'-10"			3 @ 24-53/64"					
8'-0"			3 @ 25-1/2"					
9'-0"			3 @ 29-1/2"					

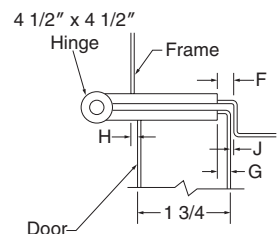
Republic Doors & Frames



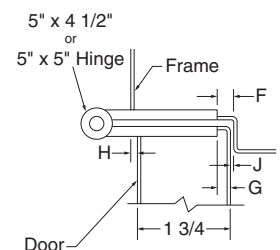
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"	40-5/16"	11-3/4"	61-1/2"	6-3/4"	5/16"	1/4"
6'-8"			2 @ 30-3/4"			
7'-0"			2 @ 32-3/4"			
7'-2"			2 @ 33-3/4"			

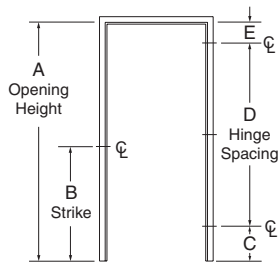


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"			2 @ 34-1/4"					
7'-6"			2 @ 35-1/4"					
7'-8"			3 @ 24-11/64"					
7'-10"			3 @ 24-53/64"					
8'-0"			3 @ 25-1/2"					
9'-0"			3 @ 29-1/2"					
10'-0"			3 @ 33-1/2"					



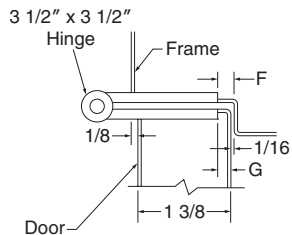
5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/2"	2 @ 30"	7-1/2"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 31"					
7'-0"			2 @ 32"					
7'-2"			2 @ 33"					
7'-4"			2 @ 34"					
7'-6"			2 @ 35"					
7'-8"			3 @ 24"					
7'-10"			3 @ 24-43/64"					
8'-0"			3 @ 25-21/64"					
9'-0"			3 @ 29-21/64"					
10'-0"			3 @ 33-21/64"					

Security Metal Products



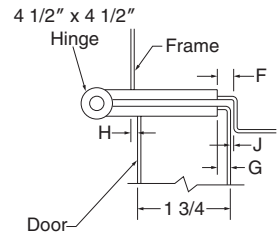
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.

Note: Does not manufacture 1 3/8" thick doors. Frames for 1 3/8" doors are manufactured by special arrangement only.



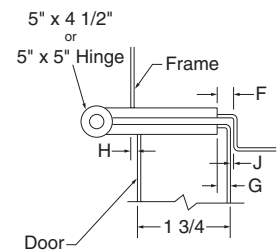
3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors

A	B	C	D	E	F	G
—	—	—	—	—	—	—



4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors

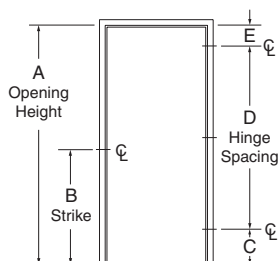
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	3/8"	1/4"	1/16"	1/8"
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		10-1/4"	2 @ 36-1/4"					
7'-8"		12-1/4"	3 @ 24-11/64"					
7'-10"		12-1/4"	3 @ 24-53/64"					
8'-0"		12-1/4"	3 @ 25-1/2"					
9'-0"		10-1/4"	3 @ 30-5/32"					
10'-0"		12-1/4"	3 @ 33-1/2"					



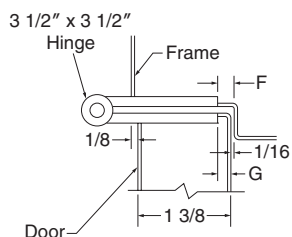
5" Hinge & Strike Comparison for 1-3/4" Thick Doors

A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/2"	2 @ 30"	7-1/2"	3/8"	1/4"	1/16"	1/8"
6'-10"		12-1/2"	2 @ 31"					
7'-0"		12-1/2"	2 @ 32"					
7'-2"		12-1/2"	2 @ 33"					
7'-4"		12-1/2"	2 @ 34"					
7'-6"		10-1/2"	2 @ 36"					
7'-8"		12-1/2"	3 @ 24"					
7'-10"		12-1/2"	3 @ 24-43/64"					
8'-0"		12-1/2"	3 @ 25-21/64"					
9'-0"		10-1/2"	3 @ 30"					
10'-0"		12-1/2"	3 @ 33-21/64"					

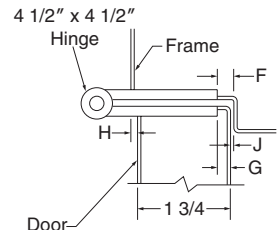
Steelcraft



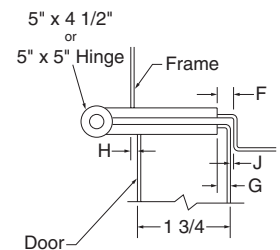
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"			59-7/8"			
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	1/4"
7'-0"			2 @ 31-15/16"			
7'-2"			2 @ 32-15/16"			
7'-2"			2 @ 32-15/16"			



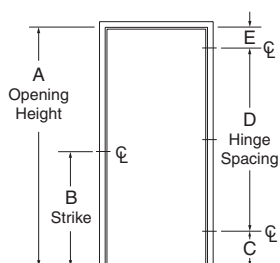
4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"					
7'-10"			3 @ 24-5/8"					
8'-0"			3 @ 25-19/64"					
9'-0"			3 @ 29-19/64"					
10'-0"			3 @ 33-19/64"					



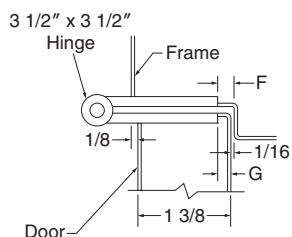
5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"					
7'-10"			3 @ 24-5/8"					
8'-0"			3 @ 25-19/64"					
9'-0"			3 @ 29-19/64"					
10'-0"			3 @ 33-19/64"					

The following companies are included for historical purposes only.
The validity of their hinge and strike spacing data cannot be confirmed.

Benchmark

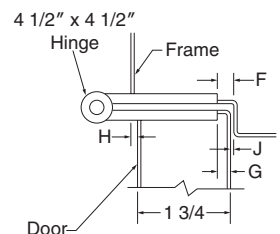


Note: Benchmark is no longer a member of the Steel Door Institute. Its hinge and strike spacing are included for legacy purposes; the validity of the data cannot be confirmed



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors

A	B	C	D	E	F	G
—	—	—	—	—	—	—

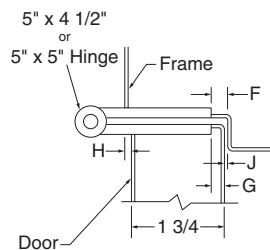


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors

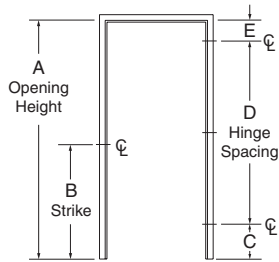
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	1 1/32"	1/4"	1/8"	3/32"
6'-10"		14-1/4"	2 @ 30-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		14-1/4"	2 @ 32-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		14-1/4"	2 @ 34-1/4"					
7'-8"		8-1/4"	3 @ 25-1/2"					
7'-10"		10-1/4"	3 @ 25-1/2"					
8'-0"		12-1/4"	3 @ 25-1/2"					

5" Hinge & Strike Comparison for 1-3/4" Thick Doors

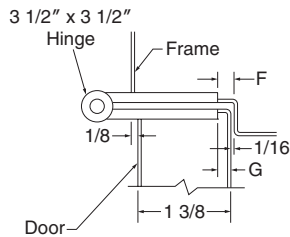
A	B	C	D	E	F	G	H	J
—	—	—	—	—	—	—	—	—



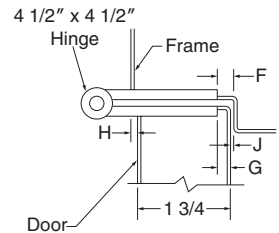
Black Mountain Door



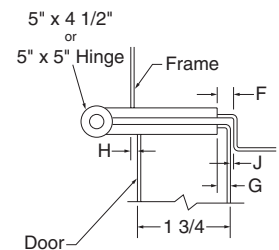
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"	40-5/16"	10-3/8"	59-7/8"	9-3/4"	5/16"	3/16"
7'-0"		14-3/8"				
7'-2"		16-3/8"				

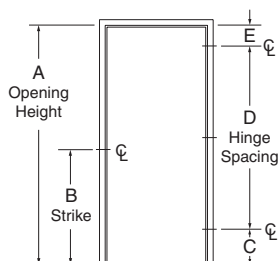


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	3/16"	1/16"	1/8"
6'-10"		8-3/8"	2 @ 31-15/16"					
7'-0"		10-3/8"	2 @ 31-15/16"					
7'-2"		12-3/8"	2 @ 31-15/16"					
7'-4"		10-3/8"	2 @ 33-15/16"					
7'-6"		12-3/8"	2 @ 33-15/16"					
7'-8"		10-7/16"	3 @ 23-15/16"					
7'-10"		8-5/16"	3 @ 25-5/16"					
8'-0"		10-5/16"	3 @ 25-5/16"					
9'-0"		8-7/16"	3 @ 29-15/16"					
10'-0"		11-7/16"	3 @ 32-15/16"					

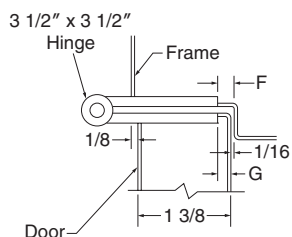


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	3/16"	1/16"	1/8"
6'-10"		8-3/8"	2 @ 31-15/16"					
7'-0"		10-3/8"	2 @ 31-15/16"					
7'-2"		12-3/8"	2 @ 31-15/16"					
7'-4"		10-3/8"	2 @ 33-15/16"					
7'-6"		12-3/8"	2 @ 33-15/16"					
7'-8"		10-7/16"	3 @ 23-15/16"					
7'-10"		8-5/16"	3 @ 25-5/16"					
8'-0"		10-5/16"	3 @ 25-5/16"					
9'-0"		8-7/16"	3 @ 29-15/16"					
10'-0"		11-7/16"	3 @ 32-15/16"					

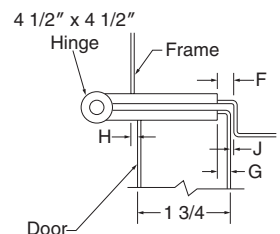
Copco



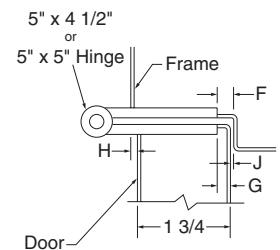
Note: Copco is no longer a member of the Steel Door Institute. Its hinge and strike spacing are included for legacy purposes; the validity of the data cannot be confirmed



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	7/32"
7'-0"			2 @ 31-15/16"			
7'-2"			2 @ 32-15/16"			

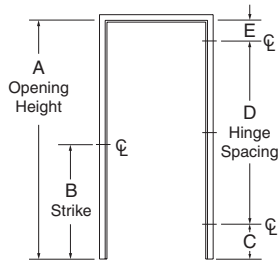


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	7/32"	1/32"	3/32"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-19/64"					
7'-10"			3 @ 24-19/64"					
8'-0"			3 @ 25-19/64"					

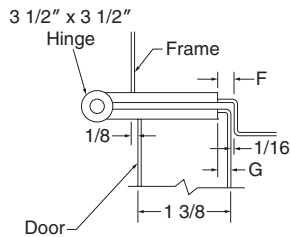


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	7/32"	1/32"	3/32"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-19/64"					
7'-10"			3 @ 24-19/64"					
8'-0"			3 @ 25-19/64"					

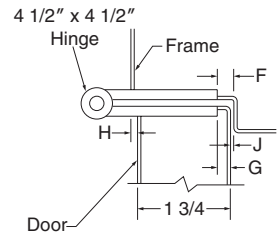
Kewanee



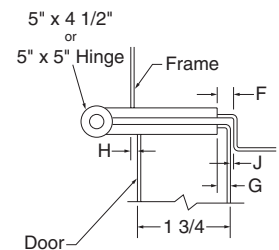
Note: Kewanee is no longer a member of the Steel Door Institute. Its hinge and strike spacing are included for legacy purposes; the validity of the data cannot be confirmed



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors						
A	B	C	D	E	F	G
6'-8"			60-1/8"			
7'-0"	40-5/16"	11-3/4"	2 @ 32-1/16"	9-5/8"	1/4"	3/16"
7'-2"			2 @ 33-1/16"			



4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30-1/16"					
6'-10"			2 @ 31-1/16"					
7'-0"			2 @ 32-1/16"					
7'-2"			2 @ 33-1/16"					
7'-4"	40-5/16"	10-1/4"	2 @ 34-1/16"	9-5/8"	3/8"	1/4"	1/16"	1/8"
7'-6"			2 @ 35-1/16"					
7'-8"			24-1/16", 24", 24-1/16"					
7'-10"			24-11/16", 24-3/4", 24-11/16"					
8'-0"			3 @ 25-3/8"					



5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30-1/16"					
6'-10"			2 @ 31-1/16"					
7'-0"			2 @ 32-1/16"					
7'-2"			2 @ 33-1/16"					
7'-4"	40-5/16"	10-1/4"	2 @ 34-1/16"	9-5/8"	3/8"	1/4"	1/16"	1/8"
7'-6"			2 @ 35-1/16"					
7'-8"			24-1/16", 24", 24-1/16"					
7'-10"			24-11/16", 24-3/4", 24-11/16"					
8'-0"			3 @ 25-3/8"					

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Electronic Hinge Preparations



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Electronic Hinge Preparations

1 Purpose

It is the intention of this document to furnish users of standard steel frames with practical information regarding an acceptable method for preparing frames for 4-½", 5" or continuous electric hinges. This document will allow frame manufacturers to provide frames prior to having knowledge of the specific electric hinge being used.

2 Scope

The information contained herein pertains to frames manufactured in accordance with ANSI/SDI A250.8. The preparation as defined herein will accommodate the majority of electric hinges sold. It is the responsibility of the hardware specifier to assure compatible hinges are used.

3 Reference Documents

ANSI/SDI A250.6 *Recommended Practice for Hardware Reinforcings on Standard Steel Doors and Frames*

ANSI/SDI A250.8 *SDI 100 Specifications for Standard Steel Doors & Frames*

ANSI/BHMA A156.7 *Template Hinge Dimensions*

ANSI/BHMA A156.115 *Hardware Preparation in Steel Doors and Steel Frames*

4 Tolerances

All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

5 Location

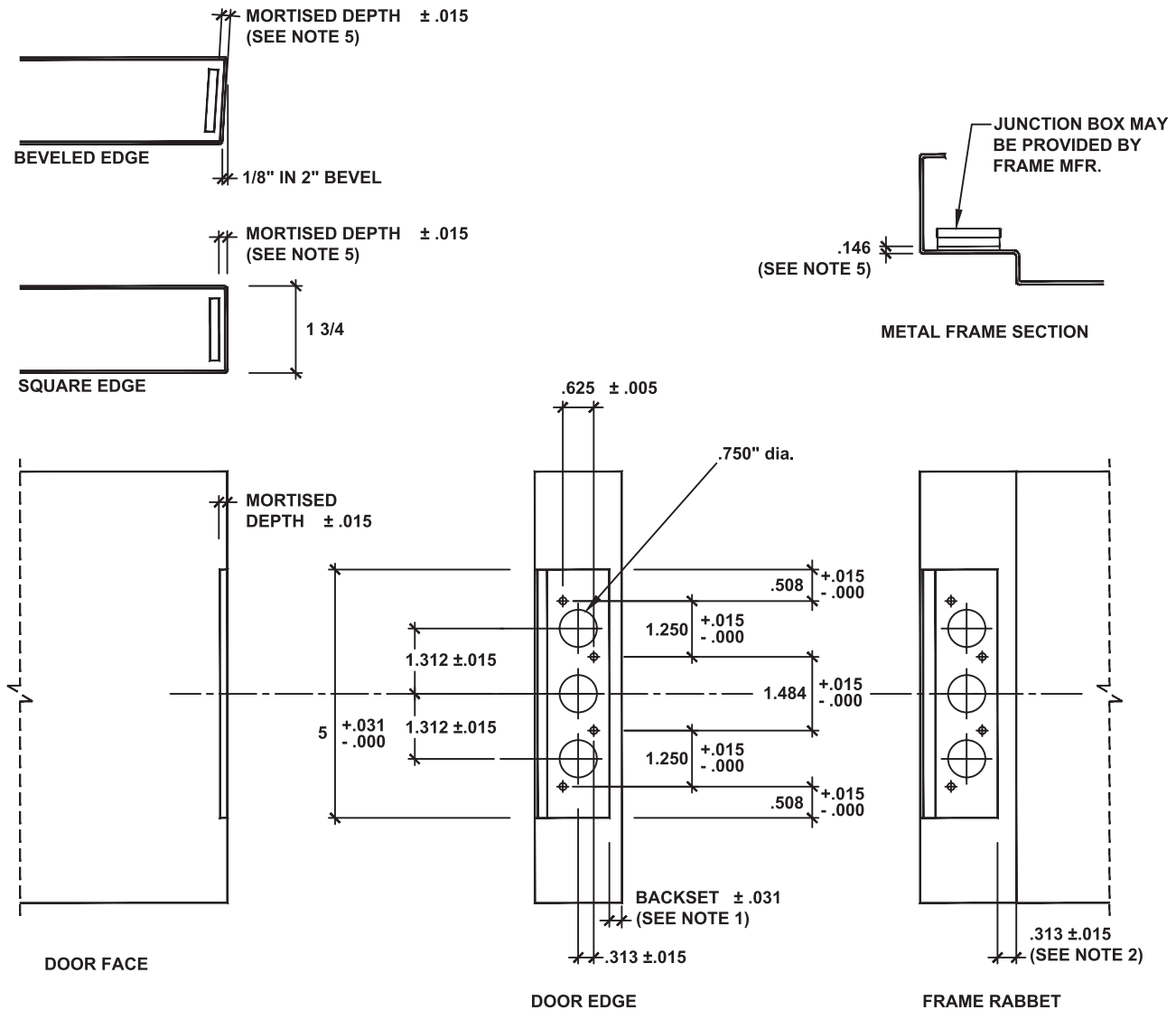
The preparation for electric hinges is intended to be non-load bearing. Therefore it shall be located in the center hinge preparation on frames with 1-½ pair of hinges, and on the second hinge from the bottom on frames with 2 pair of hinges.

6 Hinge Reinforcement

The hinge reinforcement shall comply with ANSI/SDI A250.6 and ANSI/SDI A250.8, and shall incorporate cutouts as shown in Figures 1, 2, 3 and 4.

7 Junction Box

A junction box may be provided to facilitate wiring and connector installation. In addition, a hole shall be provided at the top and bottom of the junction box to facilitate conduit (see Figure 4). It is the responsibility of the electrical contractor to plug any unused holes.



Note 1: The hinge backset on the door varies by hollow metal door manufactures from $\frac{3}{16}$ " to $\frac{1}{4}$ "

Note 2: The hinge backset on the frame varies by hollow metal frame manufactures from $\frac{5}{16}$ " to $\frac{3}{8}$ "

Note 3: Extra holes may occur in the reinforcement for tooling and installation fixturing.

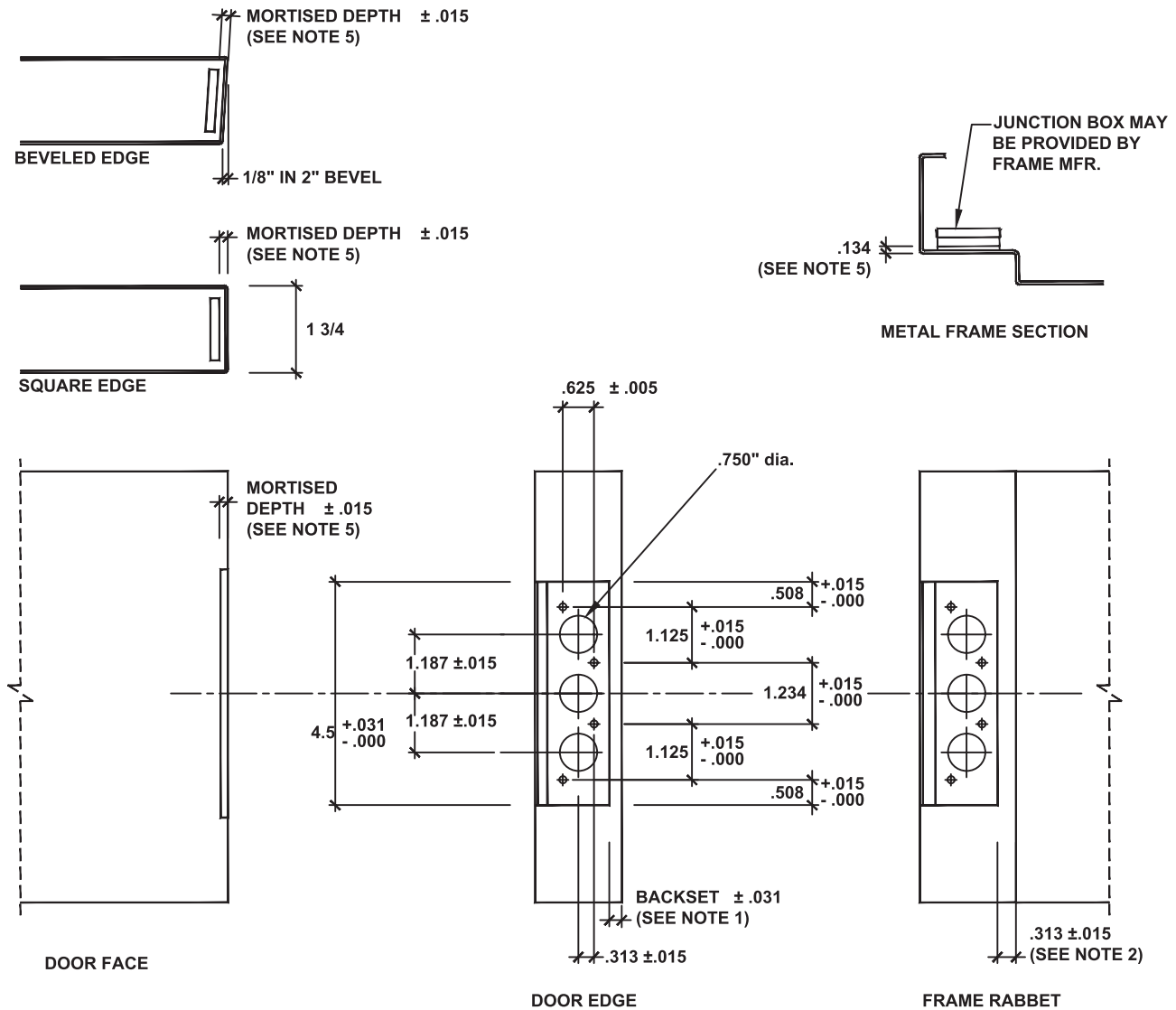
Note 4: Some manufacturers offer a removable feature (e.g. - wire, shim, standoff projection) to allow conversion of a standard weight preparation for use with heavy weight hinge butt.

Note 5: The most common mortise depths are in accordance with ANSI/BHMA A156.1 as follows:

Standard Weight butt 0.146"

Heavy weight butt 0.190"

Figure 1 – Preparation of 1 ¾" Steel Doors & Frames for 5" Full Mortise Electric Hinge



Note 1: The hinge backset on the door varies by hollow metal door manufacturers from $\frac{3}{16}$ " to $\frac{1}{4}$ "

Note 2: The hinge backset on the frame varies by hollow metal frame manufacturers from $\frac{5}{16}$ " to $\frac{3}{8}$ "

Note 3: Extra holes may occur in the reinforcement for tooling and installation fixturing.

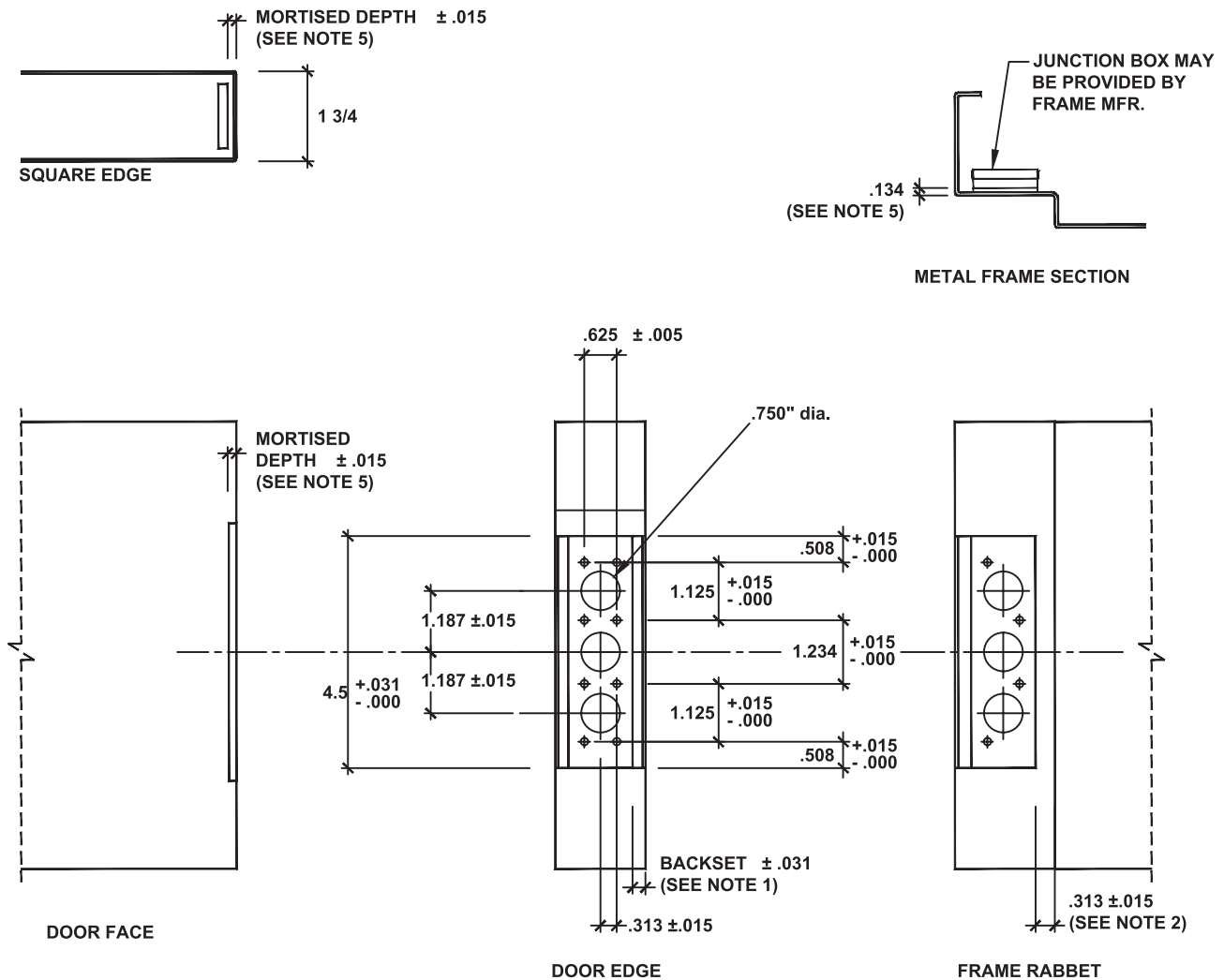
Note 4: Some manufacturers offer a removable feature (e.g. - wire, shim, standoff projection) to allow conversion of a standard weight preparation for use with heavy weight hinge butt.

Note 5: The most common mortise depths are in accordance with ANSI/BHMA A156.1 as follows:

Standard Weight butt 0.134"

Heavy weight butt 0.180"

Figure 2 – Preparation of 1 3/4" Steel Doors & Frames for 4 1/2" Full Mortise Electric Hinge



Note 1: The hinge backset on the door varies by hollow metal door manufactures from $\frac{3}{16}$ " to $\frac{1}{4}$ " when hinge filler is in place.

Note 2: The hinge backset on the frame varies by hollow metal frame manufactures from $\frac{5}{16}$ " to $\frac{3}{8}$ "

Note 3: Extra holes may occur in the reinforcement for tooling and installation fixturing.

Note 4: Some manufacturers offer a removable feature (e.g. - wire, shim, standoff projection) to allow conversion of a standard weight preparation for use with heavy weight hinge butt.

Note 5: The most common mortise depths are in accordance with ANSI/BHMA A156.1 as follows:

Standard Weight butt 0.134"

Heavy weight butt 0.180"

Figure 3 – Preparation of 1 ¾" Steel Doors & Frames for 4 ½" Full Mortise Electric Hinge Non-handed

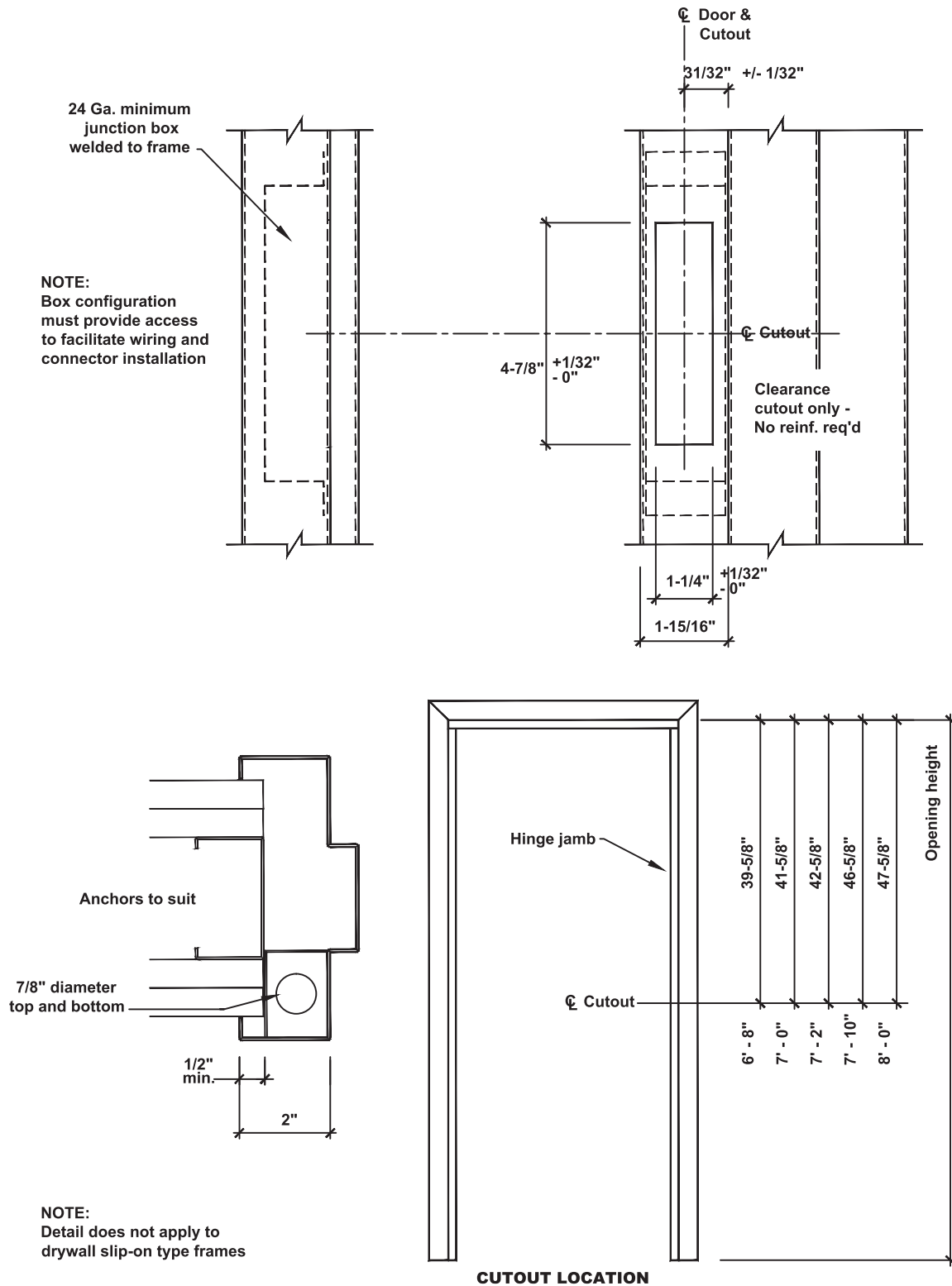


Figure 4 – Electrified Continuous Hinge Preparation on Standard Steel Frame

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Accelerated Physical Endurance Test Procedure for Steel Doors



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Accelerated Physical Endurance Test Procedure for Steel Doors

1 Purpose

The purpose of this test procedure is to provide manufacturers with an accelerated method of testing the performance of doors.

This test procedure will provide performance data for comparative purposes and is not intended to simulate field operating conditions. This test will subject the product to more severe conditions than those experienced in normal field operation.

2 Apparatus and Equipment

The main testing structure shall be constructed as shown in Figures 1 and 2. The structure shall conform to the parts shown, except the opening width and height are permitted to vary, allowing the testing of various door sizes.

The cycling mechanism shall be positioned so that the connecting arm is perpendicular to the stop face of the door. It shall have a threaded swivel connector that is attached to the door through the lock preparation or by means of a bracket mounted directly to the door face at the vertical and horizontal location of the lock preparation. The cycling mechanism shall have an operating stroke so that the door lock edge will be opened not less than 4 inches from the frame stop and then returned to the closed position. The minimum cycle rate shall be one cycle per second. A mechanical or electronic counter shall be used to record the cycles.

3 Preparation for Test

The door shall be hung in the frame on hinges conforming to the most current edition of ANSI A156.7-2009, "Template Hinge Dimensions". The hinges and their locations shall be noted on Form 1 of the report.

Care shall be taken to ensure the hinges are properly applied to the door and frame, and any required hinge fillers are in place. The initial clearances between the door and frame shall be recorded as part of the performance test report. Silencers, weather strip or gasketing shall be installed on the frame, and the stop face of the door shall contact them.

4 Test Specimen

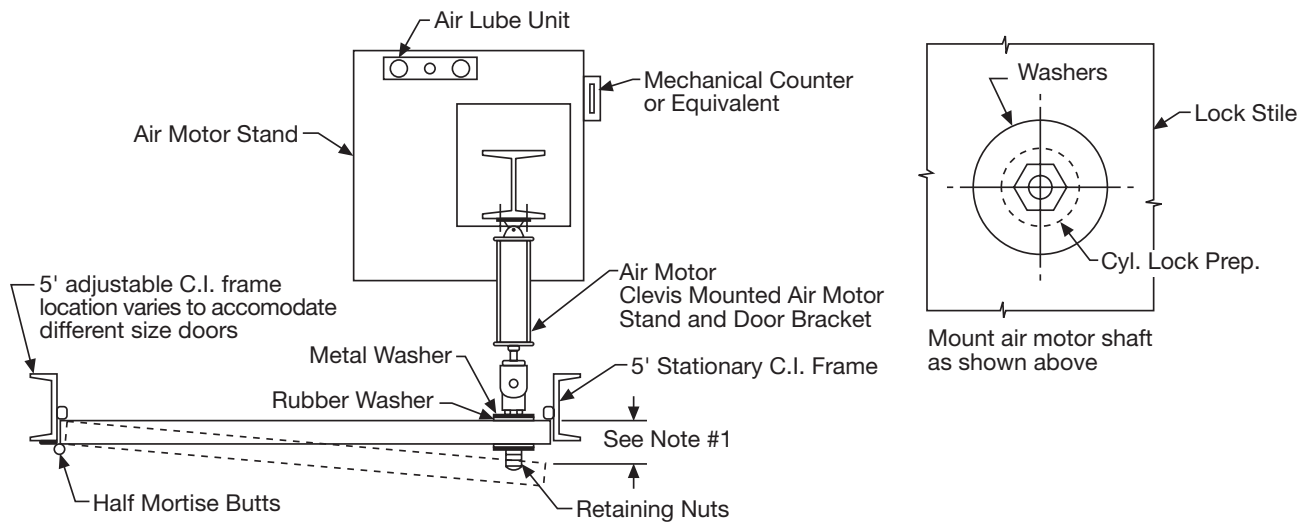
The test shall be performed on a 3'0" wide x 7'0" high nominal size door; although, other sizes are permitted to be evaluated at the discretion of the sponsor.

A detailed description of the door construction shall be recorded as part of the test report. This information shall cover all components as well as applicable processes (such as welding, bonding, etc.) used for attaching and connecting components.

5 Cycle Test

The duration of the test shall be 250,000 cycles for Level C; 500,000 cycles for Level B; 1,000,000 cycles for Level A; or longer, if specified by the test sponsor. A general inspection of the door shall be made at 25,000 cycle intervals for the first 100,000 cycles and at 50,000 cycles thereafter until the completion of the required number of cycles. The general inspection shall cover all components readily accessible, such as face skins, exposed hinge and/or lock edges, head and sill closures, flush-closing channels, hinge reinforcements, etc. Additionally, the inspection shall cover the welding, bonding, staking, mechanical interlocking, etc., used to connect the various door components.

The results shall be recorded on a standard performance report "Door Test Form 1."

**NOTES:**

- 1 Door should open approximately 4"
- 2 Cycle Rate — minimum one cycle per second
- 3 Door to contact mute

Figure 1 – Cycle Test Detail

When an independent organization is employed to certify the overall performance of the door design, they shall validate the initial, mid-point, and final observations.

6 Twist Test

Any deterioration of the door construction as a result of the cycle testing shall be determined through a series of twist tests. These tests shall occur prior to the onset of the cycle test and at the end of the cycle test.

During the twist test, the hinge pins shall be removed and the door moved to the twist test fixture (if a separate fixture is used) and clamped in place as shown in Figure 2.

If the same fixture is used for both the cycle test and twist test, the hinge pins shall be removed and the door clamped in place as shown in Figure 2.

Pressures in 30-pound increments shall be applied at the upper lock corner through the screw jack, or equivalent device, and force gage in an area

as described in Figure 2. The deflection noted on the dial indicator shall be plotted against the load applied to the corner. A maximum 300 pounds pressure shall be applied. The pressure shall then be reduced in 30-pound increments and the deflection recorded on the report form. A smooth curve drawn through the points shall graphically demonstrate the reaction of the door. Use "Performance Report – Door Test Form 2" to graphically represent the deflections.

Measurements for deflections shall be taken one minute or less after the force has been stabilized.

At the completion of each twist test, and prior to the continuance of the cycle test, the hinges shall be inspected and lubricated or replaced, if necessary.

7 Acceptance Criteria

7.1 Doors shall not show any visible signs of metal fatigue cracking, or deformation on the edges or the door face.

7.2 Doors of either laminated or welded construction shall not delaminate or have weld breakage in excess of 10% of total bonded or welded surface.

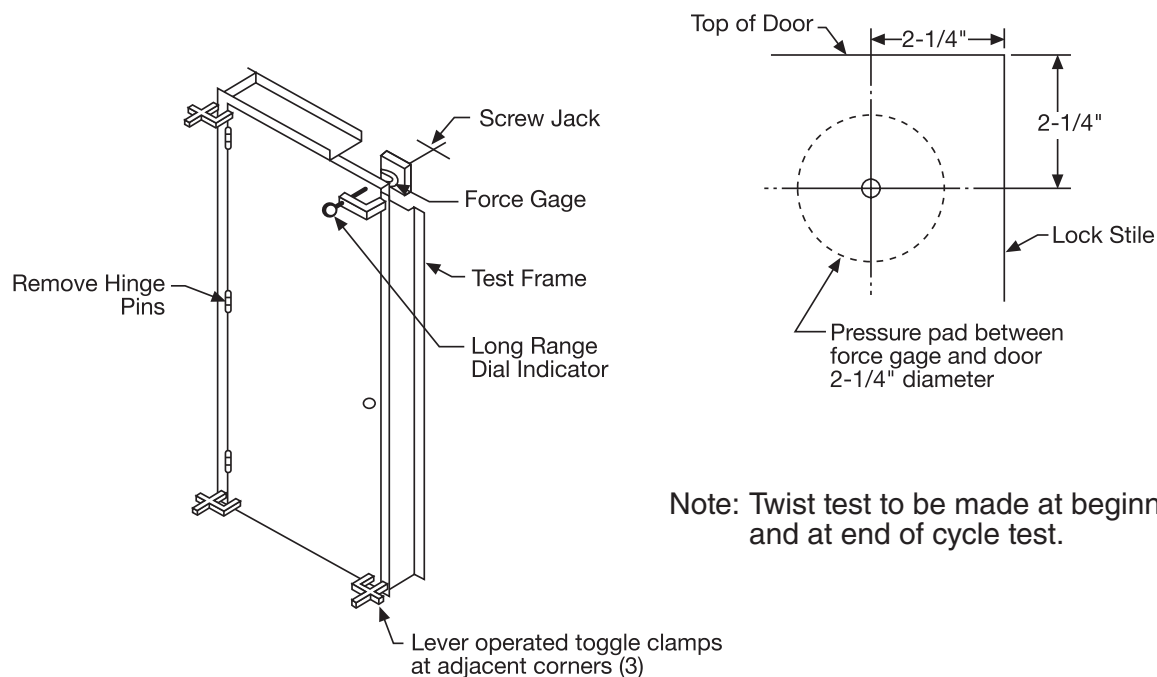
7.3 Top, bottom, or edge channels must remain securely in place, with no signs of weld or bond breakage.

7.4 Doors of stile and panel or stile and rail construction shall not be misaligned.

7.5 Where visible seams are inherent in the door design, no opening or spreading shall occur.

7.6 As a result of the twist test, the maximum deflection shall not exceed 2-½" when loaded to 300 lb for Level C doors. For Level B and A doors, the maximum deflection shall not exceed 1-¼" when loaded to 300 lb.

7.7 Permanent deflection measured within 5-minutes after the force is removed shall not exceed ⅛".



Note: Twist test to be made at beginning and at end of cycle test.

Figure 2 – Twist Test Detail

Performance Report – Cycle Test Form No. 1

Door Manufacturer:

Weight of Door:

Test No.:

Door Model:

Door Size:

Start Test Date:

Hinge Manufacturer:

Hinge Model:

Finish Test Date:

Inspection Intervals – (000)																								
		25	50	75	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	
Edge Condition	Hinge Preparations																							
		Top																						
		Intermediate																						
	Bottom																							
Top Closer Condition																								
Bottom Closer Condition																								
Condition of Core																								
Condition of Panels																								

“S” indicates satisfactory performance. Use footnotes under remarks for any further explanations.

Remarks:

Performance Report — Twist Test Form No. 2

Test No:

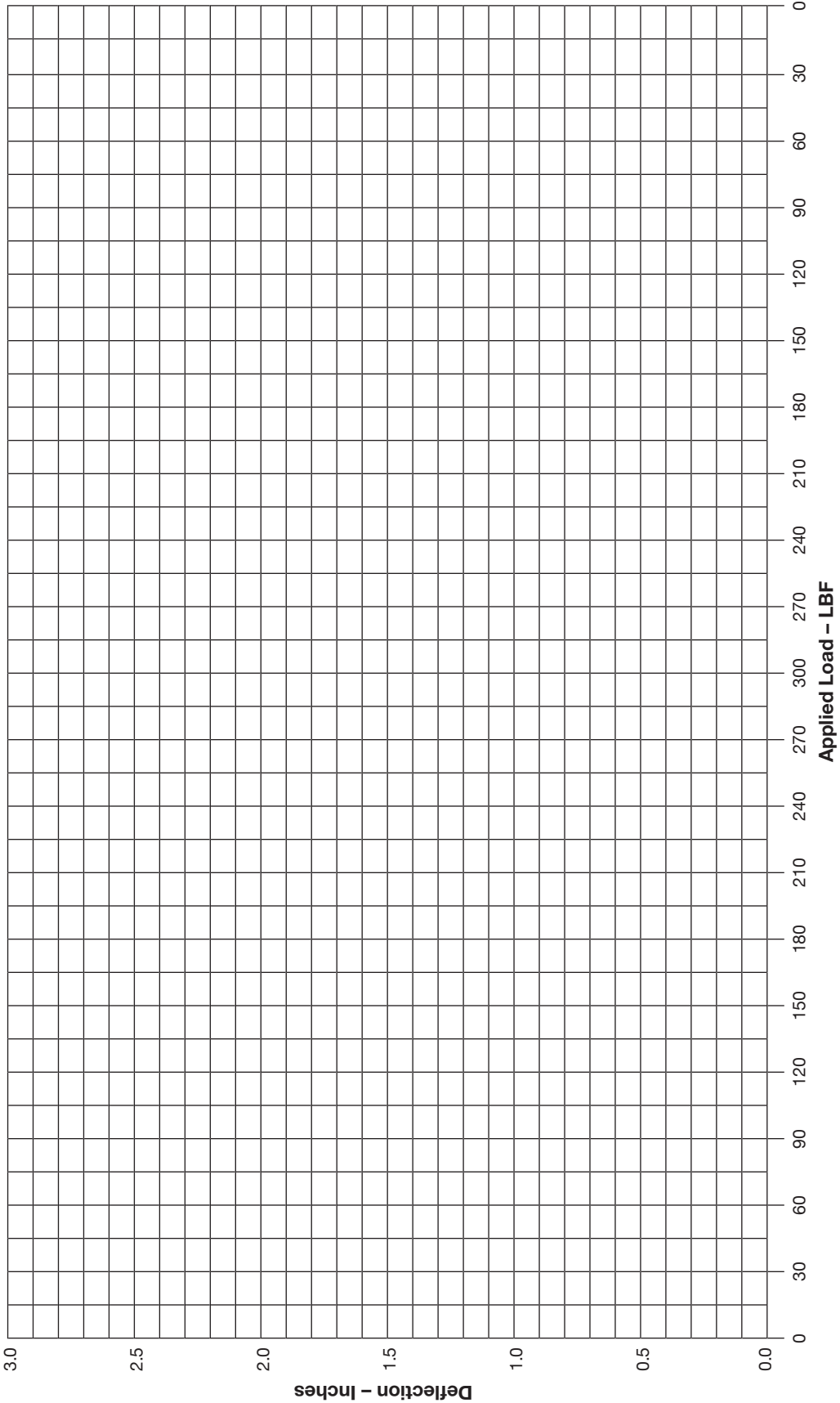
Date:

Door Manufacturer:

Door Model:

Door Size:

Weight of Door:



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- SDI-134** Nomenclature for Standard Steel Doors & Steel Frames

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Guideline for Specifying Steel Doors and Frames for Blast Resistance



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Guideline for Specifying Steel Doors and Frames for Blast Resistance

1 Introduction

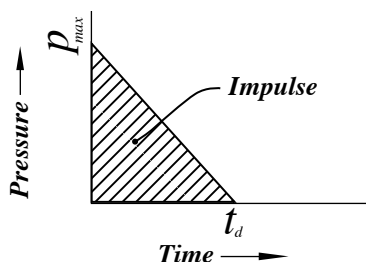
Blast-resistant hardening, or the structural strengthening of buildings, is one measure an owner may employ to minimize the risk to people and equipment from the hazards of accidental or intentional explosions. Many architects are finding it necessary to include blast-resistant products in new and existing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

2 Definitions

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

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

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



Blast Wave (Idealized)

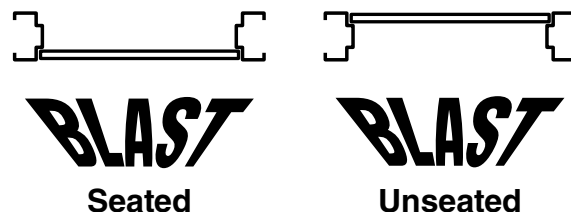
2.4 Charge Weight: The equivalent explosive weight (lbs. or kg) of TNT in the blast event. Different agencies have specific requirements for charge weight to be used. See agency specific criteria for DoD, VA, GSA, and DOS to determine required charge weight and in some cases, the required standoff distance.

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

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

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

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



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

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

Blast Product Response & Damage Categories

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

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

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

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

3 Blast Standard Test Methods and Design Criteria

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

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

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

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

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

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

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

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

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

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

Sample Blast Quote Request Form

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

AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

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

AUDIO-VISUAL PROGRAMS ALSO AVAILABLE

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GLOSSARY OF TERMS FOR HOLLOW METAL DOORS AND FRAMES



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Glossary of Terms for Hollow Metal Doors and Frames

Definitions of terms commonly used in connection with Hollow Metal Work, defined as they apply specifically to hollow metal, may be defined differently by other industries.

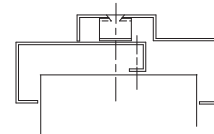
The following glossary is adapted with permission from the Hollow Metal Manufacturers Association's HMMA 801-12.

ACTIVE DOOR (ACTIVE LEAF): In a pair of doors, the door or doors in which the latching device is installed.

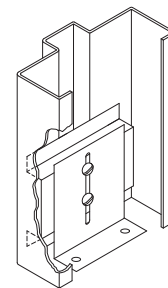
ACTUAL DOOR SIZE: The largest measured width by height of the door leaf as manufactured. Equal to the nominal door size minus design clearance. Also referred to as Net Door Size.

ADJUSTABLE BASE ANCHOR: See **ADJUSTABLE FLOOR ANCHOR**.

ADJUSTABLE FRAME: A frame with profile in two or more pieces to accommodate various wall thickness. Also referred to as an expandable frame or split frame.

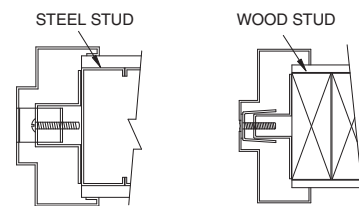


ANCHOR: A metal device provided inside of a jamb, head, sill or mullion used to secure the frame to the adjacent structure, such as wall, ceiling or floor. Also referred to as jamb anchor, wall anchor, floor anchor, etc. See listing;

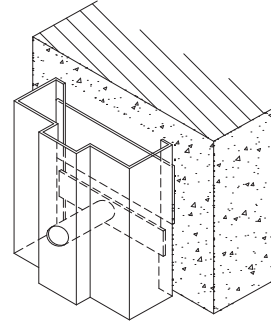


ADJUSTABLE FLOOR: A metal device used to secure a frame to floor at base which allows the jamb to be positioned at a location in height above floor. Typically used at a depressed slab or unlevel floor condition. Also referred to as Adjustable Base Anchor.

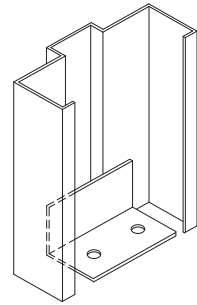
COMPRESSION: An adjustable metal device, used to secure, adjust and square a slip on frame.



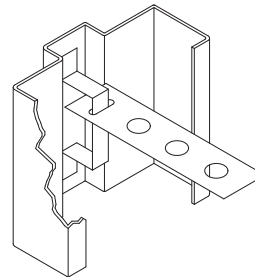
EXISTING WALL: A hole preparation, generally in the soffit of a frame member, with internal reinforcing and/or guide for an expansion bolt, machine bolt, or screw. Used to secure the frame to an existing opening.



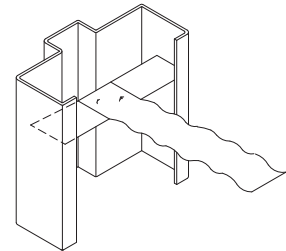
FIXED FLOOR: A metal device attached to the bottom of the frame to secure a frame to the floor. Also referred to as Base Anchor or Sill Anchor.



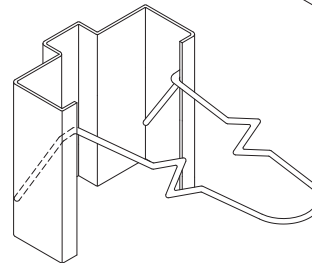
MASONRY STRAP & STIRRUP: A fixed metal device used to secure the frame to new masonry walls.



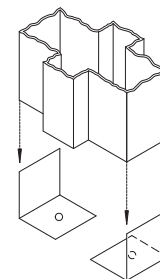
MASONRY "T"-SHAPED: A loose metal device used to secure the frame to new masonry walls.



MASONRY WIRE: A loose metal device used to secure the frame to new masonry walls.

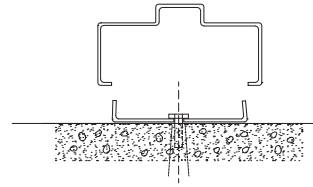


MULLION: A metal clip or angle in either 1 or 2 pieces, secured to the floor in which mullion is then positioned over.

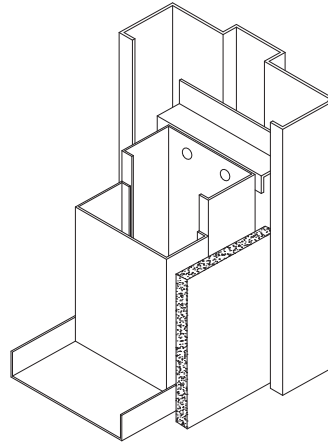


POURED IN PLACE: A metal device used to secure a frame to new concrete pour in place wall.

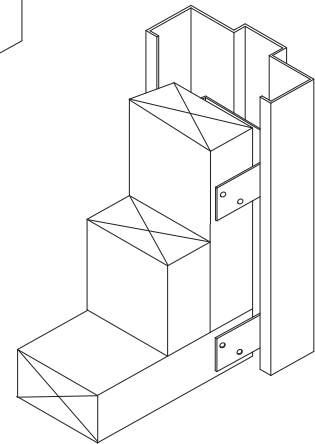
SILL: A metal channel secured to the floor in which the sill section of a hollow metal frame is positioned over.



STEEL STUD: A metal device secured in a frame to be used for attachment to a wall built with steel studs.



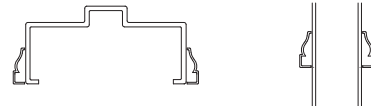
WOOD STUD: A metal device secured in a frame to be used for attachment in a wall built with wood studs.



APPLIED STOP: A separate surface mounted channel, typically used on a cased opening section. Creates a rabbeted frame profile.



APPLIED TRIM: A decorative piece mounted to the face of a frame or door.



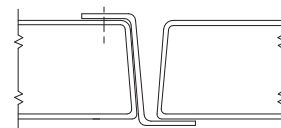
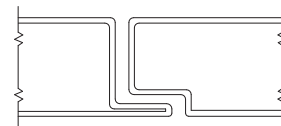
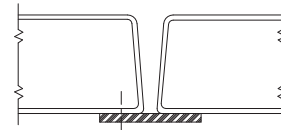
ARMOR PLATE: A plate that can be of various materials and thicknesses applied to a door and /or frame externally, and can extend to the full height and width of the door. Not to be confused with ballistic resistance armor.

ASTRAGAL: A component or combination of components applied to; (a) a single door; (b) one or both doors of a pair at their meeting stiles to cover the door edge clearance; (c) the bottom edge of the flush transom panel; or (d) the bottom of the top leaf of a dutch door. The Astragal closes the clearance gap for the purpose of ensuring privacy; minimizes the passage of light; retard the passage of air, sound, smoke or flame; and provides additional security. Provided by the hollow metal manufacturer, or the hardware supplier.

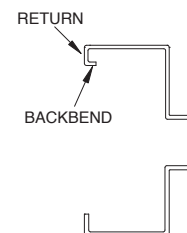
FLAT SURFACE: A one-piece steel strip attached to one door and overlapping the other door when in the closed position.

INTEGRAL: Either face of a door in a pair, formed at its lock edge to overlap the adjacent leaf.

WRAP AROUND: A formed piece of steel attached to one leaf of a pair, and overlapping the other door when in the closed position.

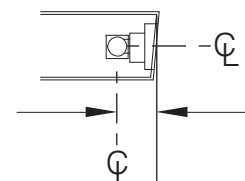


BACKBEND: The element of the frame profile which extends from the return and is formed parallel to the wall, inside the throat. Also referred to as second return, double return or drywall return. See **FRAME ELEMENTS** for additional details.

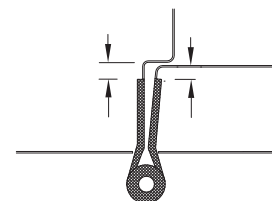


BACKSET: The distance from a cutout or datum line for a hardware preparation from a defined datum on a door or frame.

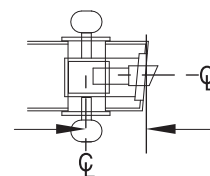
FLUSH BOLT: The distance from the centerline of the lock edge of a door to the centerline of the bolt. Shown on beveled edge door.



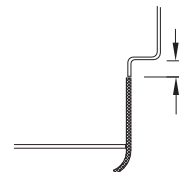
HINGE: On a door, the distance from the push side face sheet to the edge of the hinge cutout. On a frame rabbet, the distance from the stop to the edge of the hinge cutout.



LOCK: The distance from the centerline of the lock edge of a door to the centerline of the lock face prep. Shown on beveled edge door.



STRIKE: On a frame rabbet, the distance from the stop to the edge of the strike cutout. On the door edge, the distance from the push side face sheet to the edge of the strike cutout.



BASE: See **SILL**.

BASE ANCHOR: See **ANCHOR**.

BASE ANCHOR EXTENSION: See **FLOOR ANCHOR EXTENSION**.

BELOW FLOOR: Below the top of the concrete or structural slab. See also Jamb Extension.

BEVELED EDGE: See **EDGE, BEVELED**.

BLANK JAMB: See **JAMB**.

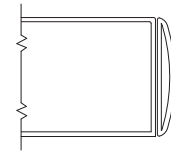
BLAST RESISTANT: Refers to a hollow metal assembly designed and manufactured to resist a specified series of impulse pressures of designated magnitude in pounds-force (Newtons).

BORROWED LIGHT: A glazed opening frame installed in an interior partition prepared for field installation of stationary (fixed) glazing. Mullions may be used to divide individual glazed areas. Similar to **WINDOW**.

BOTTOM CHANNEL: The horizontal stiffener channel secured into the bottom of a door. Also referred to as end channel.

BULL-NOSE: See **EDGE, BULL-NOSE**.

BULL-NOSE TRIM: A radius shaped component applied to the vertical door edge. A typical application would be on double acting doors.



BULLET RESISTANT: A hollow metal assembly designed and manufactured to resist penetration by fire arms projectiles.

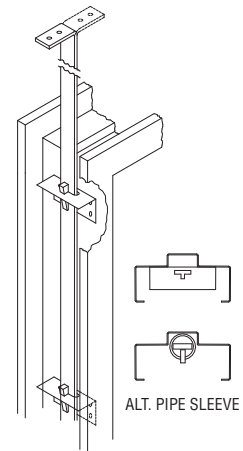
BUTT JOINT: Intersection of members, which are not mitered.

BUTTED FRAME: A frame which fits against a wall rather than wrap around it.

CAMLIFT HINGE: A hinge designed and manufactured to provide lifting of the door to a specific height as it is opened through a specific degree of opening. Commonly used on sound retardant door.

CASED OPENING FRAME: A frame without a stop and soffit. See **FRAME PROFILE** for detail.

CEILING STRUT: An adjustable member extending vertically from frame to a rigid support above to hold the frame in place.



CENTER RAIL: See **RAIL**.

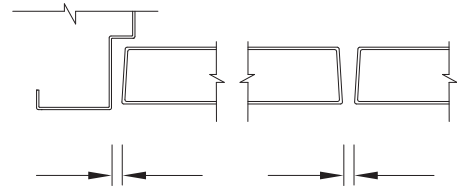
CLASSIFIED: “Products or material of a specific group category that are constructed, inspected, tested and subsequently reinspected in accordance with an established set of requirements.” (Taken directly from NFPA 80.)

CLEARANCE: A term used to define a distance between two items.

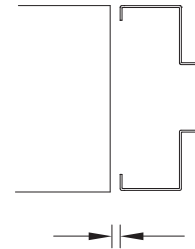
FLOOR: The distance between the bottom of the door and the top of the material directly below the door. This varies with applications, such as concrete, any floor covering and/or a threshold. (*For additional information, see HMMA TechNote HMMA 810-TN01-03, “Defining Undercuts”.*)

DESIGN: The distance around a door established by the manufacturer, used to determine the Actual Door Size.

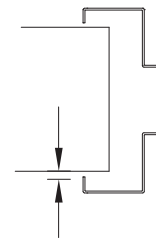
DOOR EDGE: The distance between either the edge of the door and frame rabbet, or the edges of two doors of a pair.



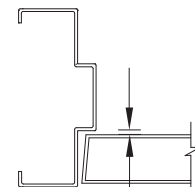
FRAME INSTALLATION, BUTTING WALL: The distance between a frame and the wall construction where the frames butts against the wall.



FRAME INSTALLATION, OVERLAPPING WALL: The distance between the frame return or backbend to accommodate irregularities in the thickness in the wall, when the frame is capping the wall.



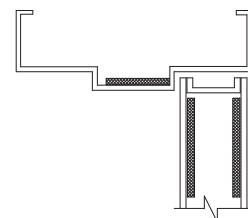
STOP: The distance between the frame stop and the face of the door when the door is in the closed position. Typically equal to the thickness of the silencer.



CLOSED SECTION: A frame member without a throat opening such as a mullion or transom bar.

CLOSER REINFORCEMENT: A metal plate or channel in a door or frame to provide additional strength for the attachment of a door closer. Sized and located to accommodate hardware requirements.

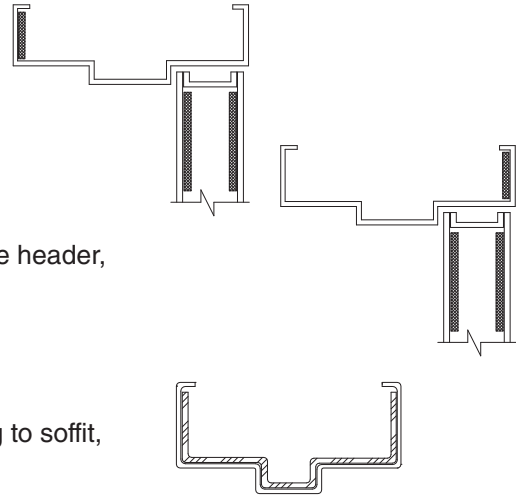
PARALLEL ARM: Reinforcing in soffit of frame header or transom mullion.



TOP JAMB MOUNT: Reinforcing in push side face of frame header, transom mullion, or panel.

REGULAR ARM: Reinforcing in pull side face of frame header, transom mullion, or panel.

SLEEVE: Reinforcing inside frame header conforming to soffit, rabbet, stop, and face.

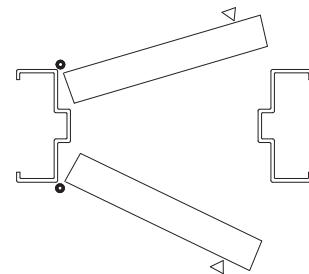


CLOSURE CHANNEL: An additional channel section fitted between the flanges of the top or bottom channel of a door, with its flanges projecting inward and its web in line with the door edge.

COMMERCIAL HOLLOW METAL: Steel door and frame products manufactured for use in office buildings, schools, hospitals, stores and other applications. (See *ANSI/NAAMM HMMA 861 Guide Specification*.)

COMMERCIAL SECURITY HOLLOW METAL: Steel door and frame products designed, tested and manufactured to resist intrusion or forced entry in commercial applications. (See *ANSI/NAAMM HMMA 862 Guide Specification*.)

COMMUNICATING FRAME: Hollow metal frame fabricated such that a door is installed in each rabbet of a double rabbetted frame (2 doors total) to facilitate dual access and control of the opening, i.e. hotel/motel suites, and acoustical applications.

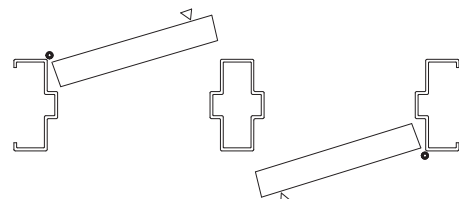


COMPOSITE DOOR: A door consisting of a nonmetal core bonded to a metal facing.

CONTINUOUS WELD: See **WELD**.

CONTINUOUSLY WELDED: See **WELDED**.

CONTRA-SWING FRAME: A frame with two doors swinging in opposite direction incorporating a fixed or removable hollow metal mullion between the doors.



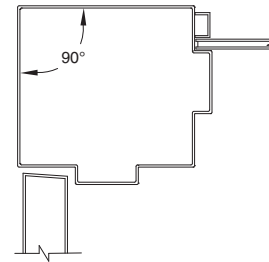
CORE: The material(s) of a hollow metal door or panel.

CORNER CLIP: See **REINFORCING GUSSET**.

CORNER JOINT: The intersection of either the perimeter members of a metal frame product or glass stops.

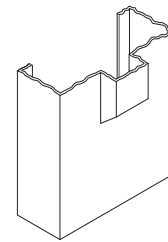
CORNER GUSSET: See **REINFORCING GUSSET**.

CORNER POST, (CORNER MULLION): A closed section, which facilitates a turn in the hollow metal frame assembly. The angle of the turn may vary, although 45 degree and 90 degree turns are common.



COVER PLATE: A removable piece of metal used to cover the hardware preparation or provide access to the interior of door or frame.

CUT-OFF STOP: The stops and soffit on a jamb or mullion at a door opening that are terminated at a specified distance above the floor, and are closed square or at an angle. To facilitate cleaning the floor. Also referred to as Hospital Stops, Sanitary Base or Terminated Stop.



CUTOUT: A hole in the hollow metal door or frame to accommodate hardware, light kits, louvers or other options.

DESIGN CLEARANCE: See **CLEARANCE**.

DETENTION SECURITY HOLLOW METAL: A steel door and frame assembly designed, tested, and manufactured for the containment of individuals to designated areas within detention or correctional facilities. (See also *ANSI/NAAMM HMMA 863 Guide Specifications*.)

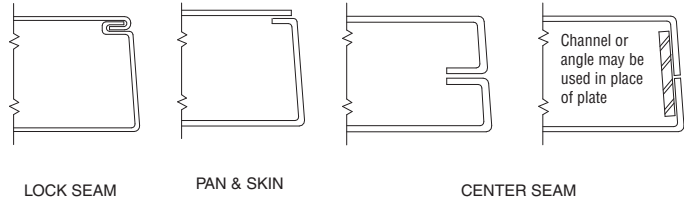
DOOR CLEARANCE: See **CLEARANCE**.

DOOR EDGE: The vertical surfaces of the door.

HINGE: The vertical edge of a door to which hinges or pivots are attached.

LOCK: The vertical edge of a door in which locking or latching hardware may be installed.

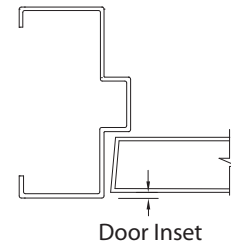
DOOR EDGE SEAM: The connection of face sheets at the vertical edge.



DOOR FACE: The exposed surface of the door not including the vertical edges and top and bottom.

DOOR FRAME: An assembly of members surrounding and supporting a door, or doors.

DOOR INSET: The distance from the face of the door to the face of the frame on the pull side.



DOOR LIGHT: The provision for glazing material in a door.

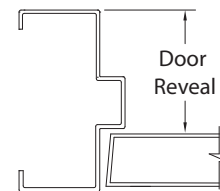
DOOR OPENING: The area in a frame product into which a door or doors are installed.

DOOR OPENING HEIGHT: The distance measured vertically between door rabbet and the top of floor or bottom of frame minus jamb extensions. Also referred to as nominal door height. *(For additional information, See HMMA TechNote HMMA-810 TN01-03 "Defining Undercuts")*

DOOR OPENING WIDTH: The distance measured horizontally between door rabbets. Also referred to as nominal door width.

DOOR RABBET: See **RABBET**.

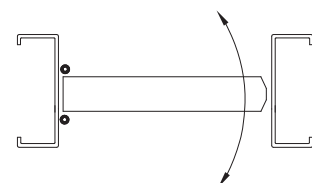
DOOR REVEAL: The distance from the face of the door to the face of the frame on the push side.



DOOR SCHEDULE: The listing of all door openings on the project by the Architect's/Designer's mark number, including a description of each door opening. The schedule is normally found in the drawings or specifications.

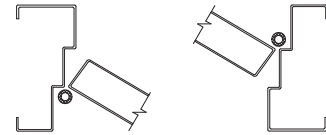
DOOR STOP: That part of a frame profile against which the door closes.

DOUBLE-ACTING DOOR: A door that swings in both directions. May incorporate bull-nose edge[s].



DOUBLE-ACTING FRAME: A frame for double-acting doors.

DOUBLE EGRESS DOORS: A pair of doors swinging in opposite directions, located in the same plane within the frame.



DOUBLE EGRESS FRAME: A frame prepared to receive double egress.

DOUBLE RABBET: A frame provided with two rabbets. See **FRAME PROFILE** for detail.

DOUBLE RETURN: See **BACKBEND**.

DOUBLE SWING FRAME: See **PAIR FRAME**.

DRIP: A head mounted molding designed to reduce rainwater infiltration at top of door.

DRYWALL FRAME: A frame designed for installation in a wall constructed with studs and gypsum wallboard or other dry sheet facing material.

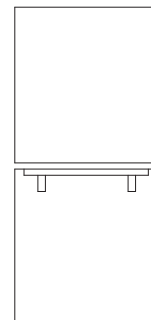
DRYWALL PROFILE: Description of a frame with backbends. Slip-on frames utilize this type of profile.

DRYWALL RETURN: See **BACKBEND**.

DUST COVER BOX: See **GROUT GUARD**.

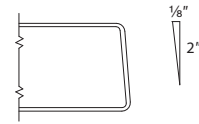
DUTCH DOOR: A door consisting of two separate leaves, one above the other. May be provide with shelf at its top edge of the bottom leave.

DUTCH DOOR FRAME: A frame prepared for a dutch door.

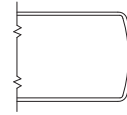


EDGE PROFILE: Description of the vertical door edge; beveled, bull nosed, rabbeted, or squared, Available on lock and/or hinge edge.

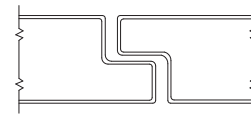
BEVELED: The vertical door edge has a 1/8" in 2" (3.1 mm in, 50.8 mm) slope from a plane perpendicular to the door pull side face.



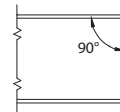
BULL-NOSED: The vertical door edge simulates a 2-1/8" (54 mm) radius.



RABBETED: The vertical door edge which overlaps another door or frame.



SQUARED: The vertical door edge that is formed 90 degree to the face of the door.



EDGE SEAM: The connection of the face sheet at the vertical edge.

ELEVATION: An orthographic projection of the vertical side of a hollow metal assembly (doors, frames, etc.) usually shown on the architectural plans in conjunction with the vertical side view of a building wall.

EMBOSSSED: Having a raised and/or indented pattern impressed on a surface by means of patterned rolls or stamping dies.

END CHANNEL: See **TOP CHANNEL** and **BOTTOM CHANNEL**.

EXISTING WALL ANCHORS: See **ANCHORS**

EXPANDABLE FRAME: See **ADJUSTABLE FRAME**.

FACE WELDED: See **WELDED**.

FIELD SPLICE: A connection of hollow metal frame components accomplished in the field. Also referred to as Shipping Splice.

FILLER PLATE: A metal plate used to fill unused mortise cutouts in a door or frame.

FINISHED FLOOR: See **FLOOR**.

FIRE ENDURANCE RATING: See **FIRE RATING**.

FIRE PROTECTION RATING: See **FIRE RATING**.

FIRE-RATED: A product which has successfully met all conditions of acceptance of the fire test standard specified in the governing model or building code, is “Listed” or “Classified” and eligible for labeling by a recognized testing agency having a factory inspection service.

FIRE RATING: A numeric designation indicating the duration of fire test exposure to which a product has been exposed, and successfully met all acceptance criteria of the standard to which it is tested. For swinging doors and frame products, typical fire ratings include 3, 1-1/2, 1, 3/4, and 1/3 hour. Also called Fire Protection Rating.

FIXED STOP: See **STOP**

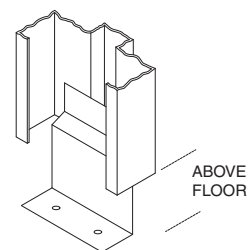
FLOOR: The top of the concrete or structural slab. Also referred to as finished floor. *(For additional information, see HMMA TechNote HMMA-810 TN01-03 “Defining Undercut.”)*

FLOOR ANCHOR: See **ANCHOR**

FLOOR CLEARANCE: See **CLEARANCE**.

FLOOR COVERING: Any material applied on top of the floor. (For additional information, see HMMA TechNote HMMA-810 TN01-03, “Defining Undercuts”)

FLOOR STILT: A metal device attached to the jamb of a door frame to hold the frame above the finished floor.



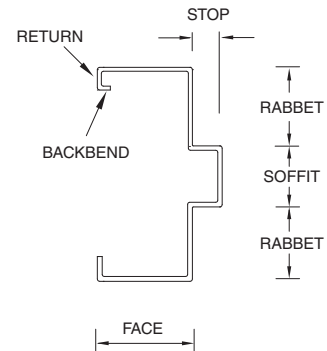
FLUSH DOOR: A door having no glass lights, panels, louvers or grilles.

FRAME: See **DOOR FRAME**.

FRAME CLEARANCE: See **CLEARANCE**.

FRAME FACE: The elements of a frame profile which is visual on the vertical side of a hollow metal assembly. See **FRAME ELEMENTS** for details.

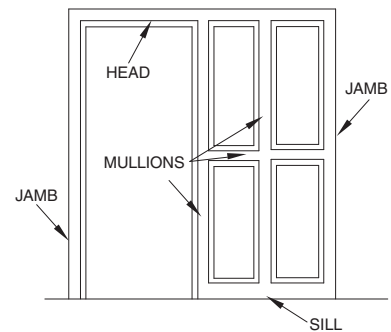
FRAME ELEMENTS: Within a Frame profile, a specific part such as; soffit, stop, rabbets, faces and returns. (For additional information, see HMMA TechNote HMMA-820 TN 02-03, "Continuously Welded Frame")



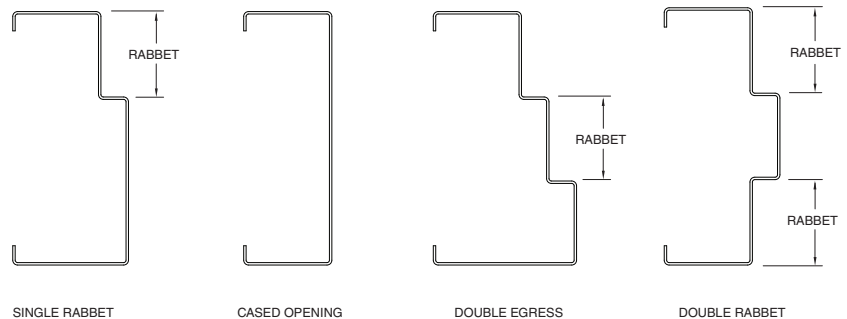
FRAME GASKET: See **GASKETING**.

FRAME JOINT: The intersection of two or more frame members.

FRAME MEMBER: A component in a frame product such as a jamb, head, mullion or sill. (For additional information, see HMMA TechNote HMMA-820 TN 02-03, "Continuously Welded Frame")



FRAME PROFILE: Visual description of a frame member. Typically referred to as cased opening, single rabbet, double rabbet, and double egress. Refer to individual description for detail.



FRAME PRODUCTS: Used to describe, as a group, "Frames," "Transom Frames," "Sidelight Frames" and "Window Frames."

FRAME SECTION: Cross cut of a frame member. See **FRAME PROFILE**.

FRAME SILL: The bottom horizontal member of a sidelight or borrowed light frame. Also referred to as Base.

FULL PROFILE WELDED: See **WELDED**

FULL (FULLY) WELDED: See **WELDED**.

FULL (FULLY) WELDED FRAME: See **WELDED**.

FULLY WELDED SEAMLESS DOOR: See **WELDED**.

GASKETING: Material applied around the door or frame to close the clearance opening and minimize or restrict the passage of smoke, light, sound or weather.

GAUGE (GAGE): An numeric value used to define the nominal thickness of material. (See NAAMM/HMMA 803-08 “STEEL TABLES”)

While the term ‘gauge’ is no longer common for defining material thickness it is still used to specify doors and frames for ordering purposes. The term ‘thickness’ is used when defining the actual dimension of an item, and the term ‘gauge’ is used in the context of specifying a particular door or frame.”

GLAZING: The process of installing glazing materials.

GLAZING (GLASS) BEAD: A removable formed metal section used to secure glazing or panel in a door or frame.

GLAZED, (GLASS) LIGHT: In a frame, the light is formed by the assembly of jamb, head, sill and mullion members into a rectangular or shaped opening. The light is equipped with factory installed glazing bead used to retain the glazing that is installed by the glazing contractor. In a door, the light is formed by providing a rectangular or shaped cutout in the door and equipping it with molding and removable bead to receive the glazing.

GLAZING, (GLASS) MOLDING: The portion of the assembly retaining glazing materials or in-fill panels in a hollow metal door which contain the integral stop, and to which a glazing bead is attached. Also referred to as Glazing Stop.

GLAZING MATERIAL: A transparent or translucent material used in door assemblies and windows.

GLAZING STOP: See **GLAZING, (GLASS) MOLDING**

GROUT: A substance used to fill up voids in hollow metal frame cavities. (For additional information See NAAMM/HMMA 820 TN1-03 Technical Note “Grouting”.)

GROUT GUARD: A metal cover attached to a frame behind reinforcement for mortised or recessed hardware items, to prevent grout from entering the mounting holes. Also referred to as Dust Cover Guard, Masonry Guard, Mortar Guard, or Plaster Guard.

GROUTED FRAME: Frame filled with grout.

HANDING: A term used to designate the direction of door swing.

HARDWARE SCHEDULE: Complete listing of all hardware specified for a project, organized by opening numbers including Door Headings, manufacturers names, template numbers, and special hardware locations. Prepared in accordance with industry standards for or by the Architect/Designer and issued for bid. Once contract is awarded and Hardware Schedule is approved, it becomes part of construction contract.

HARDWARE TEMPLATE: A detailed drawing of the hardware preparation provided by hardware manufacturing for providing preparation of hardware.

HEAD, (HEADER): The horizontal member which forms the top of a frame.

HEAD STIFFENER: A metal angle or channel attached inside the head of a door. Not to be used as a load-carrying member.

HINGE JAMB: See **JAMB**.

HINGE REINFORCEMENT: A metal plate or angle attached to a door or frame to which a hinge is attached.

HINGE SIDE: See **PULL SIDE**:

HOLLOW METAL: A term used to reference to doors, frames, partitions, enclosures and other items, fabricated from metal sheet.

HOSPITAL PROFILE: See **SPLADE STOP**.

HOSPITAL STOP: See **CUT-OFF STOP**.

INACTIVE DOOR or LEAF: The leaf of a pair of doors which does not contain a lock but is secured, when closed, by top and/or bottom bolts and contains a strike to receive the latch or bolt of the active leaf.

INFILL PANEL: See **PANEL, INFILL**.

INTEGRAL ASTRAGAL: See **ASTRAGAL**.

INTEGRAL STOP: See **STOP, INTEGRAL**.

INTERGAL TAB and SLOT: Formed as part of the frame profile used to align machined mitered frame corner joints in mechanical alignment construction.

INTERLOCKING SEAM: See **LOCK SEAM DOOR**.

JAMB: The vertical frame member forming the perimeter of a frame.

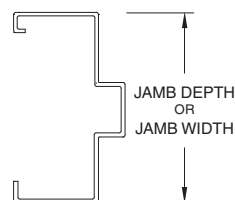
BLANK: A jamb without mortised hardware preparation.

HINGE: A jamb of a frame prepared for hinges or pivots.

STRIKE: A jamb prepared for a strike.

JAMB ANCHOR: See **ANCHOR**.

JAMB DEPTH / JAMB WIDTH: The dimension of a frame member measured perpendicular to the face from one face to the other.

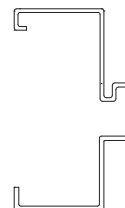


JAMB EXTENSION: That portion of a jamb which extends below the level of the floor. See Also **BELOW FLOOR**. (*For additional information, see HMMA TechNote HMMA-810 TN01-03, "Defining Undercuts."*)

JAMB OPENING: See **DOOR OPENING, WIDTH**.

JAMB WIDTH: See **JAMB DEPTH**.

KERFED FRAME: A frame that is formed with an integral pocket or recess in the area of the stop to receive gasket or seals.



KNOCKED DOWN: A frame product that is shipped disassembled, commonly abbreviated "KD."

LABEL: A metal plate, sticker, or embossment, on a product to indicate a performance level in accordance with a specific standard.

LAMINATED CORE: A door or panel construction utilizing; kraft honeycomb, rigid foam, mineral core or steel stiffeners, in which steel face sheets are bonded.

LEADING EDGE: Intersection of the lock edge and the pull side face of a door.

LEAD-LINED: A door or frame, which is lined with lead to prevent radiation penetration.

LEAF: A single door.

LEAVES: More than one door.

LOCK CENTER CLIP: A part to position a mortised lock inside the center of a door.

LOCK EDGE: See **DOOR EDGE**.

LOCK REINFORCEMENT: A plate attached inside of a door to which a lock is fastened.

LOCK SEAM: Interlocking construction of a door or panel edge.

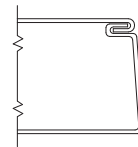
LOUVER: A series of slats, blades, or piercings to allow passage of air through an opening.

LOUVER INSERT: A louver that is fabricated separately and inserted into a preparation in the door or frame.

MASONRY GUARD: See **GROUT GUARD**.

MEETING STILE: The vertical edge of a door, in a pair, which is adjacent to the other door.

MITER JOINT: The intersection of frame members, (typically head and jambs) or frame elements (stops) in which the faces meet at an angle.



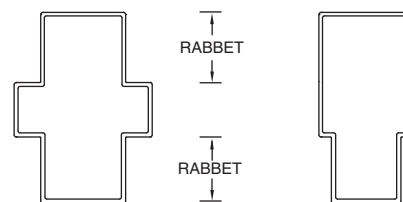
MORTAR: See **GROUT**.

MORTAR GUARD: See **GROUT GUARD**.

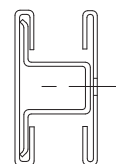
MORTISE: A recess on a minimum of 3 sides of a hardware item closely surrounding the contour of the item allowing its faceplate to finish flush with the door or frame finished surface.

MORTISE PREPARATION: For hardware, a cutout recessed into a door or frame, which may include, drilling and tapping.

MULLION: A closed member within a frame, separating doors, a door and sidelights, glazed areas or panels. A mullion may be fixed or removable. Typically a double or single rabbeted profile.



MUNTIN: A bar or formed material supporting and separating panes of glass within a door, sidelight, transom, borrowed light, or window frame.



MUTE: See **SILENCER**.

NAILING FLANGE: A reveal flange in which nail holes are provided.

NARROW SIDE OF DOOR: See **PUSH SIDE OF DOOR**.

NET DOOR SIZE: See **ACTUAL DOOR SIZE**.

NOMINAL DOOR HEIGHT: See **DOOR OPENING HEIGHT**.

NOMINAL DOOR SIZE: (Door opening width) by (door opening height).

NOMINAL DOOR WIDTH: See **DOOR OPENING WIDTH**.

OPENING SIZE: The frame opening measured between the rabbets horizontally and between the header, rabbet and bottom of frame vertically.

OPERABLE TRANSOM: Panel or glass lite above door opening which may be opened for ventilation purposes.

OVERLAPPING ASTRAGAL: See **ASTRAGAL, FLAT SURFACE**.

PANEL, HOLLOW METAL: An assembly made of the same material and construction as a door.

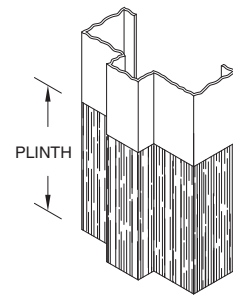
PANEL, INFILL: An assembly comprised of steel sheet secured to each face of a backing material (gypsum or cement board, etc.), installed like glazing materials, in doors, transom, sidelight and window assemblies.

PERIMETER FRAME JOINT: The intersection of two or more frame members that are accessible through the throat or from the unexposed side of the frame member. (*For additional information, See HMMA TechNote HMMA-820 TN02-03, "Continuously Welded Frames."*)

PLANKING: Wood spacers used in storage of doors and frames.

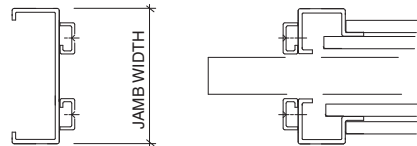
PLASTER GUARD: See **GROUT GUARD**:

PLINTH: A section of sheet metal, usually stainless steel, used as a base for a door frame at the floor. It has the same thickness and profile as the jamb section, and is flush with the jamb on all surfaces.



POCKET DOOR: A door designed to slide/recess into a wall cavity to open, and slide out of the wall cavity to close.

POCKET DOOR FRAME: Frame designed to allow a door to slide inside a pocket located within the cavity of a wall.



PRESSURE RESISTANT: Refers to a hollow metal assembly designed and manufactured to resist uniform static pressure of a specified magnitude over its exposed surface.

PRIMER / PRIME PAINT: Paint coating used as a base for finish paint.

PULL SIDE OF DOOR: The face of a door opposite the frame stops. Also referred to as Hinge Side or Wide Side.

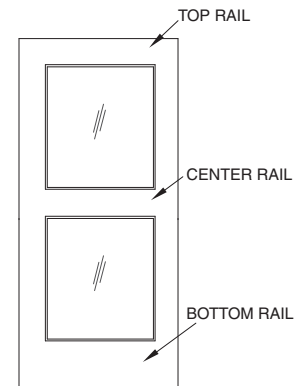
PUSH SIDE OF DOOR: The face of door, which contacts the frame stops. Also referred to as stop side or narrow side.

RABBET: On a frame, the area that is between the stop and the face, capable of accepting doors, panels or glazing materials. Also referred to as Door Rabbet. See **FRAME ELEMENT** for detail.

RABBETED: Description of a door edge formed to interlock with another door, frame or panel.

RADIATION SHIELDING: Refers to a hollow metal assembly designed and manufactured to resist penetration by a specified type of radiation.

RAIL: The horizontal member forming the top or bottom edge of a door, or separating panels or glazed areas. Referred to as Top Rail, Intermediate Rail or Bottom Rail.

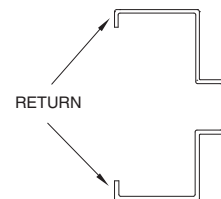


REINFORCING GUSSETT: A flat or formed component at junction of head and jamb used in interlocking of knock-down (KD) frames. May be used as an alignment feature on punch mitered frames.

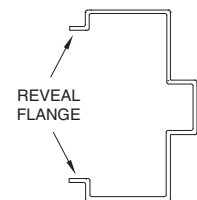
REMOVABLE MULLION: A frame member designed for temporary removal. See **MULLION** for detail.

REMOVABLE STOP: See **STOP**

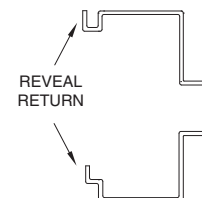
RETURN: The element of the frame profile, which extends inward from the face to the throat.



REVEAL FLANGE: The element of the frame profile, which extends from the return. Typically formed parallel to the wall.



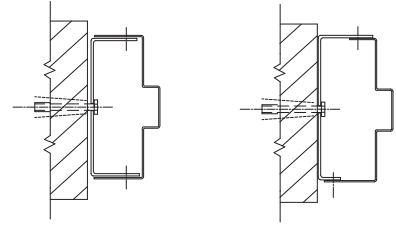
REVEAL RETURN: The element of the frame profile, which extends from the reveal flange.



REVERSE BEVEL: Refers to hand of door or lock on outswing doors.

RIB: See **STIFFENER**.

ROUGH BUCK FRAME: An assembly which consists of a finished frame and anchoring channels.



ROUGH OPENING: The size of the wall opening into which a frame is to be installed.

SANITARY BASE: See **CUT-OFF STOP**.

SEAM, INTERLOCKING: See **LOCKSEAM**.

SEAMLESS DOOR: A door having no visible seams on its faces or edges.

SHIPPING BAR: See **SPREADER**.

SHIPPING SPLICE: See **FIELD SPLICE**.

SIDELIGHT: A framed area immediately aside a door opening which may contain fixed glazing, panel or other filler.

SILENCER: A of resilient material attached to the stop on a frame to cushion the closing of a door. Also referred to as Mute.

SILL ANCHOR: See **ANCHOR**.

SILL: The bottom horizontal member of a sidelight or borrowed light frame. Also referred to as Base.

SINGLE-ACTING DOOR: A door which only opens in one direction.

SINGLE RABBET FRAME: A frame having only one rabbet See **FRAME PROFILE**, for detail.

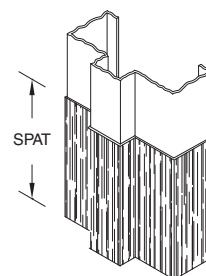
SLIP-ON FRAME: Frame designed to be installed after the wall is erected.

SMOKE CONTROL ASSEMBLY: A door and frame assembly with gasketing (by others) designed to resist the passage of smoke when the door is in the closed position. May or may not be Fire-Rated.

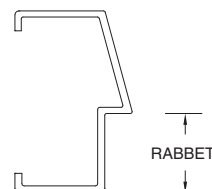
SOFFIT: The element of a door frame; (a) between the stops on a double rabbeted frame, (b) between the stop and face opposite door side of a single rabbeted frame. See **FRAME ELEMENT** for detail.

SOUND RETARDANT: A characteristic of a hollow metal assembly designed and manufactured to resist sound transmission. The Sound Transmission Classification (STC) rating of the assembly indicates the level of resistance to sound transmission.

SPAT: A protective covering, usually of stainless steel, applied over the bottom of jambs to facilitate cleaning and reduce frame damage.



SPLADE PROFILE: A frame member where the transition from stop to opposite face is sloped. Also referred to as Hospital or sloped Profile.



SPLIT FRAME: See **ADJUSTABLE FRAME**.

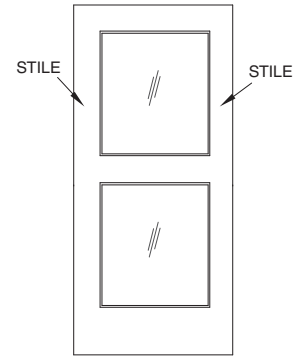
SPOT WELD: See **WELDING**.

SPREADER (SPREADER BAR): A metal channel or angle temporarily attached to the base of a door frame, extending between jambs, to keep the frame in proper alignment during shipping and handling.

SQUARE-EDGE DOOR: A door having vertical edges that are perpendicular to its face. See **EDGE PROFILE** for detail.

STEEL STUD ANCHOR: See **ANCHOR**.

STIFFENER: An internal formed steel component used to strengthen a door panel or frame member.



STILE: The vertical member which form the edge of a door.

STOP: An element of a frame profile. See also **DOOR STOP** and **GLAZING (GLASS) BEAD**. See **FRAME ELEMENT** for detail.

INTEGRAL: A stop, which is formed as part of the frame profile.

REMOVABLE: Metal channel or angle which is removable to allow installation of glass, panel or door.

STOP SIDE: See **PUSH SIDE OF DOOR**.

STRIKE JAMB: See **JAMB**.

STRIKE REINFORCEMENT: A metal plate or formed unit attached inside a door or frame to attach a strike.

STRUT: See **CEILING STRUT**.

SUB-BUCK OR SUB-FRAME: See **ROUGH BUCK FRAME**.

SURFACE HARDWARE REINFORCEMENT: A metal plate attached inside a door or frame to receive surface-mounted hardware applied in the field.

SWING: A term used to describe the operation of a hinged door.

SWINGING DOOR: A door mounted on hinges or pivots.

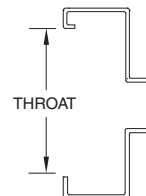
TEMPERATURE RISE RATED DOOR: A fire rated door designed to limit the transfer of heat over a specified duration to a specified temperature.

TERMINATED STOP: See **CUT-OFF STOP**, also called Hospital Stops.

THERMAL BOW: A temporary condition, affecting the operation of an exterior door due to the inside temperature differential. The extent of this condition will vary with environmental conditions, door color, door construction, length of exposure, etc. This condition can often be alleviated by painting the outside surface of the door a light color.

THICKNESS: The actual dimension of an item, see “Gauge” for defining steel material.

THROAT: The distance between Returns or Backbend Returns of a frame profile.



TOLERANCE: Permissible deviation from a nominal or specified dimension or value. All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

TOP CHANNEL: Horizontal stiffener channel secured into the top of a door. Also referred to as End Channel.

TOP RAIL: See **RAIL**:

TRANSOM: A framed area immediately above a door opening which may containing fixed glazing, an operating sash, panel or other filler.

TRANSOM BAR: See **TRANSOM MULLION**.

TRANSOM FRAME: A frame containing a door opening and transom with or without a transom mullion.

TRANSOM MULLION: The horizontal frame member, which separates the door opening from the transom. Also referred to as transom bar.

TRIM: See **FRAME FACE**.

UNDERCUT: The Distance between the bottom of door and the bottom of the frame. (See *NAAMM/HMMA 810 TN01-03 Technical Note "Determining Undercuts"*)

VISION LIGHT: A glazed opening in a door.

WEEPHOLE: A opening provided to permit the drainage of moisture.

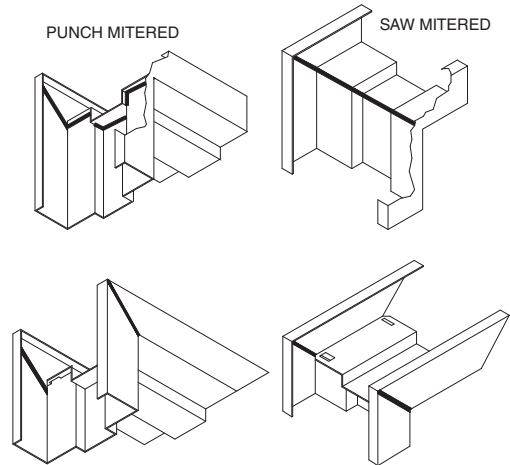
WELD/WELDING: A process for the joining of metal parts, with the necessary heat being provided by an electric arc struck between an electrode and the metal or between two electrodes.

WELD, CONTINUOUS: A weld having no gaps or spaces, over its entire length.

WELDED CONTINUOUSLY, DOOR: A door having all joints on its vertical edge continuously welded and finished smooth.

WELDED CONTINUOUSLY, FRAME: Also called Full or Fully Welded and/or Full Profile Welded. Comer/Perimeter joints shall have all elements of the frame member continuously welded: soffits, stops, rabbet, faces and returns. (See NAAMM/HMMA 820 TN2-03 Technical Note "Continuously Welded Frames" for additional information.)

WELDED, FACE, FRAME: Comer/perimeter joints shall have a continuous weld at the faces only.



WICKET DOOR: A swinging door within a door.

WIDE SIDE: See **PULL SIDE**.

WINDOW: A glazed opening frame installed in an exterior wall prepared for field installation stationary (fixed) glazing. Mullions may be used to divide individual glazed areas. Similar to **BORROWED LIGHT**.

WOOD STUD ANCHOR: See **ANCHOR**

WRAP-AROUND FRAME: A frame which fits over the wall. The frame throat is nominal 1/8" (3mm) larger than the wall thickness.

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AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

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Guidelines to Measure for Replacement Doors in Existing Frame Openings



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Guidelines to Measure for Replacement Doors in Existing Frame Openings

1 Introduction

This document is intended to provide guidance for measurement and recording of existing opening and/or door dimensions required to fully detail a replacement door(s). The included figures identify the basic dimensions of frame openings and doors with standard hardware applications. Separate illustrations are provided for detailing single and paired frame openings as well as detailing individual doors.

1.1 Referenced Documents

Related SDI Technical Series documents provide additional technical guidance on this topic:

SDI-108 *Recommended Selection and Usage Guide for Standard Steel Doors*

SDI-111 *Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components*

SDI-122 *Installation Troubleshooting Guide for Standard Steel Doors and Frames*

SDI-129 *Hinge & Strike Spacing*

SDI-134 *Glossary of Terms for Hollow Metal Doors and Frames*

1.2 Other Reference Materials

ANSI/BHMA A156.1-2016 *Butts and Hinges*

ANSI/BHMA A156.7-2014 *Template Hinge Dimensions*

ANSI/BHMA A156.115-2014 *Hardware Preparation in Steel Doors or Steel Frames*

1.3 Notes

1.3.1 Tolerances

All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

1.3.2 Gauge vs. Thickness

While the term 'gauge' is no longer common for defining material thickness it is still used to specify doors and frames for ordering purposes. The term 'thickness' is used when defining the actual dimension of an item,

and the term 'gauge' is used in the context of specifying a particular door or frame.

2 Preparation

Installation conditions and issues will affect door operation and should be considered beforehand. Door and hardware in an improperly installed frame may function poorly. Check the floor clearance and the frame opening to verify acceptable square and level conditions. Reference SDI-122 to check for frame installation issues. Slight adjustment may be possible without removal.

Note: Frame may need to be replaced for proper function of the opening.

Basic door and frame terminology used in instructions and illustrations is explained in more detail below and in SDI-134.

The term "nominal dimensions" refers to the width and height dimensions of the frame opening. When applied to a door size, it is implicit that the door is undersized to properly fit into the nominal frame opening with proper clearances. The term "net dimension" refers to the door's width and height dimensions. To illustrate, the door width and height dimensions in (Fig 3) are actual or "net" dimensions.

Technical Data Series SDI-129, "Hinge and Strike Spacing," provides standard locations for hinge and strike preparations in SDI member doors and frames. Manufacturers' locations may change so it is imperative that the hinge and strike locations be measured for replacement doors and frames.

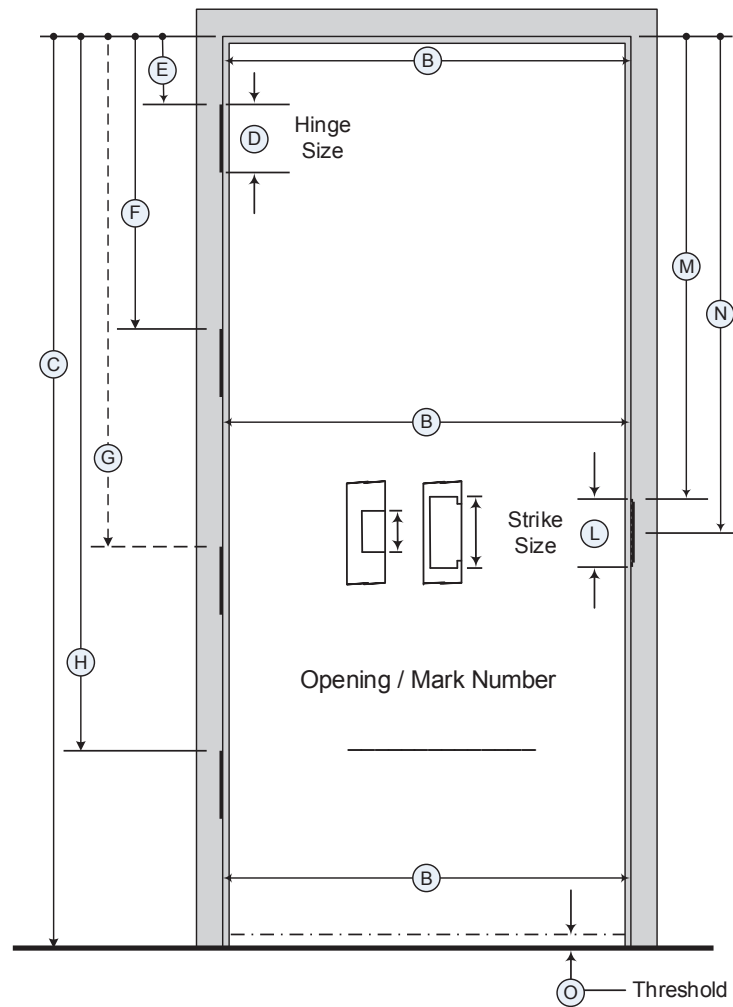
Hardware preparations of the replacement door must be sized and located to coincide with those on the existing frame to ensure proper fit, positioning and clearances for door operation.

For hardware applications not covered below, contact the replacement door or hardware manufacturer.

3 Measurements

3.1 Tools

- Tape measure
- Steel rule
- Calipers (optional)
- Framing square and small square
- Level (24" minimum)
- Plumb bob (optional)



–	Opening #	
A	Handing	
B	Opening Width (Min)	
C	Opening Height (Min)	
D	Hinge Size	
E	First Hinge	
F	Second Hinge	
G	Third Hinge (if 4)	
H	Fourth Hinge	
J	Hinge Backset	
K	Hinge Weight	
L	Strike Size	
M	Top of Strike	
N	C/L Strike Hole	
O	Threshold Height	
P/Q	Sill Condition	
R	Door Thickness	
S	Door Rabbet	
T	Stop Height	
U	Label Requirements	

All Measurements $\pm \frac{1}{32}$ "
All Measurements are of Existing Frame

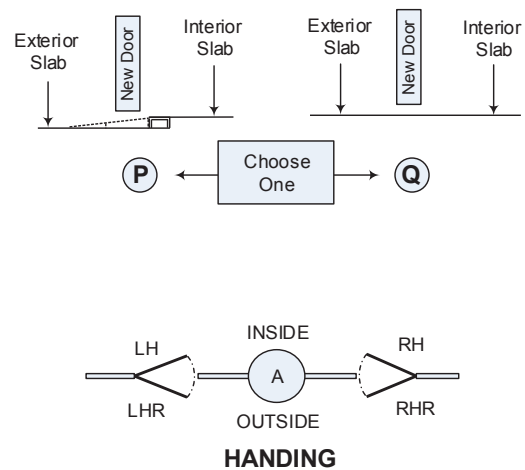
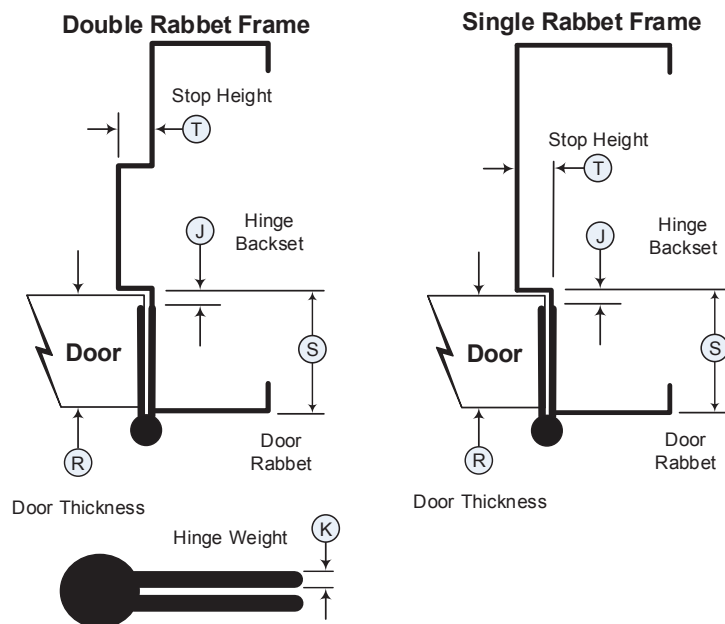


Figure 1 – Existing Frame Opening – Single Door

4 Frame Opening Measurements

4.1 The included illustrations provide guidance as follows:

- Figure 1 – frame opening dimensions for single door installation
- Figure 2 – hinge weights
- Figure 3 – frame opening dimensions for door pair installation
- Figure 4 – actual door dimensions
- Figure 5 – multiple frame openings worksheet

4.2 Frame opening width and height. These dimensions are to be taken from rabbet-to-rabbet surfaces. It is recommended that dimensions of both width and height be taken at three locations and the smallest of these measurements be used for sizing of the door.

4.3 Frame profile rabbet. The door thickness must be matched to this frame dimension. It is important that you have this dimension especially if you do not have the door.

Example – standard 1- $\frac{3}{4}$ " thick door is used with 1- $\frac{15}{16}$ " wide rabbet

4.4 Threshold height (if existing or planned) from the floor. Door undercut may need to be adjusted to allow clearance for thresholds.

4.5 Openings may have certification requirements such as fire ratings. Such requirements should be indicated by labels attached to the door (and sometimes frame). These label requirements should be noted and recorded on the form.

5 Frame Hardware Measurements

5.1 Hinge Height

The height of the hinge leaf. The most common hinge height (size) is 4- $\frac{1}{2}$ ", then 5", followed by 3- $\frac{1}{2}$ ", 4" and 6", then other sizes.

5.2 Hinge Weight

The hinge leaf thickness. Hinge mortise depth normally corresponds to this individual hinge leaf thickness. Please note that special applications exist for "double-mortise" and "surface applied". For 4- $\frac{1}{2}$ " hinge size, standard weight is 0.134" and heavy weight is 0.180". Standard and heavy weight vary by hinge size as shown in Figure 2, a table adapted from ANSI/BHMA A156.1. Additional hinge details are provided in A156.7 for hinge templating and A156.115 for door preps.

5.3 Hinge Backset

The distance from the edge of the applied hinge leaf to the frame stop. This is a critical measurement and must be accurate within $\frac{1}{32}$ ". The most common dimension is $\frac{5}{16}$ ". The hinge backset on the door will be properly adjusted from this measurement (typical - $\frac{1}{16}$ ") to ensure proper clearance.

5.4 Hinge Locations

The vertical location of each hinge cutout. The recommended method of measurement is from the door rabbet surface of the existing frame head to the top of each hinge (i.e. "top-to-top").

5.5 Strike Height

Vertical dimension of the frame strike cutout. The most common is 4- $\frac{7}{8}$ ", followed by 2- $\frac{3}{4}$ " then 3- $\frac{1}{2}$ ".

Hinge Height +0/-0.015 in	Grade 1			Grade 2	Grade 3	Grade 4
	Triple Weight	Double Weight	Heavy Weight	Standard Weight		Light Weight
	Thickness of Metal Inches +/-0.005 in.					
3"	—	—	—	—	—	>0.077
3-½"	—	—	—	0.123	0.123	>0.085
4"	—	—	—	0.130	0.130	>0.085
4-½"	—	—	0.180	0.134	0.134	—
5"	—	—	0.190	0.146	0.146	—
6"	—	—	0.203	0.160	0.160	—
8" (not in A156.1)	—	—	0.203	—	—	—

Figure 2 – Hinge Weights (adapted from ANSI/BHMA A156.1)

5.6 Strike Location

While commonly specified from the floor (bottom of frame) to centerline C/L of cutout in new installation, the recommended measurement for replacement doors is from the door rabbet surface of the frame head to the top of the cutout (top-to-top).

6 Additional Measurements for Paired Opening

Paired openings add a variety of latching options for both active and inactive doors, particularly devices that latch vertically into strikes located in the frame head and floor/sill/threshold. If device strikes mortised into either the frame head or the floor/sill/threshold and are intended to be re-used, it becomes important to note their size and centerline (C/L) of engagement. These dimensions may restrict replacement hardware options. Strike plates are indicated on the illustrations for the “Existing Frame Openings - Paired Openings” as dimensions S.1, S.2, T.1 & T.2. Consult replacement door manufacturer if moving surface-mounted strikes is necessary.

7 Door Measurements

7.1 Door width

Dimensions taken from edge to edge across the door using steel tape. On doors with beveled edges, measurements should be taken from the wide side of the door, noting whether beveled on lock, hinge or both edges. For doors of door pairs, application or absence of an astragal affects door width.

7.2 Door Height

Dimensions taken from top to bottom edges of door using a steel tape.

7.3 Door Thickness

Dimension of door thickness using steel tape or caliper.

While the term ‘gauge’ is no longer common for defining material thickness it is still used to specify doors and frames for ordering purposes. As such, the terms ‘thickness’ is used when defining the actual dimension of an item and ‘gauge’ is used in the context of specifying a particular door or frame.

8 Door Hardware Measurements

8.1 Hinge Height

The height of the hinge leaf. The most common hinge height (size) is 4-½”, then 5”, followed by 3-½”, 4” and 6” then other sizes. Note: hinge width does not impact frame hardware measurement.

8.2 Hinge Weight

The hinge leaf thickness. Hinge mortise depth normally corresponds to this individual hinge leaf thickness where 0.134” is the most common (standard weight), followed by 0.180” (heavy-weight), then other less common thicknesses. Please note that special applications may exist for “double-mortise” and “surface applied” hinge mortises.

8.3 Hinge Backset

The distance from the edge of the applied hinge leaf to the door face nearest the frame stop. This is a critical measurement and must be accurate within ⅛”. The most common dimension is ⅜”.

8.4 Hinge Locations

The vertical location of each hinge cutout. The recommended method of measurement is from the top of the door to the top of each hinge (i.e., “top-to-top”).

8.5 Latch Dimension

The width and height of the latch plate on the edge of the door. The most common are cylindrical (1-⅛” x 2-¼”) and mortise (1-⅛” x 8”).

8.6 Latch or Lock Location

Commonly specified from the floor (bottom of frame) to centerline (C/L) of cutout in edge of door or centerline (C/L) of strike in new installation. The recommended measurement for replacement doors is from the top of the door to the top of the cutout in edge of door if applicable or top of door to centerline (C/L) of latch actuating hole (i.e., “top-to-top”).

8.7 Lock Backset

The horizontal dimension from the door edge to the centerline (C/L) of the latch actuating hole on face of door. The most common backset dimension is 2-¾” for cylindrical and mortise locks. Doors with beveled lock edges should be measured from the wider beveled side.

9 Door Accessories

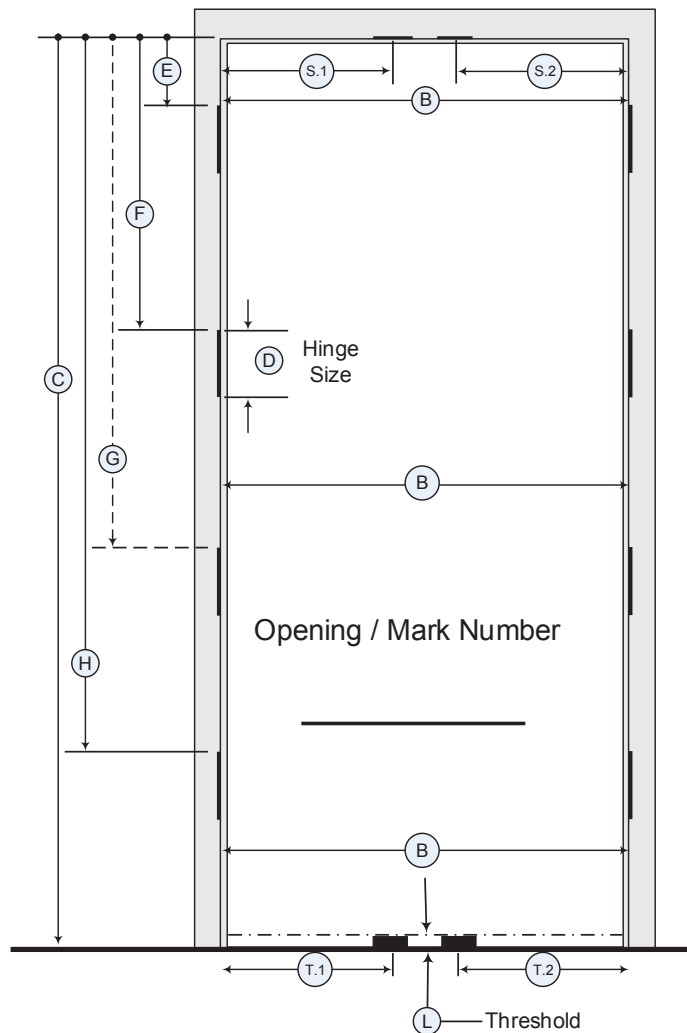
Note: Instructions vary by accessory manufacturer and replacement door manufacturer.

9.1 Glass kits / inserts

9.1.1 Measure from top of door to top of cutout, top of outside edge of insert, or top of visible glass.

9.1.2 For locating off centered inserts; measure from lock edge of door to edge of cutout; outside edge of insert; edge of visible glass.

9.1.3 Exposed glass size – specifies the resulting visible glass area shown once installed.



–	Opening #	
A	Handing	
B	Opening Width (Min)	
C	Opening Height (Min)	
D	Hinge Size	
E	First Hinge	
F	Second Hinge	
G	Third Hinge (if 4)	
H	Fourth Hinge	
J	Hinge Backset	
K	Hinge Weight	
L	Threshold Height	
M/N	Sill Condition	
N	C/L Strike Hole	
O	Door Thickness	
P	Door Rabbet	
Q	Stop Height	
S.1	Head Strike C/L	
S.2	Head Strike C/L	
S.3	Head Strike Type	
T.1	Floor Strike C/L	
T.2	Floor Strike C/L	
U	Label Requirements	

Recommended to verify that hinge locations are the same on both hinge jambs of Double Openings.

Measurements S and T locate mortised or surface-applied strikes in the frame header or floor / threshold.

All Measurements $\pm 1/32"$

All Measurements are of Existing Frame

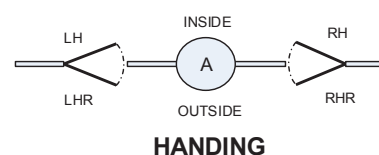
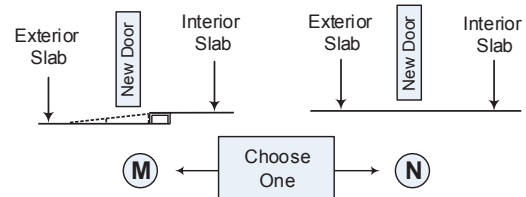
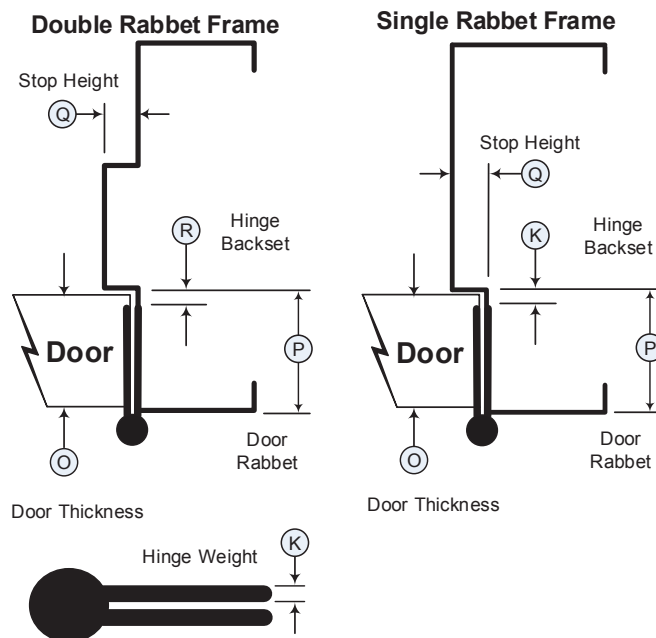
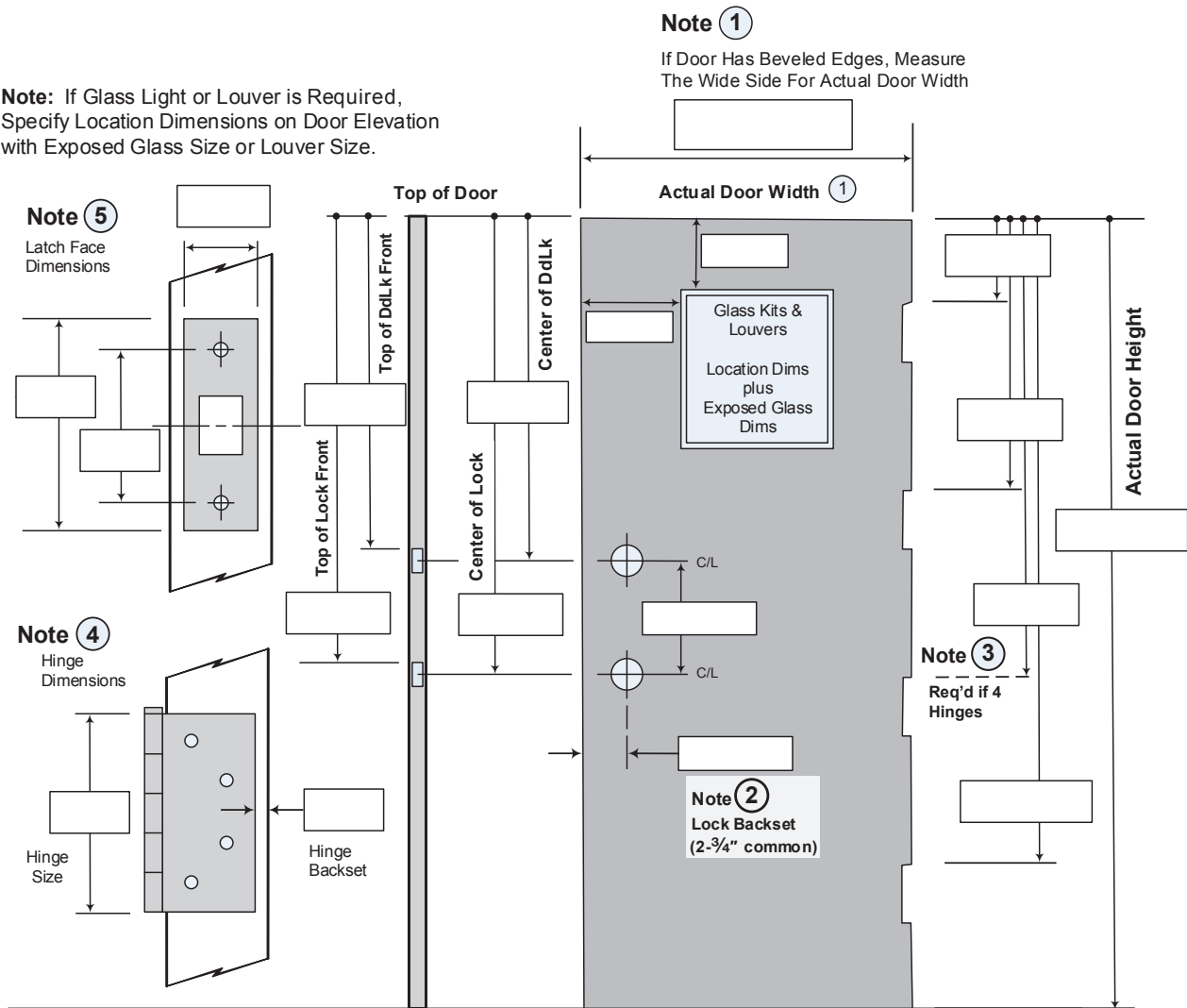


Figure 3 – Existing Frame Opening – Door Pair

Note: If Glass Light or Louver is Required, Specify Location Dimensions on Door Elevation with Exposed Glass Size or Louver Size.



Qty Req'd _____

Mark Number _____

Label Req'd _____

- A Hand of Door**
- ☐ LH ☐ RHR
☐ RH ☐ LHR
- B Door Thickness**
- ☐ 1-3/4" ☐ 1-3/8"
- C Material**
- ☐ 20 GA ☐ COLD ROLLED
☐ 18 GA ☐ GALVANIZED
☐ 16 GA ☐ STAINLESS
☐ 14 GA

Fill in all dimensions

Respond to all

- D Lock Provisions**
- ☐ CYL. GOV'T. 161 - 1-1/8" x 2-1/4" EDGE
☐ MORTISE EDGE - 1-1/4" x 8"
☐ BLANK - NO CUTOUT
☐ DEADLOCK - 1-1/8" x 2-1/4" EDGE
☐ PANIC : ☐ RIM ☐ VERTICAL ROD ☐ CONCEALED
- E Hinge Provisions**
- ☐ 3-1/4" ☐ STD. WGT.
☐ 4-1/4" ☐ HEAVY WGT.
☐ 5" ☐ _____
- F Closer Reinforcements**
- ☐ REQUIRED ☐ NOT REQUIRED
- G If Inactive Leaf:**
- ☐ ASTRAGAL ☐ NO ASTRAGAL (WIDTH + 3/32")
☐ FLUSH BOLTS

OTHER _____

Figure 4 – Replacement Door Details

9.2 Louvers

9.2.1 Measure from top of door to either top of cutout or top of outside edge of insert

9.2.2 For locating off centered inserts, measure from lock edge of door to edge of cutout; outside edge of insert.

10 Replacement Door Details

Existing frame opening dimensions should coincide with door measurements plus proper clearances. Basic options of door construction, hardware and accessories (door gauge and finish, glass kits dimensions and location, lock provisions, closer reinforcements and astragals on pairs) are listed on Figure 4.

–	Opening					
A	Handing					
B	Opening Width					
C	Opening Height					
D	Hinge Size					
E	First Hinge					
F	Second Hinge					
G	Third Hinge (if 4)					
H	Fourth Hinge					
J	Hinge Backset					
K	Hinge Weight					
L	Strike Size					
M	Top of Strike					
N	C/L Strike Hole					
O	Threshold Height					
P / Q	Sill Condition					
R	Door Thickness					
S	Door Rabbet in Frame					
T	Frame Stop Height					
U	Label Requirements					

Refer to Measuring Directions for guidance on where and how to measure existing frames.

Figure 5 – Existing Frame Measurement – Single Door – Multiple Openings

AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

- ANSI/SDI A250.3** Test Procedure & Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames
- ANSI/SDI A250.4** Test Procedure & Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
- ANSI/SDI A250.10** Test Procedure & Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
- ANSI/SDI A250.13** Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes (Not applicable for FEMA 320/361 or ICC-500 Shelters)
- SDI-113** Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies
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- SDI-111** Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components
- SDI-122** Installation Troubleshooting Guide for Standard Steel Doors & Frames

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

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Guideline for Specifying Windstorm Products



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Guideline for Specifying Windstorm Products

1 Introduction

Modern building design and construction science have evolved to a degree where ‘near-absolute’ protection can be achieved, providing occupants and contents safety from nature’s most severe wind storms. In parallel to this evolution, building codes have advanced to provide both optional and mandatory requirements to ensure life safety and the protection of property from these destructive forces of nature.

This guide is intended to inform the reader about the methodology and criteria used for specification and selection of windstorm resistant door opening assemblies for non-residential construction. In order to properly specify products for these applications, the user must first understand the type of threat – hurricane or tornado – the geographic area in which the building is located and the design pressures as calculated by the structural engineer of record. Once these parameters have been identified, a specification and product selection process can begin. The following sections provide an overview of the definitions and process for determining the design requirements for each threat.

2 Definitions

ASCE 7 – Minimum Design Loads for Buildings and Other Structures.

Design Pressure – expressed in pounds-per-square-foot, the positive and negative loads to which a door opening assembly is subjected.

Enhanced Hurricane Protection Area (EHPA) – criteria within the FBC applicable to specific portions of K-12 and Florida college educational facilities to provide emergency shelter and protection for people for a period of up to 8 hours during a hurricane.

Florida Building Code (FBC) – adopted by Florida to govern non-residential construction within the state.

High Velocity Hurricane Zone (HVHZ) – the geographic area of Broward and Dade counties.

ICC 500 – Standard for the Design and Construction of Storm Shelters.

International Building Code (IBC) – a model building code developed by the International Code Council (ICC) and adopted for use as a base code by most jurisdictions in the United States.

International Existing Building Code (IEBC) – a model code applicable to renovations and additions to existing buildings, developed by the International Code Council (ICC) and adopted for use by many jurisdictions in the United States.

Large Missile – a No. 2 or better Southern Yellow Pine or Douglas Fir 2 × 4 in. lumber having a mass of between 9 and 15 lbs.

Registered Design Professional – an individual registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

Risk Category – a categorization of buildings and other structures for determination of wind loads. The classification is based on the risk associated with failure of the building or structure.

Small Missile – a solid steel ball having a mass of 2 g with an 8-mm nominal diameter.

Wind-borne Debris Region – Areas within hurricane-prone regions located within 1 mile of the coastal mean high water line where the ultimate design wind speed is 130 mph or greater; or in areas where the ultimate design wind speed is 140 mph or greater.

Wind Speed Map – graphic depiction of wind velocity indicated by contour lines.

3 Hurricane Resistant Opening Protectives

The *Florida Building Code* is widely regarded as the most comprehensive document for addressing the unique performance characteristics of hurricane resistant construction. The 6th Edition *Florida Building Code* went into effect December 31, 2017 and classifies building types by Risk Category I through IV, using three distinct wind speed maps for the categories (see Figure 1).

In order to calculate the design pressure for a particular opening, the Registered Design Professional must first define the following variables as they pertain to the project:

1. Risk Category of the building
2. Applicable Wind Speed Map for the identified Risk Category

3. Geographic location of the building on the wind speed map and the wind speed associated with that location

Following the methodology of *ASCE 7*, these variables are utilized to calculate design pressures for each specific opening. The unique calculation takes into account the openings' location relative to the height above grade-plane, proximity to the corners of the building, the orientation towards the water and other attributes. The result of the calculation is a design pressure, expressed in both positive and negative values, in pounds-per-square foot.

Openings located in the wind-borne debris region also require a level of impact resistance. During testing, the windborne debris is simulated by small or large missile impacts as described in the *Florida Building Code*. The determination of small versus large missile requirements is based on the elevation

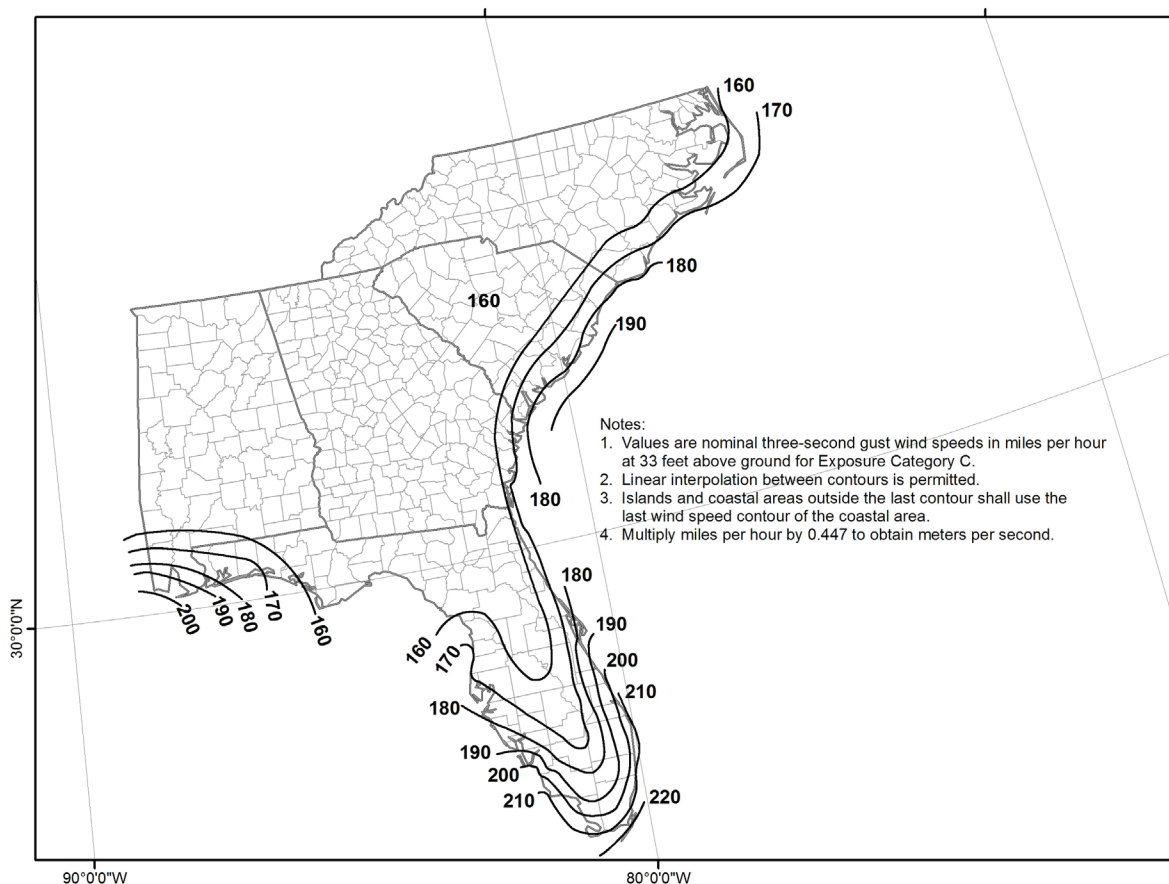


Figure 1 – Wind speed map

of the opening in the building envelope, relative to grade-plane. This test, when combined with the dynamic pressurized cycling of the assembly, will ensure the integrity of an opening so that it does not fail during a hurricane and allow the building envelop to be breached.

Design pressures, missile impact requirements and the specific attributes (size, swing, and glazing) of an opening, most often found in a door schedule, provide the basis for the selection of hurricane resistant door opening assemblies.

4 Tornado Resistant Opening Protectives

With the issuance of the ICC 500 Standard in 2008, a distinct standard explicitly written for the design and construction of storm shelters was available for the first time. This document sought to improve and further develop the concepts of protection against tornadic winds and windborne debris as first discussed in FEMA 320 and FEMA 361, for all parts of shelter design including residential and non-residential structures.

Since the introduction of the ICC 500 Standard, it has been a referenced standard in the IBC and subsequently became a mandated requirement for protection of life against tornados in an area stretching from Colorado to Ohio and from North Dakota to Texas and Alabama (see Figure 2).

ICC 500 was first included in the 2009 Edition of the IBC and was mandated within the 2015 IBC for K-12 schools and critical emergency operation centers located where the design wind speeds for tornados are designated at 250 mph. These facilities include 911 call stations, emergency operation centers and fire, rescue, ambulance and police stations as well as educational occupancies through grade 12, with occupant loads of 50 or greater. The 2015 *International Residential Code* requires storm shelters, when provided, to be constructed and evaluated in accordance with ICC 500. ICC 500 was also included in the 2018 Edition of the IBC, relative to additions constructed for existing educational occupancies.

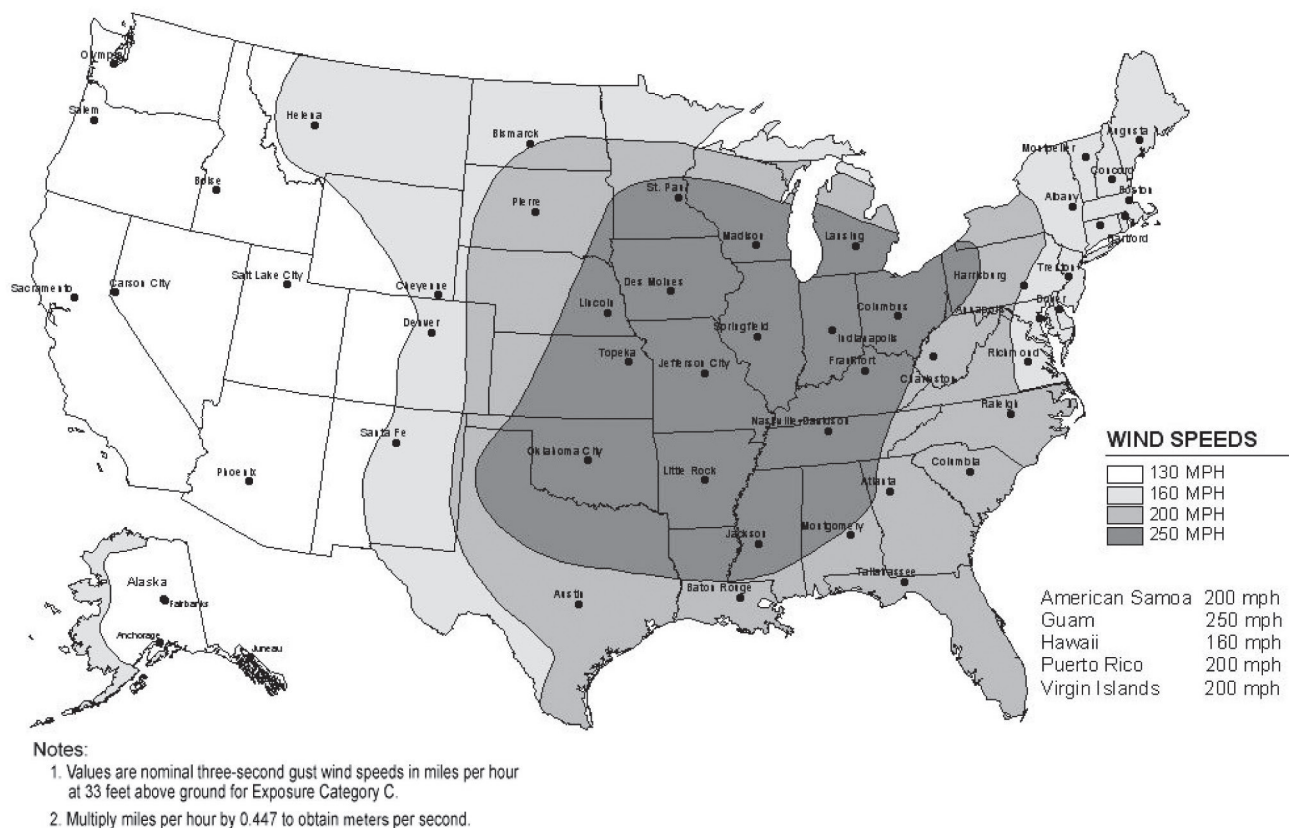


Figure 2 – Shelter design wind speeds for tornadoes

Like hurricanes, the maximum design pressure is calculated based upon the location of the structure and the maximum wind speeds shown in the shelter design wind speed map (Figure 2). The test standard requires a protective assembly and the components within the assembly to be able to sustain a specified Design Pressure with a safety factor of 20%, as well as resist up to four impacts of a fifteen pound 2x4 missile fired at a velocity of one hundred miles per hour, while providing protection for the occupants inside.

ICC 500 evaluates protective assemblies such as swinging shutters or doors with frames, latching hardware and all other assembly components. The Registered Design Professional must determine key parameters for the project such as:

1. design pressure
2. opening size
3. occupant load and egress requirements
4. swing direction
5. geographic location of building

These factors will allow someone to properly specify the openings. Since these tornado resistant assemblies are a product of many components working together, substitution of other types of hardware or any materials is not permitted without additional testing or evaluation being completed by the listing agency. Even the smallest change can have significant consequences to the performance of an assembly in a severe weather event.

5 Summary

Tornado and hurricane resistant opening protectives, often required by the building code, are complex pieces of the overall building envelop. To ensure their proper function, it is essential that they be specified correctly and installed per the manufacturers' listing and installation instructions. This guideline is provided by the Steel Door Institute to assist the reader in doing so.

6 Disclaimer

This guideline is intended to provide general information and should not be used as a substitute for the role of a Registered Design Professional.

7 Additional Resources

American Society of Civil Engineers,
www.asce.org

Florida Building Commission,
www.floridabuilding.org

Intertek SpecDIRECT,
spec-direct.com

International Code Council,
www.iccsafe.org

Underwriters Laboratories Directory,
www.ul.com/ul-databases-and-directories

Steel Door Institute,
www.steeldoor.org

AVAILABLE PUBLICATIONS

Specifications

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- ANSI/SDI A250.8** Specifications for Standard Steel Doors and Frames (SDI-100)
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*Test Procedure and Acceptance Criteria for —
Factory Applied Finish Coatings
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American National Standard

Test Procedure and Acceptance Criteria for
Factory Applied Finish Coatings
for Steel Doors and Frames

Secretariat

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Approved November 14, 2019

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ANSI/SDI A250.3-2019

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Foreword (This Foreword is not part of American National Standard A250.3-2007)

The material contained in this document has been developed under the auspices of the Technical Committee of the Steel Door Institute.

The original standard was issued on July 28, 1980 and was last revised in 2007. The current edition is a revision of the 2007 document with the contents being updated to reflect changes and advances that have taken place in the steel door and frame industry since that time.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, Ohio 44145-1967.

The organizations that have approved this standard are as follows:

Builders Hardware Manufacturers Association
Canadian Steel Door Manufacturers Association
Cedar Valley Associates
D.H. Pace Company
Door and Hardware Institute
ESTM Services
FM Approvals
Hollow Metal Manufacturers Association / Division of National Association
of Architectural Metal Manufacturers Association
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Ray and Associates
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The Accredited Standards Committee A250 TC-1 developed this standard and had the following personnel at the time of approval:

Craig Ordmandy, Chairman
J. Jeffery Wherry, Secretary

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Canadian Steel Door Manufacturers Association	Mike Van Geyn
Ceco Door	Tom Janicak
Cedar Valley Associates	Stan Horsfall
Curries	David Bill
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Door Components Inc.	Tom Popow
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Metal Products Inc,	David McConnell
Pioneer Industries.....	Kamal Sheikh
Premier Steel Doors and Frames	Joey Meggs
Ray and Associates.....	Ron Ray
Republic Doors & Frames	Steve Gilliam
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Steel Door Institute.....	J. J. Wherry
Therma-Tru	Steve Jasperson
Underwriters Laboratories Inc.....	Luke Woods
Vetrotech / Saint Gobain	Kevin Norcross

American National Standard

Test Procedure and Acceptance Criteria for — Factory Applied Finish Coatings for Steel Doors and Frames

1 General

1.1 Scope

These methods prescribe the procedures to be followed in the selection of material, chemical preparation, coating application, testing, and evaluation of factory applied finish coatings for steel doors and frames. Coatings covered by this standard include paints, stains, clear coats, and powder coats.

1.2 Reference Documents

ASTM B117-18 *Standard Practice for Operating Salt Spray (Fog) Testing Apparatus*

ASTM D1654-08 (2016)e1 *Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments*

ASTM D4585 / D4585M-18 *Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation*

ASTM G154-16 *Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials*

ASTM D4587-11 *Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings*

ASTM D2794-93 (2019) *Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)*

ASTM D3359-17 *Standard Test Method for Measuring Adhesion by the Tape Test*

ASTM D4060-14 *Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser*

ASTM D610-08 (2019) *Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces*

ASTM D714-02 (2017) *Standard Test Method for Evaluating Degree of Blistering of Paints*

ASTM D4214-07 (2015) *Standard Test Method for Evaluating Degree of Chalking of Exterior Paint Films*

ASTM D523-14 (2018) *Standard Test Method for Specular Gloss*

ASTM D2244-16 *Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates*

2 Material

2.1 The test specimen shall be the exact type and gauge of steel as used in the manufacture of the product. The specimen shall be a minimum of 4" (102 mm) × 6" (152 mm) with a 1/4" (6.4 mm) diameter hole at the center of the 4" (102 mm) width, 1/2" (12.7 mm) in from the end. Identification marks shall be added to the specimen as required for control purposes. The test specimen shall be handled at all stages of the process with clean gloves to prevent contamination.

2.2 The specimen(s) shall be hung using a method representative of that used in production.

2.3 The test specimen(s) shall be cleaned, pretreated and coated in accordance with the manufacturer's normal production method and procedure. All coating weights used on test specimens shall be documented and representative of the individual manufacturer's normal production material.

2.4 At the end of the coating process, the specimen(s) shall be removed from the system and handled carefully. The coated surface of the specimen shall not be handled or come in contact with other objects in such a way as to disrupt the coated surface.

2.5 Specimens shall be allowed to age at an ambient room temperature for a minimum 72 hour duration before any testing commences.

3 Testing

3.1 Salt spray test

- a) *Apparatus* – The apparatus used for salt spray testing shall be of such design as to conform to ASTM B117.
- b) *Test performance* – Salt spray testing shall be conducted as specified in ASTM B117 for a test period of 120 continuous hours. The test specimen shall be scribed in accordance with ASTM D1654, section 6.1.

3.2 Condensation testing (humidity)

- a) *Apparatus* – The apparatus used for condensation (humidity) testing shall be of such design to conform with ASTM D4585 / D4585M
- b) *Test performance* – Condensation (humidity) testing shall be conducted as specified in ASTM D4585 / D4585M, for a test period of 480 continuous hours. Exposure temperatures shall be maintained at a minimum of 100°F (38°C). To ensure adequate condensation, maintain at least a 20°F differential between the room and the vapor. Actual test temperature shall be noted in the report.

3.3 Accelerated weathering test

- a) *Apparatus* – The apparatus used for accelerated weathering testing shall be of such design to conform with ASTM G154. The bulb type used shall be a UVA340.
- b) *Test performance* – Accelerated weathering testing shall be conducted in accordance with ASTM D4587, for a test period of 300 hours duration. The cycle schedule for operating this type of equipment shall be 18 hours of light exposure at 140°F (60°C) followed by a 6 hour condensation cycle at 120°F (49°C).

3.4 Impact test

The coating shall be tested in accordance with ASTM D2794 with 20 inch pounds of direct impact using a Gardner Impact Tester with a 1/2" (12.7 mm) diameter ball or punch at room temperature of 70°-75°F (21°C-24°C). The test specimen shall be impacted at three locations

on the panel that have a dry film thickness within the tolerance range for the coating process. Apply one-inch (25.4 mm) wide, #600 Scotch cellophane pressure-sensitive tape firmly to the impact area and pull off sharply.

3.5 Film adhesion test

The coating film adhesion shall be tested in accordance with method "B" of ASTM D3359. A total of (11) parallel cuts shall be made with a sharp instrument, 0.039" (1 mm) apart in both a vertical and horizontal direction forming a grid. One-inch (25.4 mm) wide #600 Scotch cellophane pressure sensitive-tape shall be firmly applied to the scribed surface and pulled off sharply.

3.6 Abrasion test

The coating film shall be tested with a Taber Abraser Testing Apparatus using a No. CS-10 Resilient Calibrase Wheel in accordance with ASTM D4060. The specimen shall be run for a maximum of 1000 cycles, or until breakthrough of the finish coating occurs.

4 Acceptance criteria

4.1 Salt spray resistance

The coating film on the unscored surface of the test specimen shall have a rust grade of no less than 6 as defined per ASTM D610. See Table 1 and Figure 1 herein for evaluation of the rust grades. The coating film at the scribe line shall not be undercut by rust more than 1/8" (3.2 mm) or a Rating Number 6 on each side of the scribe line when evaluated in accordance with and rated per ASTM D1654. See Table 2 herein, "Rating of failure at scribe (Procedure A)".

4.2 Condensation resistance

The coating film shall be allowed to exhibit the dense pattern of #8 blisters, but shall have no more than the "few" pattern of #6 blisters as illustrated in the photographic reference ASTM D714. See Figures 2 through 5 herein for visual representations of the various degrees of blistering.

4.3 Accelerated weathering resistance

When tested in accordance with Paragraph 3.3 herein, the paint film shall exhibit the following traits:

Table 1 – Rust grades

Rust Grade	Maximum % of rusted area
10	00.01
9	00.03
8	00.10
7	00.30
6	01.00
5	03.00
4	10.00
3	16.67
2	33.33
1	50.00
0	100.00

4.3.1 No rust, checking, cracking, erosion or flaking shall be present.

4.3.2 No more than the “few” pattern of #6 blisters as illustrated in the photographic reference ASTM D714. Visual representations of the various degrees of blistering are shown in Figures 2 through 5 herein.

4.3.3 A degree of chalking not to exceed “visible” as described in test method B of ASTM D4214.

4.3.4 No more than a 50% decrease in gloss when tested in accordance with ASTM D523.

4.3.5 No more than a 10% change in color (fade) when tested in accordance with ASTM D2244.

4.4 Impact test

No coating film removal shall occur other than at an area $\frac{1}{8}$ " (3.2 mm) in diameter at the center of the impact area, when tested in accordance with Paragraph 3.4 herein.

4.5 Film adhesion

There shall be no adhesion loss less than a grade 3B as defined in ASTM D3359. This grade represents a film removal of between 5 and 15%. Table 3 herein illustrates the various classifications for adhesion loss.

4.6 Abrasion resistance

The coating film shall have a wear index of 100 (0.10 mg weight loss per cycle) or less when tested in accordance with Paragraph 3.6 herein. The wear index shall be calculated using the actual number of cycles to which the specimen was subjected.

5 Report

5.1 The report shall state the date the test was performed and the issue date of the report.

5.2 Identification of the specimen tested, source of supply, manufacturer, model or series number, or both, and any other pertinent information.

5.3 A detailed description of the specimen or specimens tested shall include the type of prime or barrier coating if used, the method of coating application, the procedure used to cure it and the dry film thickness.

5.4 Any modifications made on the test specimen to obtain the values of acceptance shall be noted and described in detail in the report.

5.5 A statement that the test or tests were conducted in accordance with the methods and procedures as specified herein. If deviations from these methods and procedures were made, they shall be described in the report.

5.6 When the test is made to check the conformance of the unit specimen to test requirements of a particular specification, the identification or description of the specification shall be included in the report.

6 General

6.1 Testing laboratory

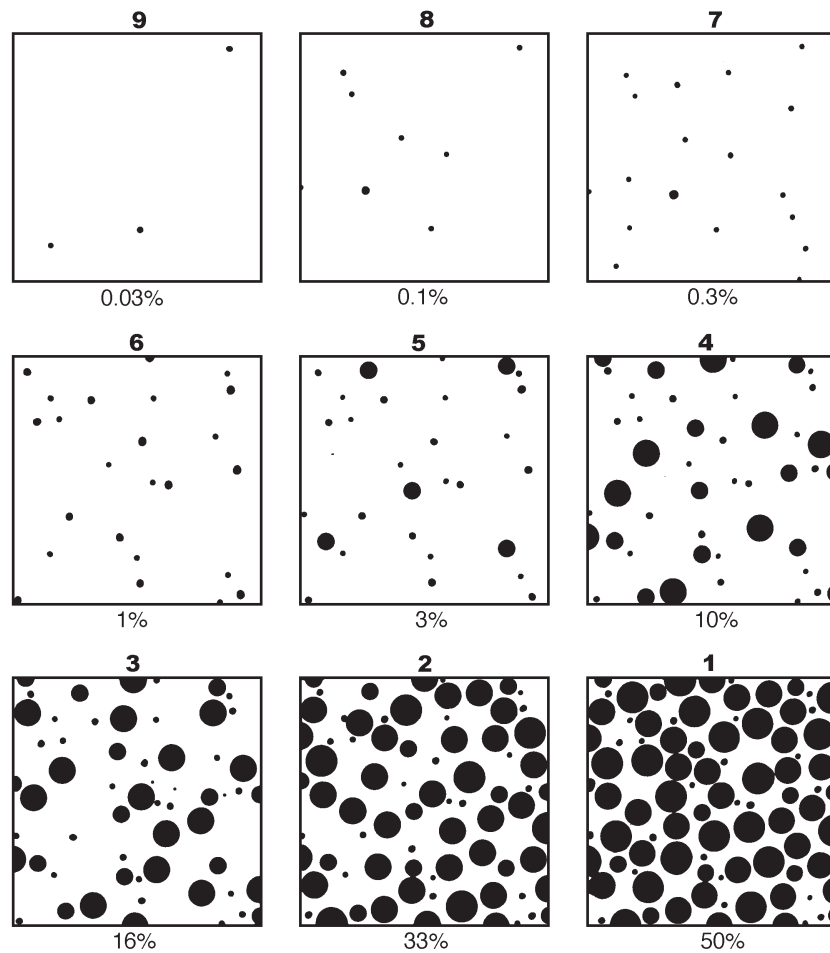
All tests shall be conducted and certified by a nationally recognized, independent testing laboratory.

6.2 Certification

When reference is made to this specification the following statement shall be used: “Finish coating has been tested in conformance with ANSI/SDI A250.3.”

Table 2 – Rating of failure at scribe (procedure A)

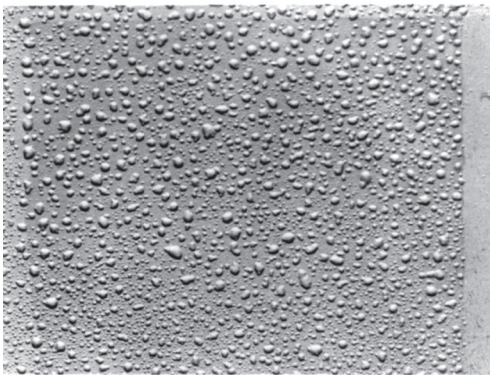
Representative Mean Creepage from Scribe		
Millimeters	Inches (Approximate)	Rating Number
Zero	0	10
Over 0 to 0.5	0 to $\frac{1}{64}$	9
Over 0.5 to 1.0	$\frac{1}{64}$ to $\frac{1}{32}$	8
Over 1.0 to 2.0	$\frac{1}{32}$ to $\frac{1}{16}$	7
Over 2.0 to 3.0	$\frac{1}{16}$ to $\frac{1}{8}$	6
Over 3.0 to 5.0	$\frac{1}{8}$ to $\frac{3}{16}$	5
Over 5.0 to 7.0	$\frac{3}{16}$ to $\frac{1}{4}$	4
Over 7.0 to 10.0	$\frac{1}{4}$ to $\frac{3}{8}$	3
Over 10.0 to 13.0	$\frac{3}{8}$ to $\frac{1}{2}$	2
Over 13.0 to 16.0	$\frac{1}{2}$ to $\frac{5}{8}$	1
Over 16 to more	$\frac{5}{8}$ to more	0

**Figure 1 – Visual reference for percentage of rust**

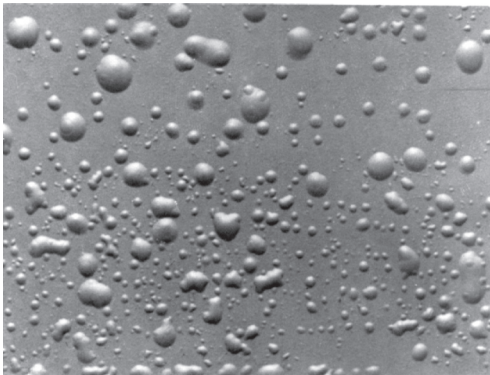
Visual examples illustrating degrees of blistering



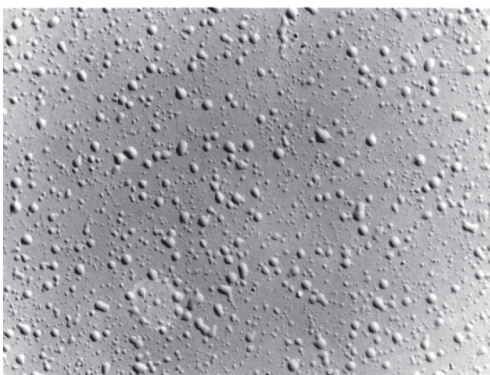
DENSE



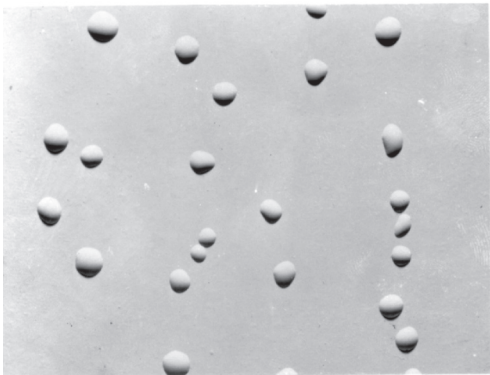
DENSE



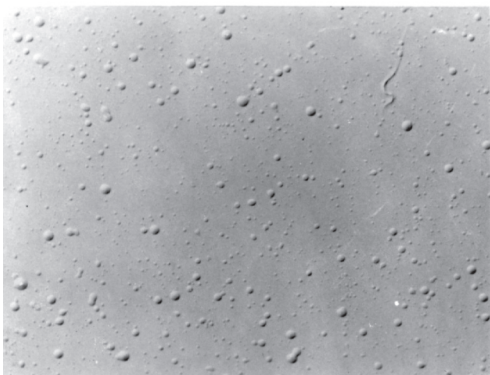
MEDIUM DENSE



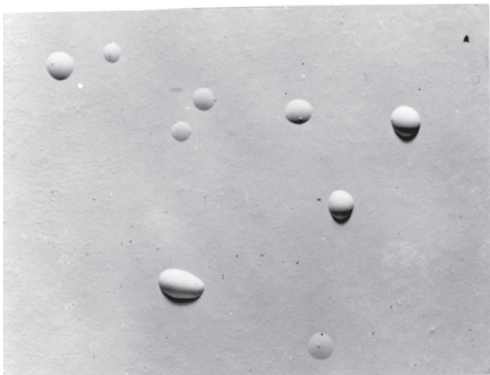
MEDIUM DENSE



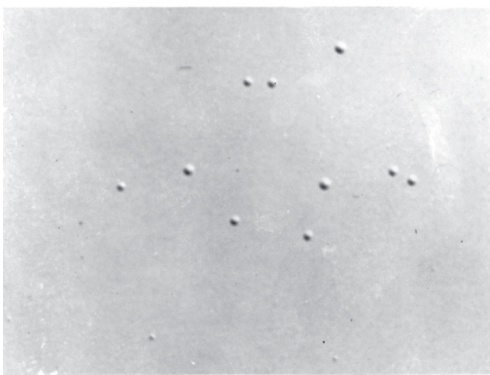
MEDIUM



MEDIUM



FEW

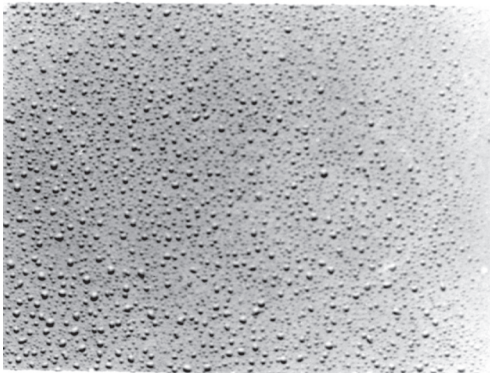


FEW

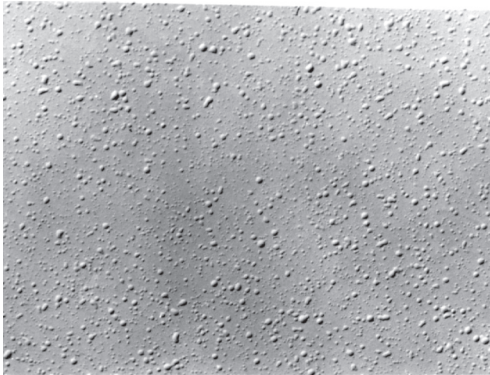
Figure 2 – Blister size #2

Figure 3 – Blister size #4

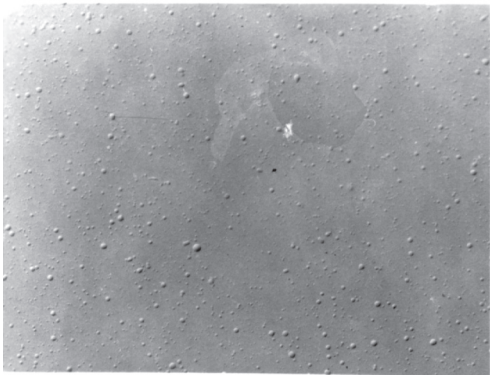
Visual examples illustrating degrees of blistering



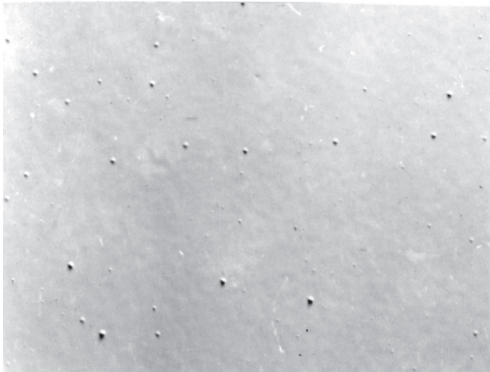
DENSE



MEDIUM DENSE

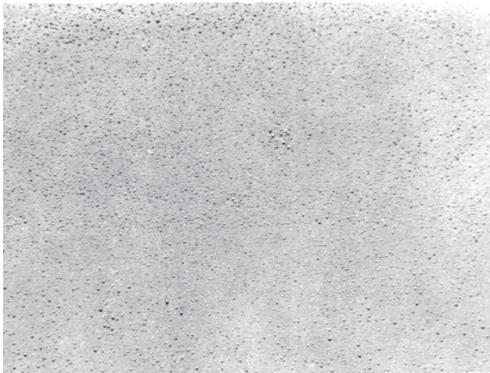


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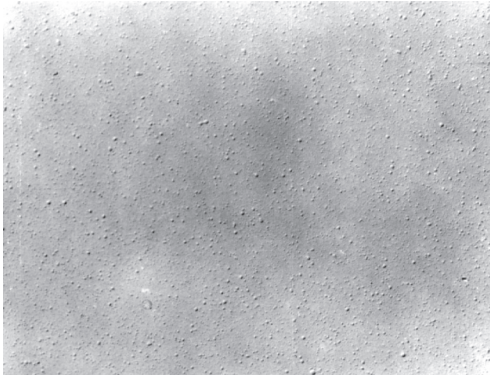


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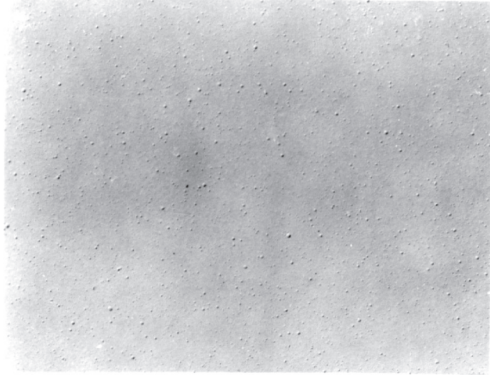
Figure 4 – Blister size #6



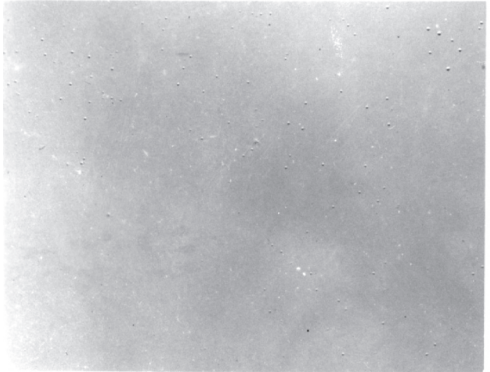
DENSE



MEDIUM DENSE



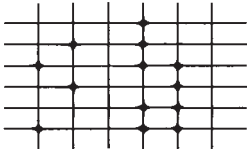
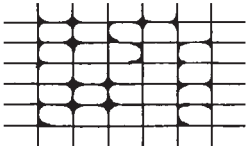
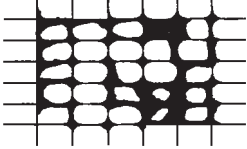

MEDIUM



FEW

Figure 5 – Blister size #8

Table 3 – Classification of adhesive test results

Classification	Surface of cross-cut areas from which listing has occurred. (Example for six parallel cuts.)	Rate of adhesion
5B	None	The edges of the cuts are completely smooth; none of the squares or the lattice are detached.
4B		Small flakes of coating are detached at intersections; less than 5% of the area is affected.
3B		Small flakes of coating are detached along edges and at intersections of cuts. The area affected is 5 to 15% of the lattice.
2B		The coating has flaked along the edges and at parts of the squares. The affected area is 15 to 35% of the lattice.
1B		The coating has flaked along the edges of cuts in large ribbons and entire squares have detached. The area affected is 35 to 65% of the lattice.
0B	Flaking and detachment in excess of 65%.	

AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

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Approved July 10, 2018



American National Standard
Test Procedure and Acceptance Criteria for –
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Steel Doors, Frames and Frame Anchors

Secretariat
Steel Door Institute

Approved July 10, 2018

American National Standards Institute, Inc.

American National Standard

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ANSI/SDI A250.4-2018

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Foreword (This Foreword is not part of American National Standard A250.4-2018)

The material contained in this document has been developed under the auspices of the Technical Committee of the Steel Door Institute.

The original standard was issued on July 28, 1980 and was revised in 1987, 1994, 2001 and 2011. The current edition is a revision of the 2011 document with the contents being updated to reflect changes that have taken place in the steel door and frame industry since that time.

Suggestions for improvement gained in the use of this standard are welcome, and should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, Ohio 44145-1967.

The organizations which approved this standard and are part of the Accredited Standards Committee A250 formed February 8, 1991, are as follows:

Avitru, Developers of MasterSpec
Builders Hardware Manufacturers Association
Cedar Valley Associates
D.H. Pace Company
Door and Hardware Institute
ESTM Services, LLC
FM Approvals
HMMA/Division of NAAMM
Intertek
Steel Door Institute
Therma-Tru
Underwriters Laboratories LLC
Vetrotech Saint-Gobain

The Technical Committee of the Steel Door Institute, which developed this standard, had the following personnel at the time of approval:

Steve Gilliam, Chairman
Tom Popow, Vice Chairman
J. Jeffery Wherry, Managing Director

<i>Organization Represented</i>	<i>Name of Representative</i>
Ceco	Tom Janicak
Curries	David Bill
Deansteel Manufacturing Company.....	Claus Heide
DCI	Tom Popow
Hollow Metal Xpress.....	Henry Ray
Mesker Door Company	Mike Mehaffy
MPI	David McConnell
Pioneer	Kamal Sheikh
Republic	Steve Gilliam
SMP	Terry Simpson
Steelcraft	Marilyn Latham

American National Standard

Test Procedure and Acceptance Criteria for – Physical Endurance for Steel Doors, Frames and Frame Anchors

1 Purpose

The primary purpose of this procedure shall be to establish a standard method of testing the performance of a steel door mounted in a hollow metal or channel iron frame installed with appropriate anchors, under conditions that might reasonably be considered an accelerated field operating condition.

The user of this performance standard must temper their usage with the knowledge that there are many variables that affect door and frame performance, such as different hardware, anchors, glass and louver cutouts, field modification by parties other than the manufacturer, environmental factors, such as heat, cold, moisture, etc.

1.1 Reference documents

ANSI/BHMA A156.1-2013 *Butts and Hinges*

ANSI/BHMA A156.3-2014 *Exit Devices*

ANSI/BHMA A156.4-2013 *Door Controls – Closers*

2 Apparatus and equipment

The apparatus and equipment used shall be the same when testing doors or frames with frame anchors. The main testing structure shall be constructed as shown in figures 1 and 2. The structure shall conform to the parts shown, except the opening width and height are permitted to vary to allow the testing of various door sizes. The test frame for testing doors and frames shall be anchored in such a manner as to ensure rigidity.

The swinging mechanism shall be in two parts:

2.1 Door opener

The door opener shall be an air cylinder positioned at 65° to the plane of the door in its closed and latched position that will actuate an exit device mounted on the test door. The contact point shall be set to push the door open 60° ± 5°, and retract to allow the door closer to bring the door back into its original closed position and then begin the cycle again. See the requirements in figures 1 and 1A.

2.2 Hardware

The exit device, door closer and hinges used in testing shall be selected based on the door manufacturers' recommendations for the testing level described in Swing Test Form 1. The manufacturer and model numbers shall be recorded in the report. All hardware shall be applied to the door and frame with fasteners provided by the hardware manufacturer (for example, machine screws or sex bolts) in the location recommended by the door manufacturer. The hardware shall conform to the latest editions of American National Standards ANSI/BHMA A156.1, 3 and 4. The device shall be set to close the door at a rate of 15 cycles, ± 1, per minute.

Inspect all hardware and silencers at regular intervals, and adjust or replace as necessary. It is acceptable to apply lubrication to hinges and exit devices.

Note: Where the applicable BHMA Test Standards have been followed, this information shall be recorded in the test report.

3 Preparation for test

The door shall be hung in the frame on the hinges. Care shall be taken to ensure the hinges are properly applied to the door and frame as recommended by the hinge manufacturer, and any hinge fillers or shims, are in place. The clearances between the door and the frame shall be recorded in the test report.

The door frame shall be securely fastened to the test frame opening structure in accordance with the door manufacturer's instructions. The manufacturer is permitted to select anchors for specific wall applications (i.e., wood stud anchors or steel stud anchors, loose or welded in or existing masonry wall anchors).

Silencers shall be installed on the frame and the stop face of the door shall contact the silencers. The frame shall be plumb, square, and rigid.

When applicable, wall surface materials (e.g., dry-wall) shall be applied to the test frame opening at

the frame throat to simulate actual construction conditions.

4 Test specimen

4.1 Doors

Unless specified otherwise, the test shall be performed on a 3'-0" x 7'-0" nominal size door. A detailed description of the construction of the door and the applicable processes such as welding, bonding, etc., used for attaching components, shall be recorded in the test report, Swing Test Form 1, under the "remarks" section.

4.2 Frames

Unless specified otherwise, the test shall be performed on a 3'-0" x 7'-0" nominal size frame having a 5 3/4" jamb depth. A detailed description of the door frame and the applicable processes such as welding, bonding, etc. used for attaching components, shall be recorded in the report, Swing Test Form 2, under the "remarks" section.

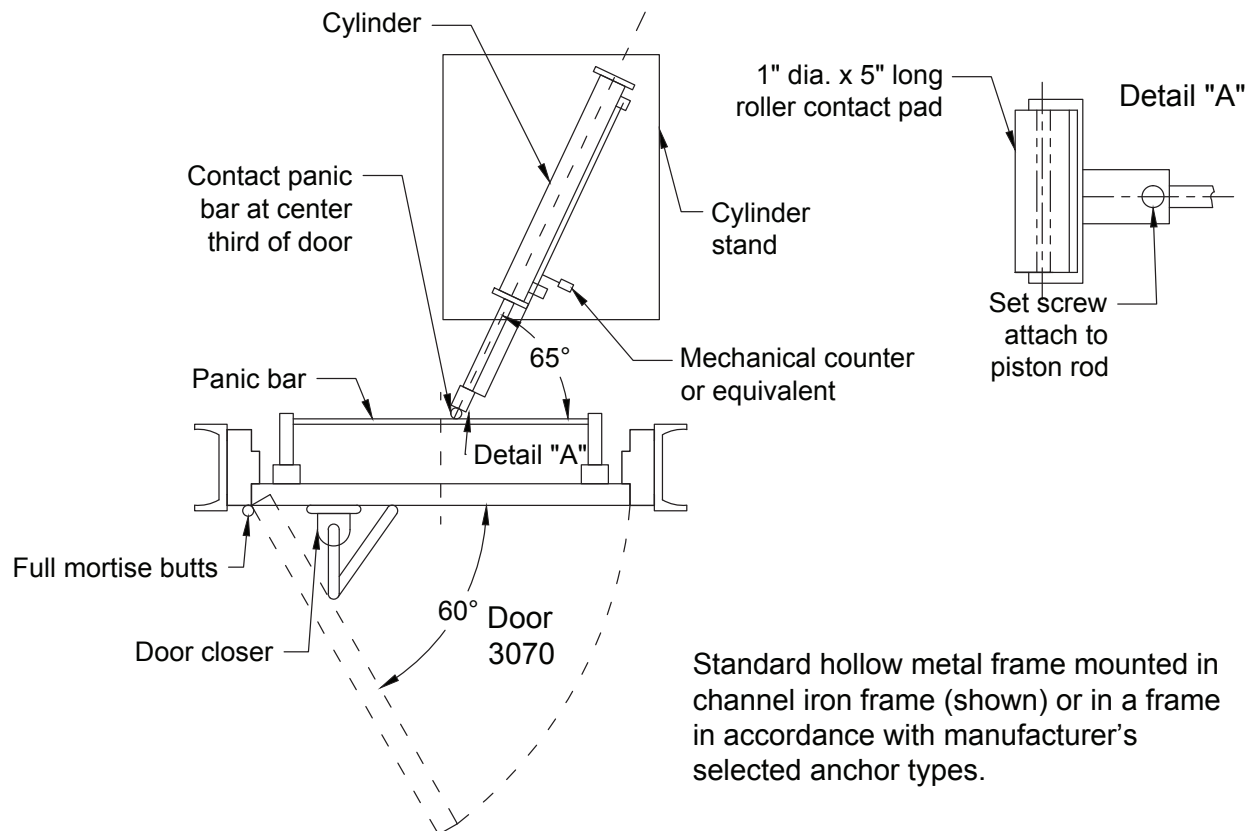


Figure 1 – Swing test detail for standard frame

A detailed description of the frame and anchoring system which shall cover all details of the anchors, as well as the means of attachment in the frame and the weight of the door used for the test shall be recorded in the test report, Swing Test Form 2.

5 Swing test

5.1 Doors

Duration of the test shall be 250,000 cycles with latching for Level C doors; 500,000 cycles with latching for Level B doors; and 1,000,000 cycles with latching for Level A doors. A general inspection of the door shall be made at 25,000 cycle intervals for the first 100,000 cycles and at 50,000 cycles thereafter. A mechanical counter or equivalent shall be used to record the cycles.

The general inspection shall cover perimeter clearances between door and frame and all components readily accessible, such as door face skins, exposed hinge and lock stiles, flush closing chan-

nels, end closures, hinge reinforcements, and lock body/face plate reinforcements and shall cover the integrity of assembly methods used to connect the door components.

Doors which have passed the cycling criteria at one level shall be deemed to have passed all lower levels. The results shall be recorded on a standard performance report, Swing Test Form 1.

5.2 Frames and frame anchors

Duration of the test shall be 250,000 cycles for Level C frames; 500,000 cycles for Level B frames; and 1,000,000 cycles for Level A frames. A general inspection of the frame shall be made at 25,000 cycle intervals for the first 100,000 cycles and at 50,000 cycle intervals thereafter.

The general inspection shall cover perimeter clearances between door and frame and all frame components readily accessible, such as corner clips and screws, corner tabs and slots, head and jamb tabs/slots hinge reinforcements, and strike

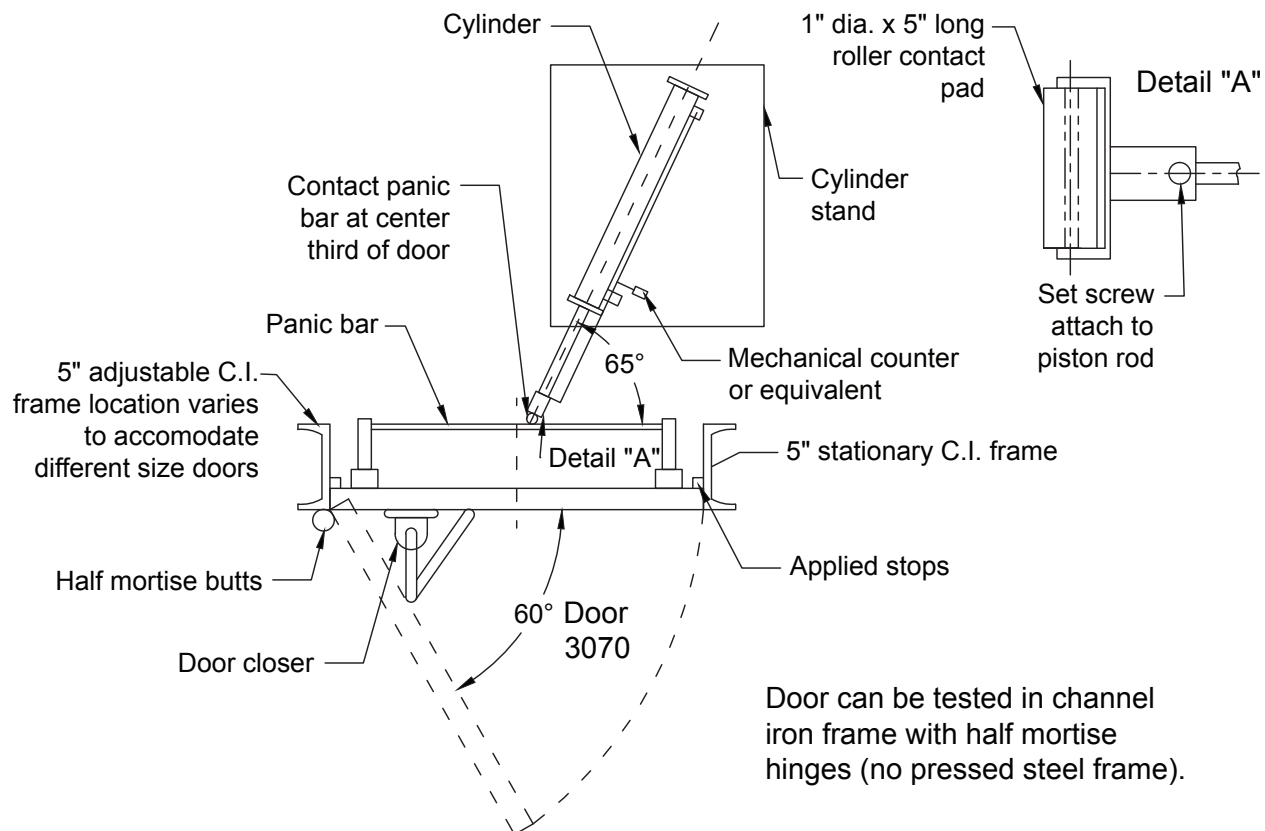


Figure 1A – Swing test detail for channel iron frame

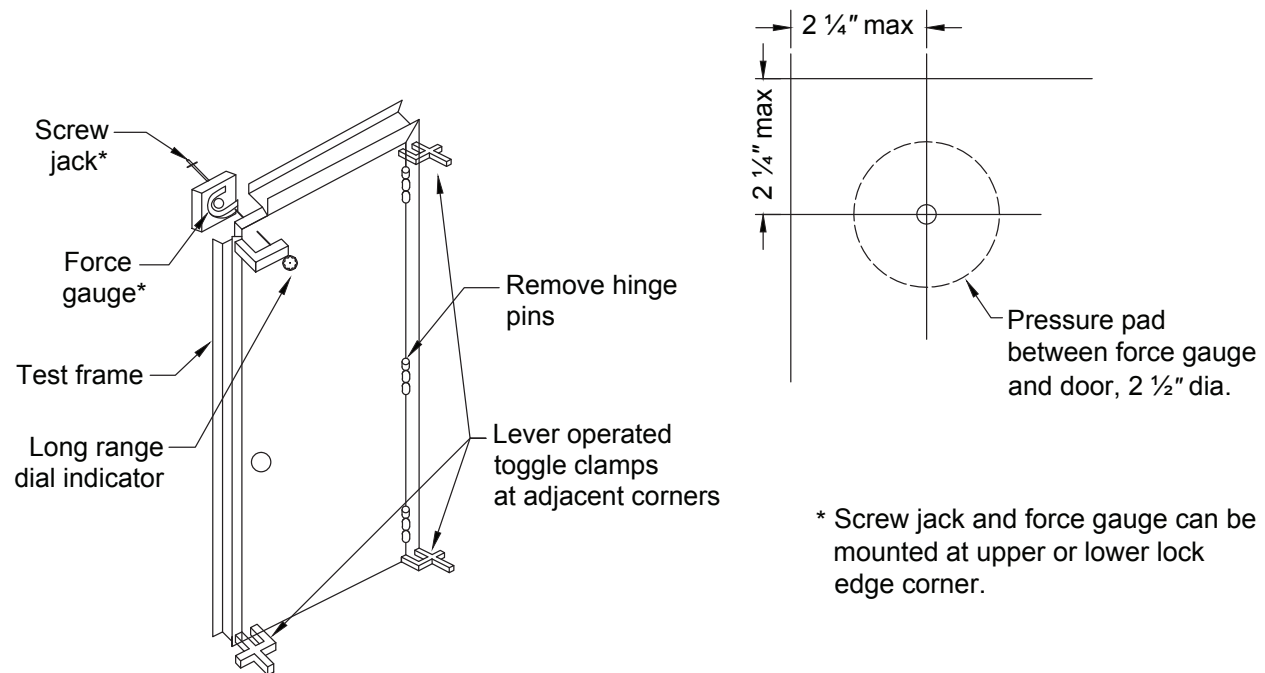


Figure 2 – Twist test detail

reinforcements and shall cover the integrity of assembly methods used to connect the frame components

Door frames which have passed the cycling criteria at one level shall be deemed to have passed all lower levels. The results shall be recorded as part of the test report, Swing Test Form 2.

6 Twist test

The twist test is applicable in evaluating door construction only.

The deterioration of the door strength during the cycle test, if any, shall be checked through a series of twist tests. These twist tests shall be performed before the cycle test begins and then at 25,000 cycle intervals for the first 100,000 cycles and at 50,000 cycle intervals for the balance of the test.

During the twist test, the hinge pins and silencers shall be removed from the door and frame assembly and the exit device shall be unlatched. The door is then clamped in place as noted in figure 2. If necessary to facilitate twist testing, the door is permitted to be taken from the test fixture and installed in a separate twist fixture. Loads in 30 lb. increments shall be applied at the upper or lower lock edge corner through the screw jack and force

gauge in the area illustrated in figure 2. The deflection noted on the dial indicator shall be plotted against the load applied to the corner on Twist Test Form 3. A maximum 300 lb. load shall be applied. The load shall then be reduced in 30 lb. increments and corresponding deflections recorded and plotted on Twist Test Form 3. A smooth curve drawn through the points shall graphically demonstrate the reaction of the door to increasing and decreasing pressures at different cycle intervals.

At the completion of each twist test, the hinges shall be reassembled by means of inserting the hinge pins, silencers shall be reinstalled, the exit device shall be latched, and the assembly shall be subjected to another 25,000 or 50,000 cycles. The condition of the silencers shall be noted and replacements made where deemed necessary.

7 Acceptance criteria

7.1 Doors

7.1.1 Doors shall not show any visual indication of metal fatigue, cracking or deformation at hardware cutouts or along form contours. Door must remain operable during the test. If the door fails to operate, it will be deemed to have passed the last passed cycle.

7.1.2 Doors of laminated construction (cores laminated to face sheets, channels or stiffeners laminated to face sheets, etc.) shall not delaminate in excess of 10% of the total surface area.

7.1.3 In doors of welded construction (stiffeners or channels welded to face sheets, etc.) breakage of welds shall not exceed 10% of the total weld of those face stiffeners.

7.1.4 Top, bottom or edge channels shall remain securely in place, without any weld breakage.

7.1.5 Where seams occur on doors, there shall be no opening or spreading of the seam.

7.1.6 All hardware reinforcements shall remain securely in place and show no visual signs of metal fatigue, cracking or deformation.

7.1.7 As a result of the twist test, the maximum deflection permitted shall not exceed 2 ½" when loaded to 300 lb. for Level C. For Level B and Level A doors the maximum deflection shall not exceed 1 ¼" when loaded to 300 lb.

7.1.8 Permanent deflection for doors shall not exceed ⅛" when load is removed after each twist test.

7.1.9 Tapped holes shall not strip.

7.1.10 At the completion of the swing and twist tests, the door shall be fully operable. If the door becomes inoperable, the door will be considered to have failed and the previous passed cycle will be recorded.

7.1.11 Upon completion of the foregoing checks and measurements, remove door from test structure and cut door into four equal sections with a horizontal and a vertical cut at the center of the door height and door width. Internal construction of door shall be inspected visually for delamination, metal fatigue, cracking and weld failure. The results of this inspection shall be recorded in the test report.

7.2 Frames and frame anchors

7.2.1 Frames shall remain plumb, square, rigid, and show no visual signs of metal fatigue, cracking, or deformation at hardware cutouts or along form contours.

7.2.2 Corners shall stay aligned with seams in a closed position.

7.2.3 Perimeter clearances between door and frame shall not be greater than ⅛" from those listed at onset of test.

7.2.4 All hardware reinforcements shall remain securely in place and show no visual signs of metal fatigue, cracking or deformation.

7.2.5 Tapped holes shall not strip.

7.2.6 At any time during the test, the frame shall not limit door operation. If during the test the door becomes inoperable, it shall be determined whether a defective door frame, hardware reinforcement, hinge, frame anchor, etc., caused the failure and shall be so noted in the test report.

Performance Report — Swing Test Form 1

Date _____

Test# _____

Manufacturers _____

Type and Size of Doors _____

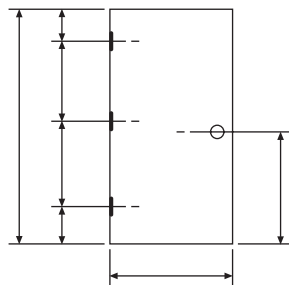
Weight of Door _____

Inspection at indicated cycle intervals ⁽¹⁾	1 25 M	2 50 M	3 75 M	4 100 M	5 150 M	6 200 M	7 250 M	8 300 M	9 350 M	10 400 M	11 450 M	12 500 M	13 550 M	14 600 M	15 650 M	16 700 M	17 750 M	18 800 M	19 850 M	20 900 M	21 950 M	22 1000 M
Condition of edge weld/bond																						
Condition of lock prep.																						
Condition of hinge prep.																						
Top																						
Center																						
Bottom																						
Condition of top closure																						
Condition of bottom closure																						
Condition of door core/stiffeners																						
Condition of panels — general																						
Level C Door ↑								Level B Door ↑					Level A Door ↑									

⁽¹⁾ Indicates condition in appropriate columns:

S — Satisfactory

Use footnotes under Remarks for further explanation



Hinge Manufacturer & Number _____

Lock Manufacturer & Number _____

Closer Manufacturer & Number _____

Remarks:

Performance Report — Swing Test Form 2

Date _____

Manufacturers _____

Test# _____

Jamb Width _____

Type and Size of Frame _____

Weight of Door _____

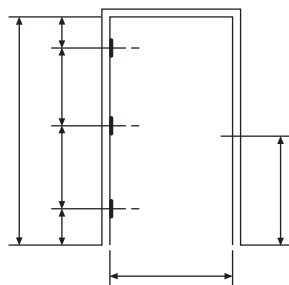
Type of Anchors _____

Inspection at indicated cycle intervals ⁽¹⁾	1 25 M	2 50 M	3 75 M	4 100 M	5 150 M	6 200 M	7 250 M	8 300 M	9 350 M	10 400 M	11 450 M	12 500 M	13 550 M	14 600 M	15 650 M	16 700 M	17 750 M	18 800 M	19 850 M	20 900 M	21 950 M	22 1000 M
Condition of general appearance																						
Condition of perimeter clearance																						
Condition of strike prep.																						
Condition of hinge prep.																						
Top																						
Center																						
Bottom																						
Condition of silencers																						
Condition of wall anchors																						
Condition of floor anchors																						
Condition of miters																						
	Level C Door ↑							Level B Door ↑					Level A Door ↑									

⁽¹⁾ Indicates condition in appropriate columns:

S — Satisfactory

Use footnotes under Remarks for further explanation



Hinge Manufacturer & Number _____

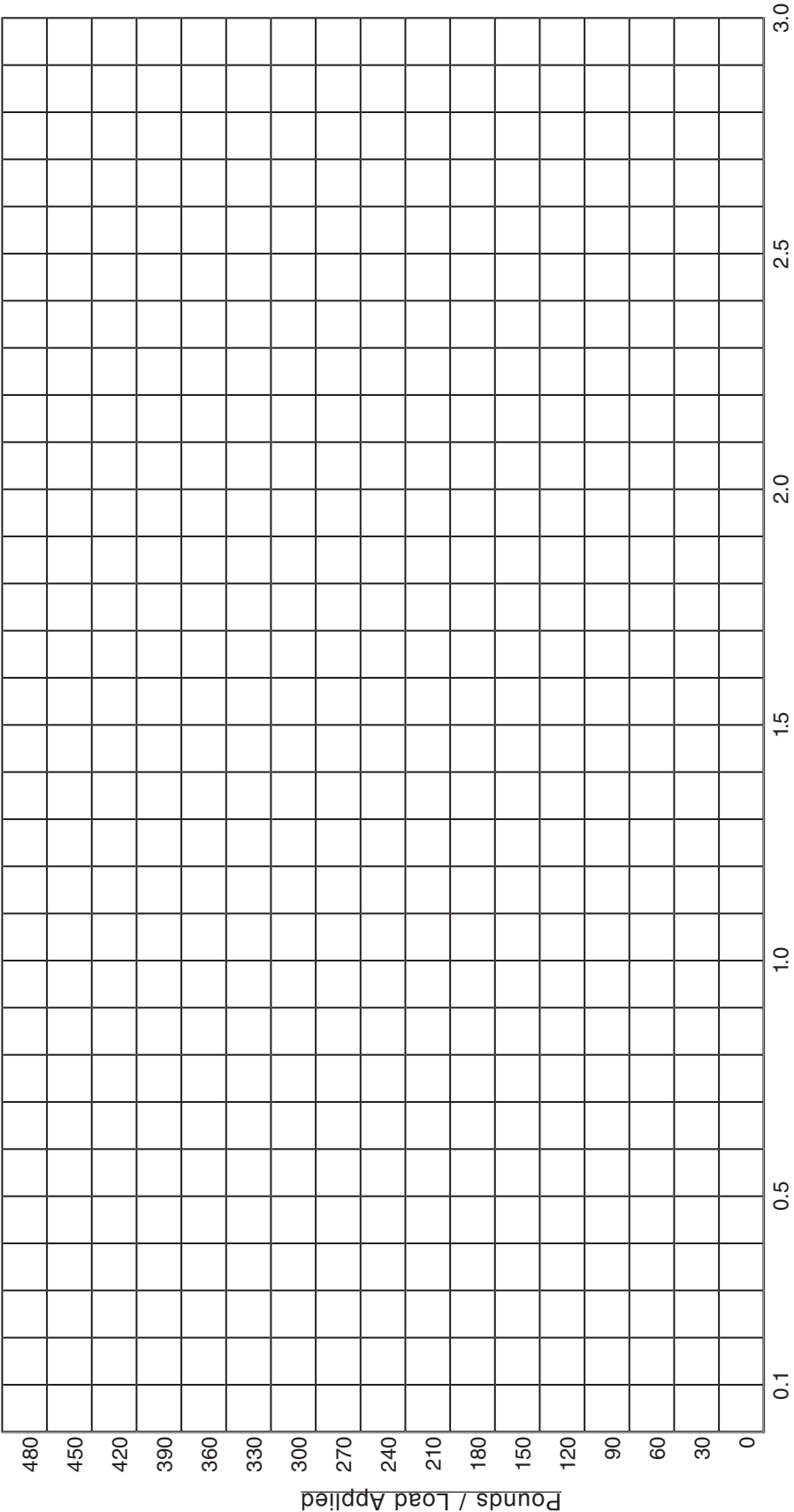
Lock Manufacturer & Number _____

Remarks:

Performance Report — Twist Test Form 3

Test No. _____ Date _____

Product Description _____



Annex A
(informative)

Acceptance Criteria for Laminated Doors

Doors of laminated construction (cores laminated to face sheets, channels or stiffeners laminated to face sheets, etc.) shall not delaminate in excess of 10% of the total laminated surface area.

AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

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American National Standard

Recommended Practice
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Secretariat

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American National Standard

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ANSI/SDI A250.6–2015

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Foreword (This Foreword is not part of American National Standard A250.6-2016)

The first edition of this standard was developed under the auspices of the Technical Committee of the Steel Door Institute and published in 1978 as SDI-107 *Hardware on Steel Doors (Reinforcement – Application)*. In 1994, the word “standard” was added to the document’s title and the decision was made to promulgate SDI-107 as an American National Standard. A250.6 was officially approved by the American National Standards Institute on October 22, 1997. Substantive changes between SDI-107 and the revised and redesignated A250.6-1997 *Hardware on Standard Steel Doors (Reinforcement – Application)* include the addition of metric equivalents, revised tap and drill sizes to eliminate those that are not recommended, and a better definition for “factory mortise.”

In 2001, the TC-1 Committee of the Accredited Standards Committee A250 initiated the 5-year review process, and changed the title of A250.6 to *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames* to more accurately define the content of the standard. In addition, this revision includes the following substantive changes: Addition of Appendices A and B, both informative; discontinuation of the use of “gauge” in favor of decimal equivalents; addition of information relating to continuous hinges; redefinition of the scope to exclude “architecturally specified or specialized conditions.”

Suggestions for improvement gained in the use of this standard will be welcome, and should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, Ohio 44145-1967.

The organizations of the Accredited Standards Committee A250 that have approved this standard are as follows:

American Institute of Architects/ARCOM
Architectural Testing
Builders Hardware Manufacturers Association
Canadian Steel Door Manufacturers Association
Door and Hardware Institute
FM Approvals
HMMA/Division of NAAMM
Intertek Testing Services
National Wind Institute
Steel Door Institute
Underwriters Laboratories LLC
Vetrotech / Saint Gobain
Therma-Tru

The Accredited Standards Committee A250 TC-1 developed this standard had the following personnel at the time of approval:

James Urban, Chairman
J. Jeffery Wherry, Secretary

<i>Organization Represented</i>	<i>Name of Representative</i>
American Institute of Architects/ARCOM.....	Joseph Berchenko
Architectural Testing.....	Dan Johnson
Builders Hardware Manufacturers Association	Mike Tierney
Canadian Steel Door Manufacturers Association	TBD
Cedar Valley Associates	Stan Horsfall
Door and Hardware Institute.....	Greg Drake
Door Control Services	Craig Ordmandy
ESTM Services, LLC	Mike Kolovich
FM Approvals.....	Mark Tyrol
HMMA / Division of NAAMM.....	Russell Tauscher
Intertek Testing Services	Nancy Kokesh
National Wind Institute.....	Larry Tanner
Steel Door Institute	J. Jeffery Wherry
Underwriters Laboratories Inc.....	Look Woods
Therma-Tru	Steve Jaspersen
Vetrotech / Saint Gobain	Kevin Norcross

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American National Standard

Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames

1 General

1.1 Purpose

It is the intention of this publication to furnish users and prospective users of standard steel doors and frames with practical information regarding accepted design methods for reinforcing and recommended practices for proper field preparation for builders' hardware.

1.2 Scope

The information contained herein pertains to doors and frames manufactured in accordance with ANSI/SDI A250.8-2014 *Specifications for Standard Steel Doors and Frames (SDI-100)* published by the Steel Door Institute. It is not intended to reference architecturally specified or specialized situations beyond the scope of this document or documents herein.

1.3 Reinforcing methods

This standard recognizes as equal a variety of reinforcing methods produced by unique manufacturing processes. These processes include forming options (see figure 1) or integral gussets or fillets on lighter gauge members to

achieve strength and performance equal to heavier gauge members.

1.3.1 Where reinforcements require tapping for machine screw threads, an equivalent number of threads may be rendered in a lighter gauge part with a pierced and dimpled ("extruded") hole as compared to a heavier gauge part manufactured with conventional processes. For example, equal thread depth can be achieved on a piece of 0.067" (1.7 mm) metal and on a flat plate of 0.123" (3.1 mm) metal (see figures 2 and 3). The extrusion process results in equal strength, pull-out strength, equivalent number of threads and a lighter weight than the parent metal or equivalent flat reinforcing plate.

2 Metrication

Metric (SI Units) are indicated in parenthesis following conventional linear measurements. These are "soft conversion" approximates based on HMMA 803-08 *Steel Tables*. Units without metric equivalents are indicated as (nm) (e.g. screws).

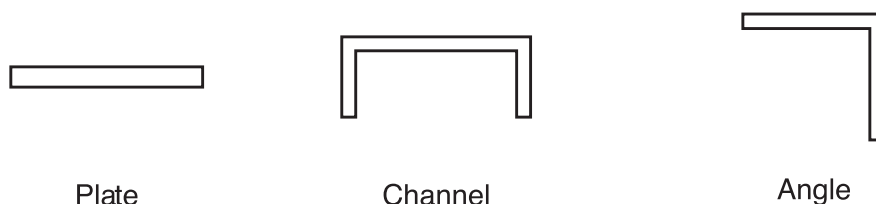


Figure 1 – Examples of equivalent reinforcing methods

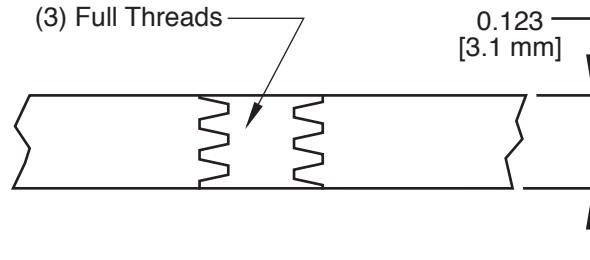


Figure 2 – Full #12-24 (nm) threads

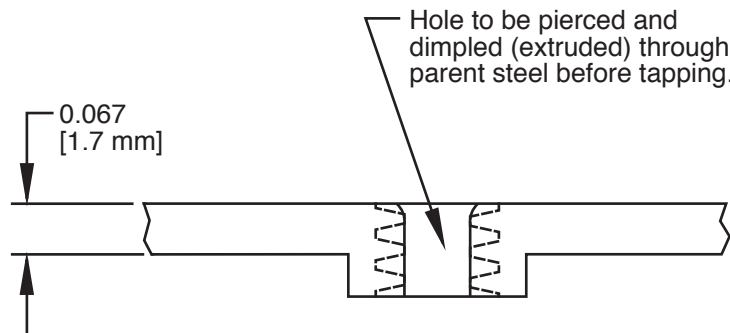


Figure 3 – Extrusion to create (3) full threads of #12-24 (nm)

3 Reference documents

ANSI/SDI A250.8-2014 *Specifications for Standard Steel Doors and Frames (SDI-100)*

ANSI/SDI A250.4-2011 *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors*

Machinery's Handbook

4 Recommended reinforcing thickness

The Manufacturer, based on individual construction methods and tooling capabilities, shall reinforce their product to ensure performance in accordance with ANSI/SDI A250.4. This reinforcing shall include (unless noted otherwise) reinforcing and tapped mounting holes for template hinges and ANSI defined locks as specified. Additional reinforcing for surface applied hardware shall be built into the door at the factory when specified.

As a guide to specification writers, table 1 shows the minimum thickness of steel to be

used for hardware reinforcing as endorsed by ANSI/SDI A250.8.

5 Recommended application of hardware

5.1 Mortised hardware

Standardized and ANSI defined preparations are made at the factory to allow installation of mortise hardware such as hinges and locks. Holes shall be made to precise diameters and accurately tapped to insure maximum thread engagement and holding strength. Cutouts shall be pierced to surround the mortised hardware item to close tolerances on three or all four sides. The hardware shall be installed using only the proper screws as furnished with or specifically recommended for each device.

NOTE: The installer must exercise caution upon initial insertion of screws to prevent cross threading, especially with the smaller diameter screws.

5.2 Field drilling and tapping

Doors and frames shall be prepared by the installer in the field for surface applied hardware, such as surface closers or holders, track type concealed closers or holders, pulls, exit device cases, or vertical rod latches. In addition, some hardware such as anchor hinges, thrust pivots, pivot reinforced hinges or floor mounted pivots must be field prepared due to design variations or to provide adjustment that can only be provided at time of installation. The installer shall use a template provided

with the device or the device itself to locate hole spacing.

5.2.1 A suitably sized punch shall be used to locate the drilling for pilot holes to prevent drill creeping, off-center holes and improper screw alignment.

IMPORTANT NOTE: Use only the correct size drill for pilot holes, as recommended by *Machinery's Handbook* (see table 4). Larger holes will decrease screw holding power causing the screw to be pulled from the reinforcing under normal stresses (see figures 4 and 5).

Table 1 – Minimum hardware reinforcing thickness

Hardware Item	Door			Frame		
	inches	mm	MSG No. ⁽⁶⁾	inches	mm	MSG No. ⁽⁶⁾
Mortise Hinge 1-3/8" [34.9 mm] Door ⁽¹⁾	0.093	2.3	12	0.093	2.3	12
Mortise Hinge 1-3/4" [44.5 mm] Door ^{(1) (2)}	0.123	3.1	10	0.123	3.1	10
Mortise Lock or Deadbolt ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Bored Lock or Deadbolt ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Flush Bolt Front ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Surface Bolt ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Surface Applied Closer ⁽⁴⁾	0.067	1.7	14	0.067	1.7	14
Hold Open Arm ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Pull Plates and Bar ⁽³⁾	0.053	1.3	16	0.053	1.3	16
Surface Exit Device ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Floor Checking Hinge	0.167	4.2	7	0.167	4.2	7
Pivot Hinge	0.167	4.2	7	0.167	4.2	7
Continuous Hinges ⁽⁵⁾	Not Required			Not Required		
Kick / Push Plate	Not Required			Not Required		

Note: The minimum steel thickness for each specific gage is derived from the published figures of Underwriters Laboratories, Inc.

⁽¹⁾ Thinner steel may be employed as long as tapped holes used for mounting the hardware are extruded to produce an equivalent number of threads.

⁽²⁾ If reinforcing is angular or channel shaped, 0.093" (2.3 mm) is permitted.

⁽³⁾ When reinforcing is omitted, thru-bolting via the use of spacers or sex-bolts is required.

⁽⁴⁾ Reinforcement shall occur on both sides.

⁽⁵⁾ Refer to section 6.

⁽⁶⁾ MSG No. to be used for reference purposes only.

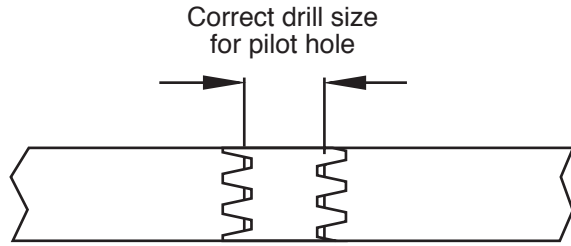


Figure 4 – Maintain a minimum of 65% of full thread

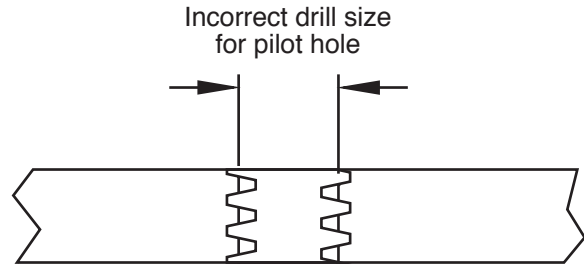


Figure 5 – Full thread shall not fall below 65%

Tables 2 and 3 illustrate the effect of variances in pilot hole sizes on thread holding power.

5.2.2 The installer shall assure that tapped holes have 75% of full thread (considered a normal condition). This percentage shall not fall below 65% to be considered adequate for proper hardware fastenings. Drills shall be positioned so the bit enters the reinforced area in perpendicular position as holes formed at angles will not permit proper seating of the screw head. After the proper pilot holes are drilled, proceed with the tapping operation. The tap shall match the thread size of the screws provided and the tap shall be held perpendicular to the surface.

5.3 Thru-bolting

Where reinforcing has not been specified or provided for other than mortised hardware, attachment shall be accomplished by thru-bolting. The hardware manufacturer's instruction sheets shall be closely followed for recommended procedures. Where thru-bolting is

required on hollow metal doors, spacers or sex-bolts shall be used to prevent collapsing of face sheets as illustrated in figures 6 and 7.

NOTE: The most popular thru-bolting applications are door closers, exit devices, overhead holders, pulls and bar sets.

5.4 Sheet metal screws

Sheet metal screws are normally used to attach accessory hardware such as kickplates, mail slots, room numbers, identification signs, and in many instances, push or pull plates. These areas are not reinforced beyond the thickness of the face sheets. Properly sized holes and correct sheet metal screws as provided with the hardware item or as specified in the mounting instructions shall be used for hardware attachment.

5.4.1 The best performance is achieved when the space between the threads is equal to or greater than the thickness of the face sheets.

Table 2 – #10-24 thread (nm)

Drill Size	Drill Diameter	% Full Thread
#23	0.154"	66%
#24	0.152"	70%
#25	0.149"	75%
#26	0.147"	79%
#27	0.144"	85%
"Machinery's Handbook" recommendation in BOLD		

Table 3 – #12-24 thread (nm)

Drill Size	Drill Diameter	% Full Thread
#15	0.180"	66%
#16	0.177"	70%
#17	0.173"	75%
"Machinery's Handbook" recommendation in BOLD		

**Table 4 – Tap drills and clearance drills for machine screws
with American National Thread form (nm)**

Size of Screw		No. of Threads per Inch	Tap Drills		Clearance Hole Drills			
No. or Diam.	Decimal Equiv.		Drill Size	Decimal Equiv.	Close Fit		Free Fit	
					Drill Size	Decimal Equiv.	Drill Size	Decimal Equiv.
0	.060	80	3/64	.0469	52	.0635	50	.0700
1	.073	64 72	53 53	.0595 .0595	48	.0760	46	.0810
2	.086	56 64	50 50	.0700 .0700	43	.0890	41	.0960
3	.099	48 56	47 45	.0785 .0820	37	.1040	35	.1100
4	.112	36* 40 48	44 43 42	.0860 .0890 .0935	32	.1160	30	.1285
5	.125	40 44	38 37	.1015 .1040	30	.1285	29	.1360
6	.138	32 40	36 33	.1065 .1130	27	.1440	25	.1495
8	.164	32 36	29 29	.1360 .1360	18	.1695	16	.1770
10	.190	24 32	25 21	.1495 .1590	9	.1960	7	.2010
12	.216	24 28	16 14	.1770 .1820	2	.2210	1	.2280
14	.242	20* 24*	10 7	.1935 .2010	D	.2460	F	.2570
1/4	.250	20 28	7 3	.2010 .2130	F	.2570	H	.2660
5/16	.3125	18 24	F I	.2570 .2720	P	.3230	Q	.3320
3/8	.375	16 24	5/16 Q	.3125 .3320	W	.3860	X	.3970
7/16	.4375	14 20	U 25/64	.3680 .3906	29/64	.4531	15/32	.4687
1/2	.500	13 20	27/64 29/64	.4219 .4531	33/64	.5156	17/32	.5312

* Screws marked with asterisk (*) are not in the American Standard but are from the former ASME Standard.

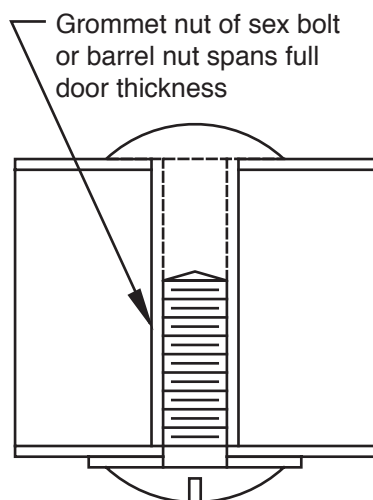


Figure 6 – Proper thru-bolting

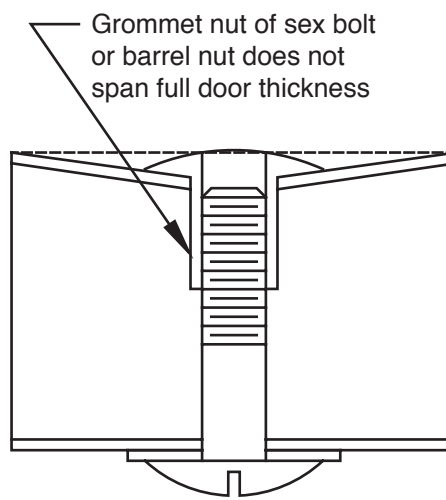


Figure 7 – Improper thru-bolting

6 Continuous hinges

6.1 Standard preparation for continuous gear type or barrel type hinges shall not include any factory reinforcing, drilling and/or tapping in doors or frames. All mounting shall be prepared in the field by the hardware installer.

6.2 For continuous hinges that require reinforcing (either for fasteners, door weight, door size or frequency of use situations) reinforcing shall be indicated at the time of order.

6.2.1 Standard reinforcing shall be a 0.067" (1.7 mm) steel strip no less than 1-1/4" (31.7 mm) in width securely welded inside the hinge edge of doors and hinge jamb door rabbet of frames.

6.2.2 Optional reinforcing shall be a 0.067" (1.7 mm) steel strip no less than 1-1/4" (31.7 mm) in width securely welded inside the hinge jamb door side face of frames.

6.3 The hardware installer shall carefully follow the hinge manufacturer's instructions for fastener preparations.

Appendix A (informative)

Conclusion

It has been the experience of the Steel Door Institute that most failures of hardware attachments have been caused by improper field installation rather than insufficient reinforcement. It is quite obvious that it is easier to tap an oversize pilot hole than to tap one of correct size necessary for maximum strength. Oversized holes will not ensure adequate product performance.

Manufacturing tolerances and dimensions may not always be consistent on machine and sheet metal screws when compared with different sources of supply.

The material used for the manufacture of screws is also a factor in the overall performance of the attachment. Stainless steel, for example, is a stronger fastener than aluminum or plain carbon steel. On installations where vibration or unusual frequency of operation is a factor, the use of thread locking inserts, liquids on threads, or binding heads should be considered.

Standard steel doors and builders hardware are made to provide many years of service and are very compatible. The specification writer and construction superintendent must be aware, however, that proper installation methods must be considered on an equal basis with door and hardware construction requirements to achieve this compatibility on the job.

Appendix B
(informative)

Bibliography

- HMMA 803 *Steel Tables*
- HMMA 830 *Hardware Selection for Hollow Metal Doors and Frames*
- HMMA 840 *Guide Specification for Installation and Storage of Hollow Metal Doors and Frames*
- SDI-134 *Glossary of Terms for Hollow Metal Doors and Frames*
- SDI-117 *Manufacturing Tolerances for Standard Steel Doors and Frames*
- SDI-122 *Installation Troubleshooting Guide for Standard Steel Doors and Frames*

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AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

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

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American National Standard

Specifications for
Standard Steel Doors and Frames
(SDI-100)

Secretariat
Steel Door Institute

Approved August 22, 2017
American National Standards Institute, Inc.

American National Standard

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ANSI/SDI A250.8-2017

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Foreword (This Foreword is not part of American National Standard A250.8-2017)

The material contained in this document has been developed under the auspices of the ANSI A250 Committee. This committee has a diverse membership of users, producers, and general interest in addition to members of the Steel Door Institute. The committee has been charged with the development of standards, test methods, and other matters relating to steel doors and frames.

The current edition is a revision, and replaces the ANSI A250.8-2014 document. The contents have been updated to reflect changes that have taken place in the steel door and frame industry since the time of the previous publication, specifically the addition of a tolerance disclaimer to section 2.1.6.

Suggestions for improvement gained in the use of this standard will be welcome, and should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, Ohio 44145-1967.

The organizations of the Accredited Standards Committee A250 that have approved this standard are as follows:

American Institute of Architects/ARCOM
Builders Hardware Manufacturers Association
Cedar Valley Associates
Door and Hardware Institute
Door Control Services
FM Approvals
HMMA/Division of NAAMM
Intertek Testing Services
National Wind Institute / Texas Tech
Steel Door Institute
Underwriters Laboratories LLC
Vetrotech / Saint Gobain
Therma-Tru

The Accredited Standards Committee A250 TC-1 developed this standard had the following personnel at the time of approval:

James Urban, Chairman
J. Jeffery Wherry, Secretary

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American National Standard

Specifications for Standard Steel Doors and Frames (SDI-100)

1 General

1.1 Scope

This specification for standard swinging steel doors and frames offers a variety of choices suitable for any commercial application. Specific performance levels of doors and frames are defined herein. SDI-108, *Recommended Selection and Usage Guide for Standard Steel Doors* shall be used as a guide. This Standard shall not act as an obstruction to the development of new, modified or improved products that meet the intent of this specification.

This specification covers sizes, design, materials, general construction requirements and finishing of standard steel doors and frames. SDI-100 is intended to define standard items not subject to variations. The products defined in this standard have demonstrated successful performance to established test procedures and physical usage (see Section 1.2).

It is the user's responsibility to coordinate the information contained herein with applicable building and/or fire code requirements.

1.2 Reference Documents

1.2.1 SDI Standards

- SDI-108-2010 (R2014) *Recommended Selection and Usage Guide for Standard Steel Doors*
- SDI-111-2009 *Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components*
- SDI-112-2008 (R2014) *Zinc Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames*
- SDI-117-2013 *Manufacturing Tolerances for Standard Steel Doors and Frames*

- SDI-118-2012 *Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements*
- SDI-124-2016 *Maintenance of Standard Steel Doors and Frames*
- SDI-134-14 *Glossary of Terms for Hollow Metal Doors and Frames*

1.2.2 ANSI Standards

- ANSI/UL 10B *Standard for Fire Tests of Door Assemblies*, 10th Edition, February 7, 2008, revisions up to and including February 16, 2015
- ANSI/UL 10C *Standard for Positive Pressure Fire Tests of Door Assemblies*, 3rd Edition, June 9, 2016
- ANSI/UL 1784, *Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives*, 4th Edition, February 17, 2015
- ANSI/NFPA 80-2016 *Standard for Fire Doors and Other Opening Protectives*
- ANSI/NFPA 252-2017 *Standard Methods of Fire Tests of Door Assemblies*
- ANSI/SDI A250.3-2007 (R2011) *Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames*
- ANSI/SDI A250.4-2011 *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings*
- ANSI/SDI A250.6-2003 (R2009) *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames*
- ANSI/SDI A250.10-2011 *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*

- ANSI/SDI A250.11-2012 *Recommended Erection Instructions for Steel Frames* (Formerly SDI-105)
- ANSI/BHMA A156.115-2014 *Hardware Preparation in Steel Doors or Steel Frames*

1.2.3 ASTM Standards

- ASTM A1008-2016 *Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable*
- ASTM A568-2015 *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*
- ASTM A1011-2017 *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength*
- ASTM A653-2015e1 *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*
- ASTM A879-2012 (R2017) *Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface*
- ASTM A924-2017 *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process*

1.3 Approval Drawings and Hardware Schedules

It is intended that approval drawings will not be required for these items and that the manufacturer's published details, together with this standard, will provide all the needed information. When specified, shop drawings shall be submitted for approval prior to manufacturing and/or delivery of product to the site. They shall show elevations of each door design, door construction details, hardware locations, dimensions, and shapes of materials, anchorage and fastening methods, door frame types and details, and finish requirements. SDI-111, *Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components* and SDI-134 *Glossary of Terms for*

Hollow Metal Doors and Frames shall be used as guides in the development of the necessary product schedule.

1.4 Classification — Level, Performance, Model

For each of the following levels and models, doors, frames, frame anchors, and hardware reinforcements shall be provided to meet the requirements of the performance levels indicated below. The material used in manufacturing these products and components shall comply with Tables 2, 3, and 4 of this document. The physical performance levels are determined by testing assemblies in accordance with ANSI/SDI A250.4, *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcements*. See Section 2.3.1.1 and 2.3.1.2 for a description of Full Flush and Seamless.

Level 1 and Physical Performance Level C

Standard-duty 1- $\frac{3}{8}$ " (34.9 mm) and 1- $\frac{3}{4}$ " (44.5 mm)

Model 1 – Full Flush

Model 2 – Seamless

Level 2 and Physical Performance Level B

Heavy-duty 1- $\frac{3}{4}$ " (44.5 mm)

Model 1 – Full Flush

Model 2 – Seamless

Level 3 and Physical Performance Level A

Extra Heavy-duty 1- $\frac{3}{4}$ " (44.5 mm)

Model 1 – Full Flush

Model 2 – Seamless

Model 3 – Stile and Rail

Level 4 and Physical Performance Level A

Maximum-duty 1- $\frac{3}{4}$ " (44.5 mm)

Model 1 – Full Flush

Model 2 – Seamless

1.5 Sizes

Standard doors and frames are sized to fit openings noted in Table 1.

Table 1 – Standard opening sizes

Widths*	Ft-in	2'0"	2'4"	2'6"	2'8"	2'10"	3'0"	3'4"	3'6"	3'8"	3'10"	4'0"
	mm	610	711	762	813	864	914	1016	1067	1118	1168	1219

* Sizes shown are for single doors only; equal pairs of doors use twice the width indicated. Pairs of doors can consist of two unequal widths.

Heights	1-¾" Doors	Ft-in	6'8"	7'0"	7'2"	7'10"	8'0"
		mm	2032	2134	2184	2388	2438

	1-⅝" Doors	Ft-in	6'8"	7'0"	7'2"
		mm	2032	2134	2184

2 Products

2.1 General

2.1.1 Steel Specifications

All steel used to manufacture doors, frames, anchors, and accessories shall meet at least one or more of the following requirements.

2.1.1.1 Cold rolled steel shall conform to ASTM A1008, *Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable* and A568, *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*.

2.1.1.2 Hot rolled, pickled and oiled steel shall comply with ASTM A1011, *tandard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength* and A568, *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*.

2.1.1.3 When specified, hot dipped zinc coated steel shall be of the alloyed type and comply with ASTM A924, *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process* and A653, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*. The

coating weight shall meet or exceed the minimum requirements for coatings having 0.4 oz/ft² (122 g/m²), total both sides, i.e., A40 (ZF120). See SDI-112 *Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames* for further information.

2.1.1.4 When zinc coated steel is specified for anchors and accessories, and electrolytically deposited zinc coated steel is provided, it shall comply with ASTM A653 *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*. The minimum coating designation shall be A40 i.e., 0.4 oz/ft² (122 g/m²).

2.1.2 Fire Doors and Related Frames

2.1.2.1 Fire Doors and Frames

When specified for either insurance rating purposes or for compliance to building codes, manufacturers shall provide the type of fire door and frame assembly that has been investigated and/or successfully fire tested in accordance with the latest revision of ANSI/UL10B, *Standard for Fire Tests of Door Assemblies*, ANSI/UL10C, *Standard for Positive Pressure Fire Tests of Door Assemblies*, or ANSI/NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*. The assembly shall be identified by labels and/or an approved identification marking of an agency accepted by the authority having jurisdiction. The door label shall indicate the applicable fire test rating for the door construction furnished. See Appendix "A," and SDI-118, *Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and*

Window Frame Requirements for additional information.

2.1.2.2 Smoke Control Doors

When specified, manufacturers shall provide the type of fire door and frame assembly that has been investigated and/or successfully tested in accordance with the latest revision of ANSI/UL1784 *Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives*. See SDI-118, *Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements* for additional information.

2.1.2.3 Steel Astragals on Fire Doors

Where required by a manufacturer's listing or ANSI/NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, a steel overlapping astragal shall be provided.

2.1.2.4 Louvers for Fire Doors

When specified, fire doors shall be provided with fire labeled louvers. See SDI-118, *Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements* for acceptable labeling methods.

2.1.3 Prime Finish

Doors and frames shall be thoroughly cleaned and chemically treated to ensure paint adhesion. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10, *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*. Proper job site storage as outlined in Section 4.1, shall be followed.

2.1.4 Factory Applied Finish Paint

When specified, doors and frames shall be finish painted on all surfaces of the door and frame exposed to view. The factory applied finish paint shall meet the performance requirements and acceptance criteria as stated in ANSI/SDI A250.3, *Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames*. Consult individual manufacturers for product availability and color selection. Proper job site storage, as outlined in Section 4.1, shall be followed.

2.1.5 Field Applied Finish Paint

Unless doors and frames are factory finish painted, a compatible coat of finish paint shall be applied in the field. The finish paint shall be of a type recommended for use on prime-painted steel. Consult the door and frame manufacturer's literature for description of primer used. The manufacturer of the finish paint should verify compatibility with the primer.

2.1.6 Tolerances

SDI-117, *Manufacturing Tolerances for Standard Steel Doors and Frames* shall apply to the standard steel doors and frames specified.

Note: All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be $\pm 1/16$ in. (1.6 mm). Weight or force shall be $\pm 2\%$. Angles shall be ± 2 degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

2.1.7 Test Procedures

The products furnished under this standard shall have demonstrated successful performance to the following established standard test methods:

ANSI/SDI A250.3 – *Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames*.

ANSI/SDI A250.4 – *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings*.

ANSI/SDI A250.10 – *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*.

2.1.8 Design Clearances

2.1.8.1 The clearance between the door and frame shall be a maximum of $1/8$ " (3.2 mm) in the case of both single swing and pairs of doors.

2.1.8.2 The clearance between the meeting edges of pairs of doors shall be $3/16$ " (4.8 mm) $\pm 1/16$ " (1.6 mm). For fire rated applications, the clearances between the meeting edges of pairs of doors shall be $1/8$ " (3.2 mm) $\pm 1/16$ " (1.6 mm).

2.1.8.3 The clearance measured from the bottom of the door to the bottom of the frame (Undercut) shall be a maximum of $3/4$ " (19.1 mm)

Table 2 – Steel thickness / door faces

Level	Model	Minimum Thickness		MSG No. ⁽¹⁾
		Inches	mm	
1	1	0.032	0.8	20
	2	0.032	0.8	20
2	1	0.042	1.0	18
	2	0.042	1.0	18
3	1	0.053	1.3	16
	2	0.053	1.3	16
	3	See Sec. 2.3.3 Construction Features		16
4	1	0.067	1.7	14
	2	0.067	1.7	14

⁽¹⁾ MSG No. to be used for reference purposes only.

unless otherwise specified. Fire door undercuts shall comply with ANSI/NFPA 80, *Standard for Fire Doors and Other Opening Protectives*.

2.1.8.4 The clearance between the face of the door and the stop shall be $\frac{1}{16}$ " (1.6 mm) to $\frac{3}{32}$ " (2.4 mm).

2.1.8.5 All clearances shall be, unless otherwise specified in this document, subject to a tolerance of $\pm\frac{1}{32}$ " (0.8 mm).

2.1.9 Steel Thickness (see Table 2)

2.2 Manufacturers Standard Gage (MSG) vs. Minimum Steel Thickness

The minimum steel thickness for each specific gage is derived from the published figures of Underwriters Laboratories LLC, and shall be used for reference purposes only.

2.3 Construction Features

2.3.1 Door Faces and Edge

2.3.1.1 Full Flush

Each door face shall be formed from a single sheet of steel of a thickness as defined by Table 2. There shall be no visible seams on the surface of the faces. A full height vertical seam is permitted on door edges.

2.3.1.2 Seamless

In addition to the requirements for full flush doors, no visible seams are permitted along the vertical edges. One of the following methods, at the discretion of the manufacturer, shall be used when a seamless door is specified:

- vertical seam edge filled, dressed smooth
- intermittently welded seams, edge filled, dressed smooth
- continuously welded seam dressed smooth

2.3.1.3 Door Edges

Door edges shall be fabricated utilizing the following different profiles:

- Square Edge – edge of door which is 90° to the face
- Beveled Edge – edge of a door which is not at a 90° angle to the face of the door (standard bevel is $\frac{1}{8}$ " (3.2 mm) in 2" (50.8 mm) – narrow side of door is in contact with stop of frame when door is closed

Unless specified, door edges will be manufactured in accordance with manufacturer's standard for that model.

2.3.1.4 End Channels or Closures

The top and bottom of the door shall be closed with either flush or inverted channels or closures. The channels or closures shall have a minimum material thickness of 0.042" (1.0 mm).

2.3.1.5 Decorative Faces

When specified, door faces shall be fabricated of textured and/or embossed steel. These materials shall meet the requirements of Table 2.

2.3.2 Core Construction

The core design shall be at the discretion of the manufacturer.

Doors of the following core designs have met the performance requirements of the documents listed under Section 2.1.7:

- **KraftPaper Honeycomb**
- **Polystyrene**
- **Polyurethane**
- **Mineral Board**
- **Vertical Steel Stiffeners**

This shall not restrict the development of alternate core materials that meet the performance requirements specified above.

2.3.3 Construction Features – Stile and Rail – Flush Panel

Stiles and rails shall be a minimum of 0.053" (1.3 mm) in thickness and shall be cold rolled or galvanized steel. Door corners shall be mitered or butted. Mitered joints shall be internally reinforced, welded and ground smooth such that no miter joints appear on door faces. Where specified, intermediate rails shall be butted and either permanently mechanically fastened or internally welded to door stiles. Butted joint seams shall remain visible. Center panels shall be made using cold rolled or galvanized steel with a minimum thickness of 0.042" (1.0 mm), and shall be reinforced with manufacturer's standard core material. Panel faces shall be flush with perimeter surfaces and shall be joined to abutting perimeter members by welding or permanent mechanical fastening. Where specified, panels shall be recessed in lieu of flush. Recessed panels shall be reinforced and fastened as specified for flush panels. Hardware reinforcements shall be as specified in Table 4 and located as specified in Table 5.

2.3.4 Vision Lights

When doors are specified to contain glazed openings, the manufacturer's standard light kit shall be supplied unless otherwise specified.

2.3.5 Louvered Doors

When specified, doors shall be provided with louvers. SDI-111C, *Recommended Louver Details for Standard Steel Doors* shall be used as a guide in detailing/specifying louvers.

2.4 Frames

2.4.1 General

Provide steel frames for doors, transoms, sidelights, mullions, interior glazed panels and other openings, where indicated. Provide either knockdown field assembled type, or welded unit type frames as specified.

Performance tests shall be conducted on 3-sided door frames and corresponding door designs. The variety and complexity of openings containing transom, sidelights, or other such configurations preclude the use of these test methods on such designs.

SDI-134 *Glossary of Terms for Hollow Metal Doors and Frames* and SDI-111, *Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components* shall be used as guides in the development of frame details.

2.4.1.1 Knockdown Frames

Unless otherwise specified, frames shall be supplied as knockdown, and shall have rigidly interlocked frame joints so as to maintain alignment and assure performance of completed frames when field assembled. These frames can consist of either single rabbet or double rabbet profiles.

2.4.1.2 Frames for Existing Drywall Openings

When frames are specified for installation in existing drywall construction they shall be of the slip-on drywall type. These frames are not available with welded corners. A butted wall frame with existing wall anchors may also be installed in existing drywall wall construction. This frame type is available with welded corners.

Table 3 – Minimum steel thickness / frames

Level	Thickness		MSG No. ⁽¹⁾
	inches	mm	
1	0.042	1.0	18
2	0.053	1.3	16
3	0.053	1.3	16
4	0.067	1.7	14

⁽¹⁾ MSG No. to be used for reference purposes only.

2.4.1.3 Welded Frames

Welded frames required to comply with this standard shall be supplied as face welded unless otherwise specified as either full profile welded, fully welded or continuously welded.

Face Welded: The joint between the head and jamb faces shall be completely arc welded along their length either internally or externally. **The remaining elements of the frame profile, i.e., soffit, stops, rabbets, are not welded.** Face joints shall be ground and finished smooth with no visible seam. Face joints at meeting mullions or between mullions and other frame members shall be completely arc welded externally, ground, and finished smooth.

Full Profile Welded: (Also specified as fully welded or continuously welded.) The joints between all elements of the head and jamb profiles, i.e., soffit, stops, rabbets, faces and returns, shall be completely arc welded. Faces and returns may be arc welded either internally or externally, all other frame elements shall be welded internally. Faces and returns shall be ground and finished smooth with no visible seam. The joint at other frame elements shall appear as a hairline seam on the external side. Face joints at meeting mullions or between mullions and other frame members shall be completely externally welded on the faces only, welds shall be ground and finished smooth. The meeting joints of other mullion profile elements are not welded.

Welded frames shall be provided with a temporary spreader bar for shipping and handling purposes only. This temporary spreader bar shall be removed and a setting spreader, supplied by the installer, shall be used for installation of the frame. See ANSI/SDI A250.11,

Recommended Erection Instructions for Steel Frames for details.

2.4.2 Manufacturers Standard Gages for Frames

Table 3 shall be used to determine the proper gage thickness for the corresponding door levels.

2.4.3 Frames with Mullions and Transom Bars

Mullions and transom bars shall be joined to adjacent members by welding (see 2.4.1.3) or by rigid mechanical connection, so as to maintain alignment of parts and assure performance of completed frames when field assembled. When specified, vertical mullions shall be provided with floor anchors.

2.4.4 Frame Anchors for Wall Conditions

Provide frames, other than slip-on drywall type, with a minimum of three anchors per jamb suitable for the adjoining wall construction. Provide anchors of not less than 0.042" (1.0 mm) in thickness or 0.167" (4.2 mm) diameter wire. Frames OVER 7'6" (2286 mm) in height shall be provided with additional anchors.

2.4.4.1 Slip-On Drywall Frame Anchors

Slip-on drywall frames shall have an anchoring system that is an integral part of the frame, and allows installation of the frame after the wall has been constructed and finished.

2.4.4.2 Base Anchors

Provide frames, other than slip-on drywall type, with base anchors that are not less than 0.042" (1.0 mm) in thickness for attachment to the floor. For wall conditions that do not allow for

Table 4 – Minimum hardware reinforcing thickness

Hardware Item	Door			Frame		
	inches	mm	MSG No. ⁽⁶⁾	inches	mm	MSG No. ⁽⁶⁾
Mortise Hinge 1-3/8" [34.9 mm] Door ⁽¹⁾	0.093	2.3	12	0.093	2.3	12
Mortise Hinge 1-3/4" [44.5 mm] Door ^{(1) (2)}	0.123	3.1	10	0.123	3.1	10
Mortise Lock or Deadbolt ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Bored Lock or Deadbolt ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Flush Bolt Front ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Surface Bolt ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Surface Applied Closer ⁽⁴⁾	0.067	1.7	14	0.067	1.7	14
Hold Open Arm ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Pull Plates and Bar ⁽³⁾	0.053	1.3	16	0.053	1.3	16
Surface Exit Device ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Floor Checking Hinge	0.167	4.2	7	0.167	4.2	7
Pivot Hinge	0.167	4.2	7	0.167	4.2	7
Continuous Hinges ⁽⁵⁾	Not Required			Not Required		
Kick / Push Plate	Not Required			Not Required		

Note: The minimum steel thickness for each specific gage is derived from the published figures of Underwriters Laboratories LLC.

⁽¹⁾ Thinner steel may be employed as long as tapped holes used for mounting the hardware are extruded to produce an equivalent number of threads.

⁽²⁾ If reinforcing is angular or channel shaped, 0.093" (2.3 mm) is permitted.

⁽³⁾ When reinforcing is omitted, thru-bolting via the use of spacers or sex-bolts is required.

⁽⁴⁾ Reinforcement shall occur on both sides.

⁽⁵⁾ Refer to ANSI/SDI A250.6, *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames*.

⁽⁶⁾ MSG No. to be used for reference purposes only.

the use of a floor anchor, an additional jamb anchor shall be specified.

2.4.5 Glazing Beads

On frame assemblies that incorporate glazed openings, the frame shall be provided with glazing beads designed to receive the glazing materials specified. The glazing beads shall be butted at the corners. Glazing beads shall be of snap-on or screw-applied design.

2.4.6 Terminated Stops

When specified, stops for interior door frames shall be terminated above the floor 6" (152.4 mm) standard, measured from frame bottom

to bottom of terminated stop. The stop is cut at a 45° or 90° angle and closed with a steel filler plate welded in place. Terminated stops on frames for lightproof doors, sound-rated doors, double egress, or lead-lined doors are not available.

3 Hardware Preparation

3.1 Reinforcings

Provide minimum hardware reinforcing gages as noted in Table 4 and ANSI/SDI A250.6, *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames*.

3.1.1 Mortise Hardware Preparations

Doors and frames shall be reinforced, drilled and tapped to receive mortised hinges, locks, latches, and flush bolts as required. Preparation shall be in accordance with ANSI/BHMA A156.115 *Hardware Preparation in Steel Doors or Steel Frames* and ANSI/SDI A250.6, *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames* where applicable.

3.1.2 Surface Applied Hardware

When specified, doors and frames shall be reinforced for surface applied hardware. Drilling and/or tapping shall be completed by others.

3.1.3 Function Holes

The preparation for locks and/or exit devices shall include reinforcements (as shown in Table 4) and function holes. Trim and/or mounting holes are not included.

3.1.4 Anchor or Pivot Reinforced Hinges

Where specified, the appropriate recessing and reinforcing shall be provided. Mounting holes shall be field drilled and tapped by others.

3.1.5 Hinge Preparations

See Table 5. Doors up to and including 7'6" (2184 mm) high require a minimum three (3) hinge preparations. Doors over 7'6" (2286 mm) high require a minimum four (4) hinge preparations. Exception: 1-3/8" (34.9 mm) thick, 6'8" (2032 mm) high non-fire rated doors shall be prepared for a minimum of two hinges.

3.1.6 Hardware Locations

Hardware shall be located in accordance with Table 5.

Other items of hardware shall be located according to the door and/or hardware manufacturer's directions. This includes the door closers, floor hinges, overhead door holders, pocket pivot, and most specialized-purpose hardware.

4 Storage, Handling, and Installation

4.1 Jobsite Storage

All doors and frames shall be stored vertically under cover. The units shall be placed on at least 4" (102 mm) high wood sills or in a manner that will prevent rust or damage. The use of non-vented plastic or canvas shelters that can create a humidity chamber shall be avoided. A 1/4" (6.3 mm) space between the doors shall be provided to promote air circulation.

Table 5 – Hardware locations

Locks, Latches, Roller Latches and Double Handle Sets		38" – 42" (965 mm – 1067 mm) Centerline of Lock Strike from Bottom of Frame
Rim and Mortise Panic Devices		
Cylindrical and Mortise Deadlocks ⁽¹⁾		48" (1219 mm) to Centerline of Strike from Bottom of Frame
Push Plates		Centerline 45" (1143 mm) from Bottom of Frame
Pull Plates		Centerline of Grip @ 42" (1067) from Bottom of Frame
Combination Push Bar		Centerline of 42" (1067 mm) from Bottom of Frame
Hospital Arm Pull		Centerline of Lower Base is 45" (1143 mm) from Bottom of Frame with Grip Open at Bottom
Hinges	Top	Up to 11-¾" (298.5 mm) from Rabbet Section of Frame to Centerline of Hinge
	Bottom	Up to 13" (330.2 mm) from Bottom of Frame to Centerline of Hinge
	Intermediate	Equally Spaced Between Top and Bottom Hinges

⁽¹⁾ Cylindrical and Mortise Deadlock strikes shall be located at 48" (1219 mm) from the bottom of the frame unless otherwise specified.

tion. If the wrapper on the door becomes wet, it must be removed immediately. Proper jobsite storage is extremely important in maintaining the quality and integrity of the factory applied paint. Improper Storage of material will have an adverse effect on the factory applied paint's ability to meet the requirements of ANSI/ SDI A250.10, *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames* or ANSI/SDI A250.3, *Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames*.

4.2 Frame Installation

4.2.1 Frames shall be installed plumb, level, rigid and in true alignment as recommended in ANSI/SDI A250.11 *Recommended Erection Instructions for Steel Frames*.

All frames, other than drywall slip-on types, shall be fastened to the adjacent structure so as to retain their position and stability. Slip-on drywall frames shall be installed in prepared wall openings in accordance with manufacturer's instructions.

4.2.2 Where grouting is required in masonry installations, frames shall be braced or fastened in such a way that will prevent the pressure of the grout from deforming the frame members. Grout shall be mixed to provide a 4" (102 mm) maximum slump consistency and hand troweled into place. Grout mixed to a thinner, "pumpable" consistency shall not be used. Excess water from thin consistency grout will cause premature rusting of steel frames and probable deformation or discoloration of certain wall constructions. Standard mortar protection in frames **is not** intended for thin consistency grout or drywall compound.

Steel Frames, including fire rated frames do not require grouting. GROUTING SHALL NOT

BE USED FOR FRAMES INSTALLED IN DRY-WALL WALLS.

4.3 Door Installation

Doors shall be installed and fastened to maintain alignment with frames to achieve maximum operational effectiveness and appearance. Doors shall be adjusted to maintain perimeter clearances as specified in Section 2.1.8. Shimming shall be performed by the installer as needed to assure the proper clearances are achieved.

4.4 Hardware Installation

Installation of hardware items shall be in accordance with the hardware manufacturer's recommendations and templates. ANSI/SDI A250.6, *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames* shall be consulted for other pertinent information.

4.5 Installation of Factory Applied Finish Painted Materials

In addition to storage and handling precautions noted in Section 4.1, it is IMPERATIVE that the work of all other rough trades MUST be completed prior to the installation of factory applied finished painted product.

4.6 Door and Frame Maintenance

It is the responsibility of the installer or end user to properly maintain the doors and frames in accordance with SDI-124, *Maintenance of Standard Steel Doors and Frames*.

4.7 Door and Frame Repair

Any repair required to either the door or frame in a fire rated opening shall be conducted in accordance with ANSI/NFPA 80, *Standard for Fire Doors and Other Opening Protectives*.

Appendix A (informative)

Fire Door Considerations

Fire door testing

There are two primary fire test methods that are used to establish the fire ratings of doors. The first is ANSI/UL 10B, *Fire Tests of Door Assemblies*, and is referred to as neutral pressure; the second is ANSI/UL 10C, *Positive Pressure Fire Tests of Door Assemblies*, and is referred to as positive pressure.

The difference between the two test methods concerns the location of a neutral pressure plane in the test furnace. In the late 1990's the test method required in building codes changed to a positive pressure test method. This change was adopted in the Uniform Building Code (UBC) and the International Building Code (IBC) for swinging-type fire doors.

Fire doors required to be tested by either method may be specified by calling out the test method or by indicating that the product must meet a specific section of a model building code.

These tests incorporate two phases: A fire test phase utilizing an established time-temperature curve and a structural integrity phase utilizing a hose stream test conducted under established time-pressure criteria determined by exposure time and area of the assembly. To be a valid fire door assembly, the unit must pass both phases of the test.

In certain instances as permitted by building codes, the integrity portion (hose stream) is deleted. The deletion of this requirement negates the assembly's use as a true fire door.

The fire test procedures also include a measurement of unexposed surface temperatures at regular intervals up to 30 minutes.

The fire test does not address or measure the amount of smoke leakage through the assembly. For this criteria, ANSI/NFPA-105 *Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives* and ANSI/UL 1784 *Air Leakage Tests of Door Assemblies* should be consulted.

Fire door ratings

Swinging steel doors and frames are commonly tested as flush (non-glazed) units for a 3-hour time period. This allows their usage for all lower fire protection ratings. Lights in doors may be permitted based on the performance of flush doors when evaluated with the testing database and experience of the test lab or certifying agency.

Typical hourly ratings for swinging steel fire doors are 3-hours, 1-½-hours, ¾-hours, and ⅓-hour. Usage of these ratings is as follows:

3-Hour — Openings in fire walls that divide a single building into fire areas, normally 4-hour rated walls.

1-½-Hour — Openings in enclosures of vertical communications through buildings and in 2-hour partitions providing horizontal fire separations. These may also be used as non-glazed doors for openings in exterior walls subject to severe fire exposure from outside of the building.

¾-Hour — Openings in 1-hour rated (or less) partitions between rooms and corridors, or other separation of occupancy. With certain light restrictions these may also be used in exterior walls subject to moderate or light fire exposure from outside of the building. The ¾-hour fire door may also be used as a smoke and draft control door.

½-Hour (20 minute) — Doors of this rating are used for the protection of openings between living quarters and corridors and where smoke control is a primary concern. They may also be used as a smoke partition across corridors.

Fire door temperature rise

In addition, a temperature rise rating may be required by building codes in areas such as enclosures of vertical communications or in areas of storage for hazardous materials. Temperature rise ratings indicate the maximum temperature, above ambient, of the unexposed surface at 30 minutes into the fire test. Three ratings, 250°F (121°C), 450°F (232°C), or 650°F (343°C) are recognized, with the 250°F (121°C) rating being the most thermally efficient. Ratings over 650°F (343°C) are not recognized as temperature rise doors.

Fire door labeling

Doors and frames may bear labels or marks of a recognized third party certification agency, acceptable to the authority having jurisdiction. Fire door labels must indicate the hourly rating and either the latch throw for single point locks or must bear a notation “Fire door to be equipped with fire exit hardware”. Fire door labels may also indicate the temperature rise rating.

Door labels may be of metal (installed by welding, riveting, adhesive or drive screw) or of mylar. The existence of a label is the only method of verification that the door is rated.

Frame labels, except in specific instances, do not indicate hourly ratings. Fire door frames assume the rating of the fire door installed or a rating that corresponds to the rating of the wall in which it is installed, whichever is lesser.

Frame labels may be of metal (installed by welding, riveting, or drive screw), mylar, or may be embossed into the frame.

Door and/or frame labels may be of the same or different certifying agencies. A door assembly may consist of labeled components of different manufacturers.

Other fire door considerations

The effectiveness of a fire door assembly is dependent on the use of listed or labeled items for all components. These may include glazing material, locks, hinges, closers, latches, light frames, other hardware items, etc. The substitution of a non-rated component or one that is rated less than the intended fire protection rating of the assembly results in a corresponding decrease in rating or the loss of the rating in its entirety.

For further information, see SDI-118 *Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements* or ANSI/NFPA 80 *Standard for Fire Doors and Other Opening Protectives*.

For information on fire doors used in a means of egress consult NFPA-101 *Life Safety Code*®.

Appendix B (informative)

General Considerations

Steel coating types

ASTM A924, *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process* and A653, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process* provide specifications for both galvannealed (A Type) and Galvanized (G Type) coatings. For purposes of this standard, G type coatings are not recommended due to problems related to paint adhesion and welding. In addition, heavier coating weights, i.e., G60 and G90 are known to experience cracking and peeling of the coating resulting in potential performance failures under ANSI/SDI A250.10, *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames* and ANSI/SDI A250.3, *Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames*.

Steel thickness

When ordering steel directly from the mill, manufacturers order sheet and coil to a minimum decimal thickness and not a nominal gage. This thickness is generally at the low end of the range for a specific gage. For example, the nominal thickness of 16 gage is 0.059" (1.5 mm). The thickness tolerance permitted by ASTM A568, *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*, is $\pm .006$ " (0.15 mm). Therefore the minimum ordering dimension would then become 0.053" (1.3 mm) as shown in Table 2. These minimum values meet the requirements of Underwriters Laboratories LLC. Steel gages, or MSG numbers may be used for reference purposes only.

Thermal bow

Thermal bow is a condition which may occur in metal doors due to an inside / outside temperature differential. It is warping of the top and bottom of the lock edge of the door either toward or away from the frame stop. This condition may result in force on the latch that increases the difficulty of opening the door and may increase the air leakage of the opening.

This condition, and the degree of bowing, depends on the door color, construction, length of exposure, temperature, etc. Thermal bow can often be alleviated by painting the exposed surface a light color. In some cases of extreme cold, this condition may also occur in reverse.

Aesthetics

The production of steel doors and frames relies on a variety of manufacturing processes including spot welding, projection welding, arc welding ground smooth, grinding, filling, etc. These processes may result in a show-through after application of finished paint. These characteristics are inherent in production and are not to be considered as manufacturing defects.

The show-through characteristics increase as the paint gloss increases. This standard recommends a maximum paint gloss rating of 20% reflectance, measured using a 60° gloss meter, which should be suitable for most applications. Translucent paints may emphasize show-through characteristics and their use is not recommended. The 20% reflectance is equivalent to a Master Painters Institute (MPI) gloss rating description of a traditional "eggshell-like" finish.

Water penetration

Borrowed light, transom, sidelight, and combination transom sidelight frames are not factory sealed to prevent water penetration. In situations where this is a concern, the contractor must seal all joints that are exposed to the elements after the frame assembly is installed.

Whenever possible, it is strongly recommended that glass and glazing be installed on the exterior rabbet of the frame assembly, which will help act as a deterrent to water penetration. It should be noted that a fully welded corner does not ensure a water tight condition.

The member companies of the hollow metal industry cannot control the workmanship associated with the frame installation and therefore, this work must be specified in the installation/glazing/caulking section of the specifications. It is the responsibility of the contractor to assure all steps are taken by the installer, glazer, or others to prevent water penetration.

Appendix C (informative)

Section 08100 Standard Hollow Metal Doors and Frames (intended as a sample specification)

Part 1: General

1.01 Work included

- A. Furnish only standard hollow metal doors, frames, sidelights and borrowed lights as specified and shown on plans and schedules.
- B. Related sections
 - 1. Section 08700 — Finish hardware
 - 2. Section 09900 — Painting
 - 3. Section 08800 — Glass & glazing

1.02 References

- A. SDI standards
 - 1. SDI-106-1999 *Recommended Standard Door Type Nomenclature*
 - 2. SDI-108-2010 *Recommended Selection and Usage Guide for Standard Steel Doors*
 - 3. SDI-111-2009 *Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components*
 - 4. SDI-112-2008 *Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames*
 - 5. SDI-117-2009 *Manufacturing Tolerances for Standard Steel Doors and Frames*
 - 6. SDI-118-2012 *Basic Fire Door Requirements*
 - 7. SDI-124-2011 *Maintenance of Standard Steel Doors and Frames*
- B. ANSI standards
 - 1. ANSI/UL 10B-2009 *Fire Tests of Door Assemblies*
 - 2. ANSI/UL 10C-2009 *Positive Pressure Fire Tests of Door Assemblies*
 - 3. ANSI/UL 1784-2009 *Air Leakage Tests of Door Assemblies*
 - 4. ANSI/NFPA 80-2010 *Standard for Fire Doors and Other Opening Protectives*
 - 5. ANSI/NFPA 252-2012 *Fire Tests of Door Assemblies*
 - 6. ANSI/SDI A250.3-2007 (R2011) *Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames*
 - 7. ANSI/SDI A250.4-2011 *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings*
 - 8. ANSI/SDI A250.6-2003 (R2009) *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames*
 - 9. ANSI/SDI A250.7-1997 (R2002) *Nomenclature for Standard Steel Doors and Steel Frames*
 - 10. ANSI/SDI A250.10-1998 (R2011) *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*

11. ANSI/SDI A250.11-2012 *Recommended Erection Instructions for Steel Frames* (Formerly SDI-105)
12. ANSI/BHMA A156.115-2006 *American National Standard for Hardware Preparations in Steel Doors and Steel Frames*

C. ASTM standards

1. ASTM A1008-2012 *Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability*
2. ASTM A568-2011 *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*
3. ASTM A1011-2012 *Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability*
4. ASTM A653-2011 *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*
5. ASTM A879-06 *Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface*
6. ASTM A924-2010 *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process*

1.03 Quality assurance

- A. Manufacturer shall meet or exceed all standards as noted in Section 2.01 references.
- B. Fire rated assemblies shall be manufactured in accordance with [Underwriters Laboratories] [Intertek Testing Services] [Factory Mutual] established procedures and shall bear the appropriate labels for each application.
- C. No product shall be manufactured prior to receipt of approved hardware schedule and templates.

1.04 Submittals

- A. Shop drawings, if required, shall show all openings in the door schedule and/or the drawings.
- B. When required, provide details of door design, door construction details and methods of assembling sections, hardware locations, anchorage and fastening methods, door frame types and details, and finish requirements.

1.05 Delivery, marking and storage

- A. Where specified, all products shall be marked with architects opening number on all doors, frames, misc. parts and car tons.
- B. All materials upon receipt shall be inspected for damage, and the shipper and supplier notified if damage is found.
- C. All doors and frames shall be stored vertically under cover. The units shall be placed on at least 4" (102 mm) high wood sills or in a manner that will prevent rust or damage. The use of non-vented plastic or canvas shelters that can create a humidity chamber shall be avoided.
- D. A ¼" (6.3 mm) space between the doors shall be provided to promote air circulation. If the wrapper on the door becomes wet, it must be removed immediately.

1.06 Warranty**1.07 [See manufacturer's warranty]****Part 2: Product****2.01 Materials**

2.02 All steels used to manufacture doors, frames, anchors, and accessories shall meet at least one or more of the following requirements:

- A. Cold rolled steel shall conform to ASTM designations A1008, *Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability* and A568, *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*.
- B. Hot rolled, pickled and oiled steel shall comply with ASTM designations A1011, *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability* and A568, *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*.
- C. Hot dipped zinc coated steel shall be of the alloyed type and comply with ASTM designations A924, *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process* and A653, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*.

2.03 Frames

- A. Interior frames
 - 1. Level 1 for door model [1] [2] [0.042" (1.0mm)] [0.053" (1.3mm)] minimum steel thickness for frames
 - 2. Level 2 for door model [1] [2] [0.042" (1.0mm)] minimum steel thickness for frames
 - 3. Level 3 for door model [1] [2] [3] [0.053" (1.3mm)] [0.067" (1.7mm)] minimum steel thickness for frames
- B. Exterior frames
 - 1. Level 1 for door model [1] [2] [0.042" (1.0mm)] [0.053" (1.3mm)] minimum steel thickness for frames
 - 2. Level 2 for door model [1] [2] [0.053" (1.3mm)] minimum steel thickness for frames
 - 3. Level 3 for door model [1] [2] [3] [0.053" (1.3mm)] [0.067" (1.7mm)] minimum steel thickness for frames
 - 4. Level 4 for door model [1] [2] [0.067" (1.7mm)] [0.093" (2.3mm)] minimum steel thickness for frames
- C. Frames shall be [knockdown type] [slip-on drywall type] [face welded type] [full profile weld type]
- D. Provide frames, other than slip-on drywall type with a minimum of three anchors per jamb suitable for the adjoining wall construction. Provide anchors of not less than 0.042" (1.0 mm) in thickness or 0.167" (4.2 mm) diameter wire. Frames OVER 7'6" (2286 mm) shall be provided with an additional anchor per jamb.
- E. Slip-on drywall frame anchors shall be as provided by the manufacturer to assure performance.

- F. Base anchors shall be provided, other than slip-on drywall type, with minimum thickness of 0.042" (1.0mm). For existing masonry wall conditions that do not allow for the use of a floor anchor, an additional jamb anchor shall be provided.
- G. All frames shall be fully prepared for all mortise template hardware and reinforced only for surface mounted hardware. Drilling and/or tapping shall be completed by others.
- H. Minimum hardware reinforcing gages shall comply with Table 4 of ANSI/SDI A250.8, *Specifications for Standard Steel Doors and Frames (SDI-100)*.

2.04 Doors

- A. Doors shall meet at least one or more of the following requirements:
 - 1. Level 1 – Standard duty 1-³/₈" (34.9 mm) and 1-³/₄" (44.5 mm)
 - Model 1 – Full flush
 - Model 2 – Seamless
 - 2. Level 2 – Heavy duty 1-³/₄" (44.5 mm)
 - Model 1 – Full flush
 - Model 2 – Seamless
 - 3. Level 3 – Extra heavy-duty 1-³/₄" (44.5 mm)
 - Model 1 – Full flush
 - Model 2 – Seamless
 - Model 3 – Stile and rail
 - 4. Level 4 – Maximum-duty 1-³/₄" (44.5 mm)
 - Model 1 – Full flush
 - Model 2 – Seamless
- B. Interior doors

Level [I]	[II]	[III]	[IV]
Model	[1]	[2]	[3]
- C. Exterior doors

Level [I]	[II]	[III]	[IV]
Model	[1]	[2]	[3]
- D. Door [and panel] construction
- E. Face steel sheet shall meet at least one or more of the following requirements:
 - 1. Level 1
 - Model 1 – 0.032" (0.8mm) minimum thickness
 - Model 2 – 0.032" (0.8mm) minimum thickness
 - 2. Level 2
 - Model 1 – 0.042" (1.0mm) minimum thickness
 - Model 2 – 0.042" (1.0mm) minimum thickness
 - 3. Level 3
 - Model 1 – 0.053" (1.3mm) minimum thickness
 - Model 2 – 0.053" (1.3mm) minimum thickness
 - Model 3 – 0.053" (1.3mm) minimum thickness

- 4. Level 4
 - Model 1 – 0.067" (1.7mm) minimum thickness
 - Model 2 – 0.067" (1.7mm) minimum thickness
- F. End closure: The top and bottom of the doors shall be closed with [flush] [inverted] channels or closures. The channels or closures shall have a minimum material thickness of 0.042" (1.0mm).
- G. Core: See ANSI/SDI A250.8, *Specifications for Standard Steel Doors and Frames (SDI-100)*, Section 2.3.2.
- H. Door edge design: See ANSI/SDI A250.8, *Specifications for Standard Steel Doors and Frames (SDI-100)*, Section 2.3.1.3.
- I. Minimum hardware reinforcing gages shall comply with Table 4 of ANSI/SDI A250.8, *Specifications for Standard Steel Doors and Frames (SDI-100)*.
- J. Label requirements, steel astragals, louvers, vision lights – see ANSI/SDI A250.8, *Specifications for Standard Steel Doors and Frames (SDI-100)* Section 2, Products.

2.05 Finishing

Prime finish: Doors and frames shall be thoroughly cleaned, and chemically treated to insure maximum paint adhesion. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10 *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*.

2.06 Design clearances

- A. The clearance between the door and frame head and jambs shall be $\frac{1}{8}$ " (3.2 mm) in the case of both single swing and pairs of doors.
- B. The clearance between the meeting edges of pairs of doors shall be $\frac{1}{8}$ " (3.2 mm) to $\frac{1}{4}$ " (6.3 mm), for fire rated doors $\frac{1}{8}$ " (3.2 mm) \pm $\frac{1}{16}$ " (1.6 mm).
- C. The clearance at the bottom shall be [$\frac{3}{4}$ " (19.1 mm)] [$\frac{5}{8}$ " (15.8 mm)].
- D. The clearance between the face of the door and door stop shall be $\frac{1}{16}$ " (1.6 mm) to $\frac{1}{8}$ " (3.2 mm).
- E. All clearances shall be, unless otherwise specified, subject to a tolerance of $\pm \frac{1}{32}$ " (0.8 mm).

Part 3: Execution

3.01 Installation

- A. Frames shall be installed plumb, level, rigid and in true alignment as recommended in ANSI/SDI A250.11, *Recommended Erection Instructions for Steel Frames*. All frames other than slip-on types shall be fastened to the adjacent structure so as to retain their position and stability. Drywall slip-on frames shall be installed in prepared wall openings in accordance with manufacturer's instructions.
- B. Where grouting is required in masonry installations, frames shall be braced or fastened in such a way that will prevent the pressure of the grout from deforming the frame members. Grout shall be mixed to provide a 4" (102mm) maximum slump consistency, hand troweled into place. Grout mixed to a thin "pumpable" consistency shall not be used.

- C. Doors shall be installed and fastened to maintain alignment with frames to achieve maximum operational effectiveness and appearance. Doors shall be adjusted to maintain perimeter clearances as specified in Section 2.1.8. Shimming shall be performed by the installer as needed to assure the proper clearances are achieved.
- D. Installation of hardware items shall be in accordance with the hardware manufacturer's recommendations and templates. ANSI/SDI A250.6, *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames* shall be consulted for other pertinent information.

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AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

- ANSI/SDI A250.3** Test Procedure & Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames
- ANSI/SDI A250.4** Test Procedure & Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
- ANSI/SDI A250.10** Test Procedure & Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
- ANSI/SDI A250.13** Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes (Not applicable for FEMA 320/361 or ICC-500 Shelters)
- SDI-113** Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies
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- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

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*Test Procedure and Acceptance Criteria for —
Prime Painted Steel Surfaces
for Steel Doors and Frames*



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American National Standard

**Test Procedure and Acceptance Criteria for
Prime Painted Steel Surfaces
for Steel Doors and Frames**

Secretariat

Steel Door Institute

Approved June 24, 2020

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American National Standard

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ANSI/SDI A250.10-2020

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Foreword (This Foreword is not part of American National Standard A250.10-2020)

The material contained in this document has been developed under the auspices of the Technical Committee of the Steel Door Institute.

The original standard was issued on July 28, 1980 and was revised in 1990 and 1998. The 1998 edition was reaffirmed in 2004, and revised in 2011. The current edition is a revision of the 2011 document with the contents being updated to reflect changes and advances that have take place in the steel door and frame industry.

Suggestions for improvement gained in the use of this standard are welcome and should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, OH 44145-1967.

The organizations that have approved this standard are as follows:

Builders Hardware Manufacturers Association
Canadian Steel Door Manufacturers Assoc.
Cedar Valley Associates
D. H. Pace Company
Door and Hardware Institute
Door Control Services
ESTM Services, LLC
HMMA/Division of NAAMM
Intertek
MasterSpec
Ray and Associates
Steel Door Institute
Underwriters Laboratories LLC
Vetrotech / Saint Gobain

The Accredited Standards Committee A250 TC-1 developed this standard and had the following personnel at the time of approval:

Craig Ordmandy, Chairman
J. Jeffery Wherry, Secretary

<i>Organization Represented</i>	<i>Name of Representative</i>
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Ceco Door Products	
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Underwriters Laboratories LLC.....	Luke Woods
Vetrotech Saint-Gobain.....	Kevin Norcross

American National Standard

Test Procedure and Acceptance Criteria for — Prime Painted Steel Surfaces for Steel Doors and Frames

1 General

1.1 Scope

These methods prescribe the procedures to be followed in the selection of material, chemical preparation of the steel substrate, prime paint coating application, testing, and evaluation of prime painted steel surfaces for steel doors and frames.

1.2 Referenced Documents

ASTM B117-16 *Standard Practice for Operating Salt Spray (Fog) Apparatus*

ASTM D610-08 (2012) *Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces*

ASTM D714-09 (2017) *Standard Test Method for Evaluating Degree of Blistering of Paints*

ASTM D1654-08 (2016)e1 *Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments*

ASTM D2794-93 (2010) *Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)*

ASTM D3359-17 *Standard Test Methods for Rating Adhesion by Tape Test*

ASTM D4585 / D4585M-13 *Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation*

2 Material

2.1 The test specimen shall be of the ASTM specification per ANSI/SDI A250.8 as used in the manufacturing of the products. Separate specimens shall be used for each test. The specimen shall be a minimum 4" (102mm) x 6" (152mm) with a 1/4" (6.4mm) hole at the center of the 4" (102mm)

width, 1/2" (12.7mm) in from the end. Identification marks shall be added to the specimen as required for control purposes. The test specimen shall be handled at all stages of the process with clean gloves to prevent contamination.

2.2 The specimen(s) shall be hung using a method representative of that used in production.

2.3 The specimen(s) shall be cleaned, pre-treated and prime painted in accordance with the manufacturer's normal production method and procedure. All dry fill thickness used on test specimens shall be documented and representative of the individual manufacturer's normal production material.

2.4 At the end of the coating cycle, the specimen(s) shall be removed from the system in such a manner as to avoid any contact with the primed surface by any other object. The primed surface of the specimen shall not be handled or come in contact with other objects in such a way as to disrupt the primed surface.

2.5 All specimens shall be allowed to age at ambient room temperature, for a minimum 72 hour duration before any testing commences.

3 Testing

3.1 Salt Spray Testing

- a) *Apparatus* – The apparatus used for salt spray testing shall be of such design as to conform to ASTM B117.
- b) *Test performance* – Salt spray testing shall be conducted as specified in ASTM B117 for a test period of 120 continuous hours. The test specimen(s) shall be scribed with an "X" per ASTM D1654, sections 4.1 and 5.1.

3.2 Condensation testing (humidity)

- a) *Apparatus* – The apparatus used for condensation (humidity) testing shall be of such design as to conform to ASTM D4585.
- b) *Test performance* – Condensation (humidity) testing shall be conducted as specified in ASTM D4585 for a test period of 240 continuous hours. Exposure temperatures shall be maintained at a minimum of 100° Fahrenheit (38° C). Actual test temperature shall be noted in the report.

3.3 Impact Test

The prime paint coating shall be subject to one impact per ASTM D2794 with 20 inch pounds of direct impact using a Gardner Impact Tester with a 1/2" (12.7 mm) diameter ball or punch at room temperature of 70° – 75° Fahrenheit. Apply one-inch (25.4 mm) wide #600 Scotch cellophane pressure-sensitive tape firmly to the impact area and pull off sharply.

Note: In order to ensure adhesion, #600 Scotch cellophane pressure sensitive tape must be stored and used within shelf life, as recommended by the manufacturer.

3.4 Film adhesion test

The prime coating film adhesion shall be tested in accordance with method "B" of ASTM D3359.

A total of (11) parallel cuts are made with a sharp instrument, 0.039" (1 mm) apart in both a vertical and horizontal direction, forming a grid.

One-inch (25.4 mm) wide pressure-sensitive tape is then firmly applied to the scribed surface and pulled off sharply.

Note: In order to ensure adhesion #600 Scotch cellophane pressure sensitive tape must be stored and used within shelf life, as recommended by the manufacturer.

4 Acceptance criteria

4.1 Salt Spray resistance

Applied prime paint on the unscored surface of the test specimen shall have a rust grade of no less than 6 as defined in ASTM D610.

Table 1 and the depictions shown in Figure 1 illustrate the scale used to evaluate the rust grades. The painting film at the scribe line shall not be undercut by rust more than 1/8" (3.2 mm) each side,

Table 1 – Rust grades

Rust Grade	Maximum % of rusted area
10	00.01
9	00.03
8	00.10
7	00.30
6	01.00
5	03.00
4	10.00
3	16.00
2	33.00
1	50.00
0	100.00

when tested in accordance with paragraph 3.1 (or a Rating Number 6 on each side of the scribe line, when evaluated and rated in accordance with ASTM D1654, Table 1. "Rating of Failure at Scribe (Procedure A).")

4.2 Condensation resistance

Applied prime paint shall be allowed to exhibit the dense pattern of #8 blisters but, shall have no more than the "few" pattern of #6 blisters as illustrated in the photographic reference of ASTM D714. See Figures 2 through 5 herein for visual representations of the various degrees of blistering.

Testing shall be in accordance with paragraph 4.2 of ASTM D714.

4.3 Impact test

No prime paint coating film removal shall occur other than at an area 1/8" (3.2 mm) in diameter at the center of the impact area, when tested in accordance with paragraph 3.3.

4.4 Film Adhesion

There shall be no adhesion loss less than a grade 3B as defined in ASTM D3359. This grade represents a film removal of between 5% and 15%. Table 2 illustrates the various classifications for adhesion loss.

5 Report

5.1 The report shall cover the date the test was performed and the issue date of the report.

5.2 Identification of the specimen tested, source of supply, manufacturer, model or series number, or both, and any other pertinent information.

5.3 A detailed description of the specimen or specimens tested shall include the type of prime paint, the method of paint application and the procedure used to cure it, the dry film thickness and the ASTM grade of the steel substrate.

5.4 A statement that the test or tests were conducted in accordance with the methods and procedures as specified herein. If deviations from these methods and procedures were made, they shall be described in the report.

5.5 When the test is made to check the conformance of the unit specimen to the test requirements of a particular specification, the identifica-

tion or description of the specification shall be included in the report.

6 General

6.1 Test laboratory

All tests shall be conducted by a testing laboratory accredited to the standards referenced in this document.

6.2 Certification

When reference is made to this specification, the following statement shall be used: "Prime paint finish has been tested in conformance with ANSI/SDI A250.10."

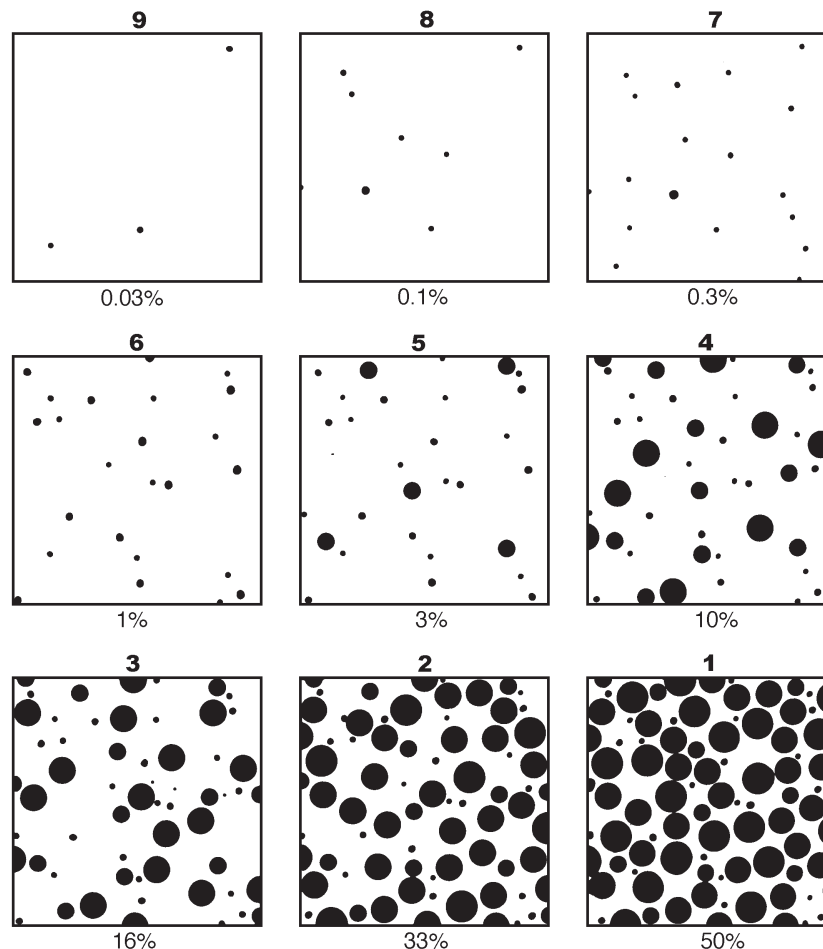
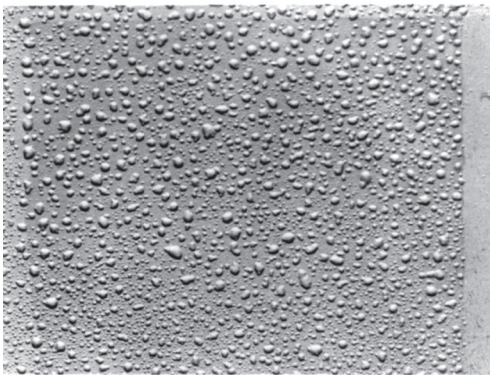


Figure 1 – Visual reference for percentage of rust

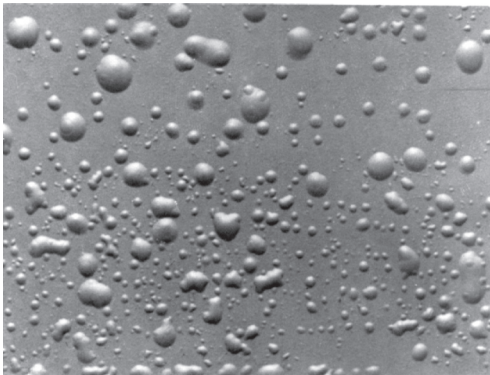
Visual examples illustrating degrees of blistering



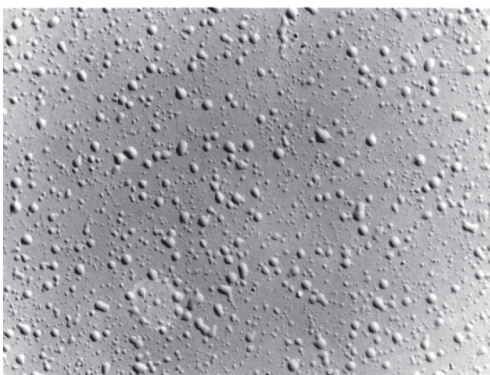
DENSE



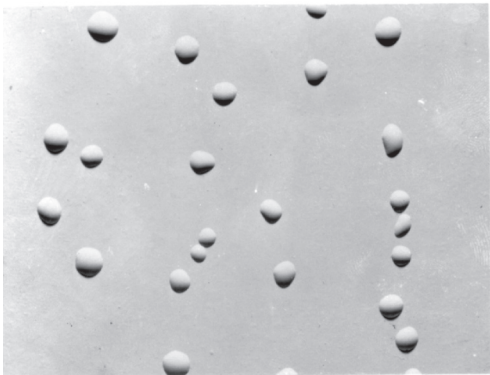
DENSE



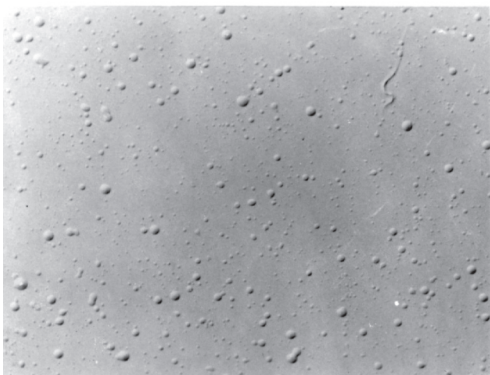
MEDIUM DENSE



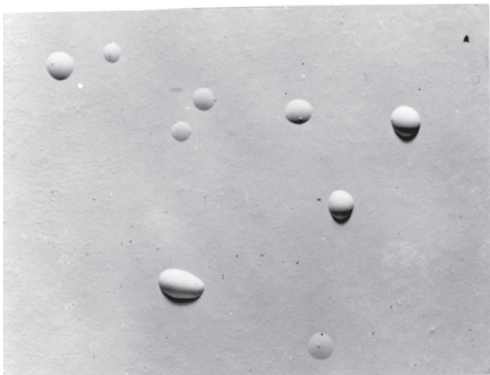
MEDIUM DENSE



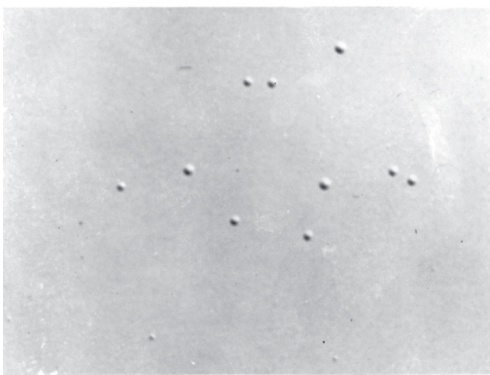
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MEDIUM



FEW

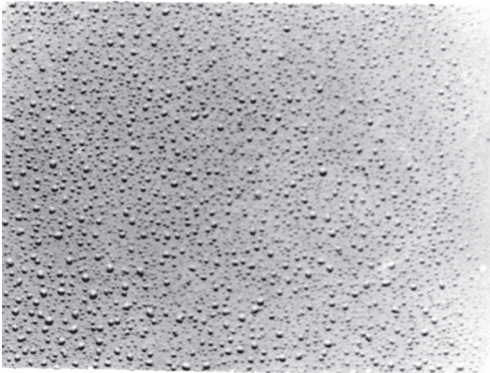


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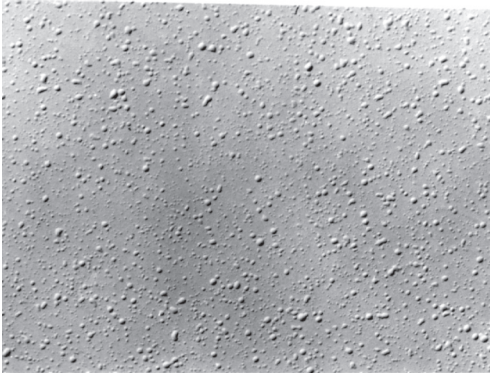
Figure 2 – Blister size #2

Figure 3 – Blister size #4

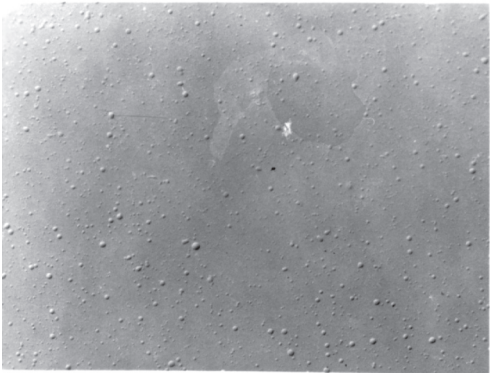
Visual examples illustrating degrees of blistering



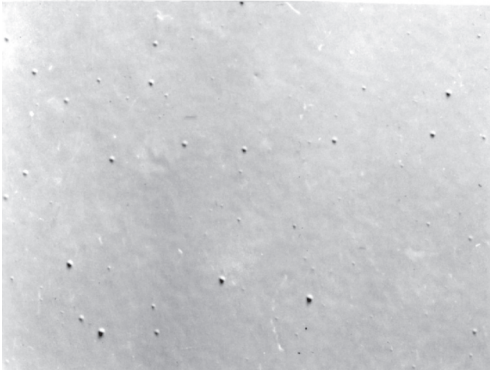
DENSE



MEDIUM DENSE

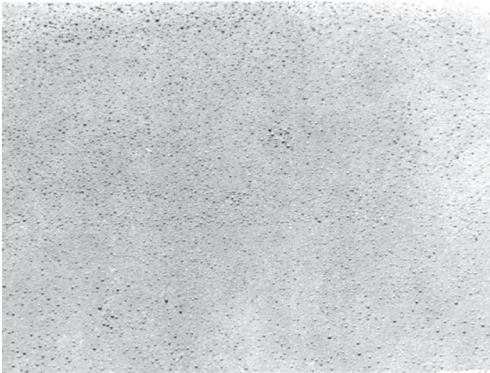


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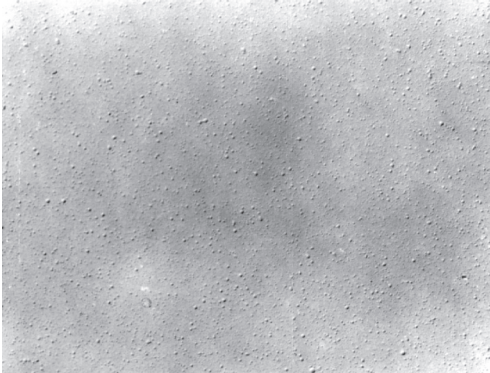


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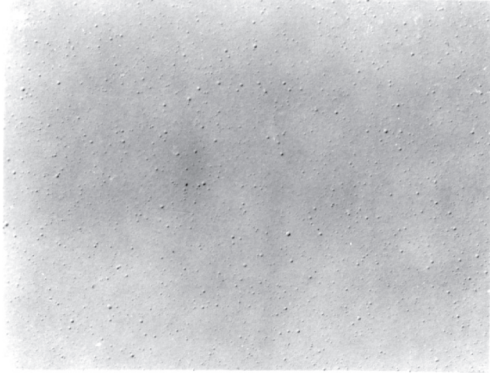
Figure 4 – Blister size #6



DENSE



MEDIUM DENSE



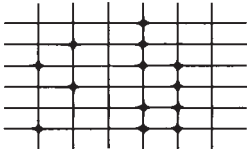
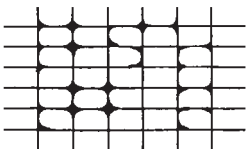
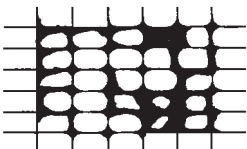

MEDIUM



FEW

Figure 5 – Blister size #8

Table 2 – Classification of adhesive test results

Classification	Surface of cross-cut areas from which listing has occurred. (Example for six parallel cuts.)	Rate of adhesion
5B	None	The edges of the cuts are completely smooth; none of the squares or the lattice are detached.
4B		Small flakes of coating are detached at intersections; less than 5% of the area is affected.
3B		Small flakes of coating are detached along edges and at intersections of cuts. The area affected is 5 to 15% of the lattice.
2B		The coating has flaked along the edges and at parts of the squares. The affected area is 15 to 35% of the lattice.
1B		The coating has flaked along the edges of cuts in large ribbons and entire squares have detached. The area affected is 35 to 65% of the lattice.
0B	Flaking and detachment in excess of 65%.	

AVAILABLE PUBLICATIONS

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Recommended Erection Instructions for Steel Frames



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Steel Door Institute

Approved January 17, 2012



American National Standard
Recommended
Erection Instructions
for Steel Frames

Secretariat
Steel Door Institute

Approved June 10, 2011

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Foreword (This Foreword is not part of American National Standard A250.11-2012)

The material contained in this document has been developed under the auspices of the Technical Committee of the Steel Door Institute.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, OH 44145-1967.

The organizations that have approved this standard are part of the ANSI A250 Accredited Standards Committee, formed February 8, 1991, and are as follows:

American Institute of Architects
Architectural Testing
Builders Hardware Manufacturers Association
Canadian Steel Door Manufacturers Association
Cedar Valley Associates
Door and Hardware Institute
FM Approvals
Hollow Metal Manufacturers Association/Division of NAAMM
Intertek Testing Services
Door Control Services
Wind Science & Engineering Research Center
Steel Door Institute
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The Technical Committee of the Steel Door Institute, which developed this standard, had the following personnel at the time of approval:

Claus D. Heide, *Chairman*
Mike Torres, *1st Vice Chairman*
Tom R. Janicak, *2nd Vice Chairman*
J. Jeffery Wherry, *Manager*

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Security Metal Products	Terry Simpson
Steelcraft	Karen Bishop
Steel Door Institute.....	J. Jeffery Wherry

American National Standard

Recommended Erection Instructions for Steel Frames

1 Scope

1.1 Recommended methods for the installation of steel frames for swinging doors in a variety of wall conditions, commonly used in commercial buildings, are covered within this standard. The installation of transom/sidelight (or panel) type frames and single or multiple borrowed lights are not covered in this standard.

1.1.1 It is not the intention of this document to obstruct the development of alternative installation methods, nor is it intended to restrict frame installation solely to the wall types noted herein.

1.1.2 Although this document is commonly referenced for severe windstorm installations, critical performance requirements (such as type, quantity, and location of anchors) shall be as indicated in the manufacturer's published Approvals or Listings.

1.2 Reference documents

SDI 127E-2006, *Prime Painted Materials Alert*

SDI 127F-2010, *Butted Frames Rough Opening Sizes*

SDI 127J-2010, *Back-Coating of Frames*

SDI 117-2009 *Manufacturing Tolerances for Standard Steel Doors and Frames*

NFPA 80-2010, *Standard for Fire Doors and Other Opening Protectives* (National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269; www.nfpa.org)

UL10C-2009 *Standard for Safety Positive Pressure Fire Tests of Door Assemblies*

ANSI/SDI A250.8-2003(R2008) *Recommended Specifications for Standard Doors and Frames*

HMMA 840-07, *Installation and Storage of Hollow Metal Doors and Frames*

HMMA 841-07, *Tolerances and Clearances for Commercial Hollow Metal Doors and Frames*

1.2.1 Further information on wall construction, anchoring, details, manufacturing tolerances or installation may be found in the following:

SDI 110-2009, *Standard Steel Doors and Frames for Modular Masonry Construction*

SDI 111-2009, *Recommended Standard Details for Steel Doors, Frames, Accessories and Related Components*

SDI 122-2007, *Installation and Troubleshooting Guide for Standard Steel Doors and Frames*

SDI 127D-2006, *Electric Strikes in Stud Walls*

1.3 Metrication

1.3.1 Standard dimensions used in this document are in inch-pound units. Metric values, where applicable, are included in parenthesis for reference only. These are "soft conversion" approximates.

2 Storage and Preliminary Assembly

(see SDI 127E, and ANSI/SDI A250.8)

2.1 All frames, including knocked-down, shall be stored under cover.

2.1.1 Knocked-down frames shall be placed flat on at least 4" (102 mm) wood sills to prevent the frames from resting on the ground.

2.1.2 Assembled frames shall be stored vertically. The units shall be placed on at least 4" (102 mm) high wood sills or in a manner that will prevent rust or damage.

2.1.3 The use of non-vented plastic or canvas shelters that can create a humidity chamber shall be avoided.

2.1.4 Refer to project specifications for required cleanup and touchup work.

2.2 Back-Coating (see SDI 127J for further information)

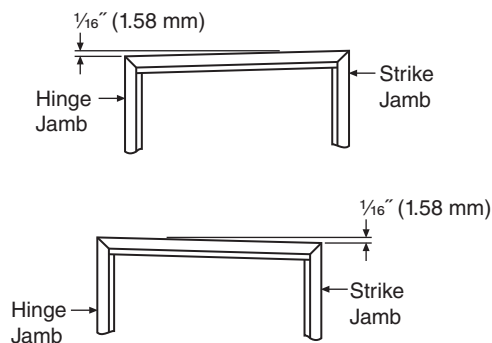
2.2.1 When temperature conditions necessitate the use of anti-freezing agents in plaster or mortar, the inside of the frame shall be coated at the jobsite with a corrosion resistant coating by the contractor responsible for installation.

2.3 Grouting of frames (see ANSI/SDI A250.8 for further information)

2.3.1 Where grouting is required in masonry installations, frames shall be braced or fastened in such a way that will prevent the pressure of the grout from deforming the frame members.

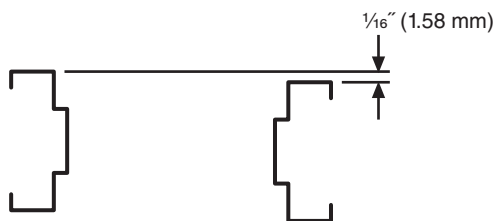
2.3.2 Grout shall be mixed to provide a 4" (102 mm) maximum slump consistency, and be hand troweled into place. Grout mixed to a thinner "pumpable" consistency shall not be used.

2.3.3 Standard mortar protection in frames is not intended for thin consistency grout. Steel frames, including fire rated frames, do not require grouting. Grouting is not recommended for frames installed in drywall.



Maximum $\frac{1}{16}$ " allowable tolerance on total opening.

1a – Squareness



1c – Alignment

2.4 Assembly of frame/anchor provisions

2.4.1 Follow manufacturers' recommended procedure for assembly of frame and quantity and spacing of anchors. If not indicated, install anchors at hinge levels and directly opposite at strike jamb.

2.5 Verification

2.5.1 Prior to installation, jobsite personnel shall ensure correct swing, size and labeling.

2.6 Installation tolerances

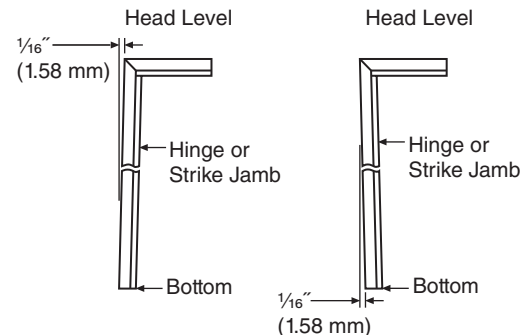
2.6.1 While this document is mainly concerned with tolerances relating to the manufacturing process, openings will not function properly if the frame is not installed within recognized tolerances.

Figure 1 shows examples of the accuracy to be maintained while setting frames.

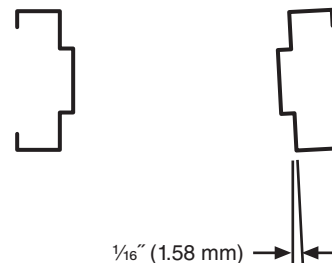
3 Plumbing and bracing frames

3.1 Wood Spreaders (see Figure 2)

The Contractor(s) responsible for installation shall have available a sufficient supply of wood



1b – Plumbness



1d – Twist

Figure 1 – Examples of the accuracy to be maintained while setting frames

spreaders for bracing frames. Spreader bars for shipping purposes shall not be used as installation spreaders.

3.1.1 Wood spreaders shall be square and fabricated from lumber no less than 1" (25.4 mm) thick. Correct length is the door opening width between the jambs at the header (i.e., Single Door 3'-0" = 36" = 915 mm). Length tolerance is $+\frac{1}{16}"$, -0" (+1.6 mm, -0). Cut clearance notches for frame stops. Spreader shall be nearly as wide as frame jamb depth for proper installation.

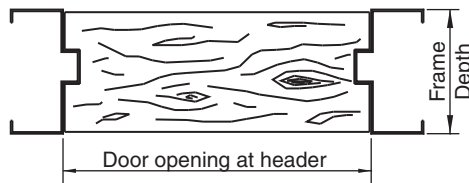


Figure 2 – Spreader

3.2 Equipment for plumbing the frame (see Figure 3)

3.2.1 The contractor should be equipped with a carpenter level, square and wood spreaders.

3.2.2 Where welded frames are provided with spreader bars, they shall be removed with a suitable saw or chisel and filed flush before setting frames.

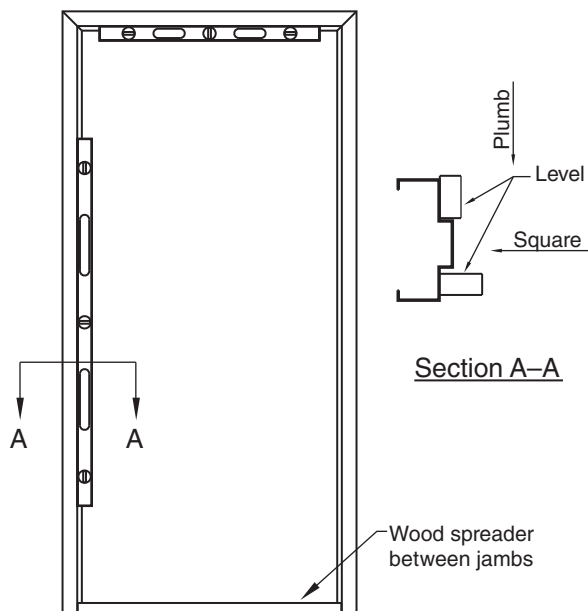


Figure 3 – Plumbing the frame

3.3 Bracing the frame (see Figure 4)

3.3.1 Frame bracing shall be as shown or shore to a structure above.

3.3.2 Bracing shall be perpendicular to the intended wall.

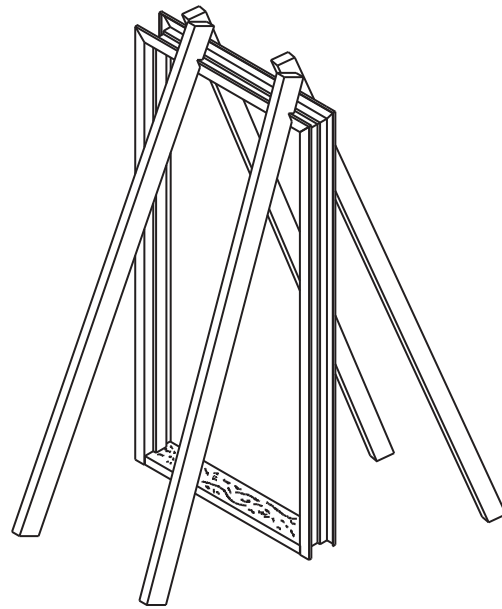


Figure 4 – Bracing the frame

3.4 Positioning the frame

3.4.1 Set the frame in the desired location and level the header. Square jambs to header. Shim under jambs if necessary. With frame properly aligned, insert wood spreaders at bottom and mid-height and fasten jambs to floor through floor anchors.

3.4.2 Plumb and square jambs. Install vertical brace to support header for openings over 4'-0" (1219 mm) wide.

4 Accessories

4.1 Install rubber silencers (see Figure 5)

4.1.1 Cut the point from a #6d box or finishing nail. Insert nail in hole to elongate rubber silencers.

Moisten the end and insert rubber silencers in predrilled holes on frame stop, remove nail. The thickness of the silencer shall permit latching of door with $\frac{1}{16}"$ to $\frac{3}{32}"$ (1.6 to 2.4 mm) clearance between face of door and stop of frame.

4.1.2 Install rubber silencers before frame erection to avoid grout filling rubber silencer

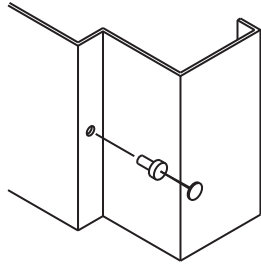


Figure 5 – Rubber silencers

holes. In some cases rubber silencers are factory installed.

4.2 Extended base anchor (see Figure 6)

4.2.1 Extended base anchors are supplied upon request only. (If required for tool attachment.)

5 New masonry construction (see Figure 7)

5.1 Assemble frame per manufacturer's instructions.

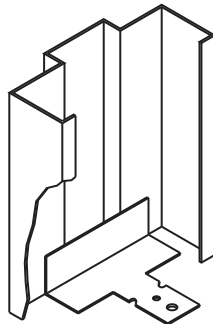


Figure 6 – Extended base anchor

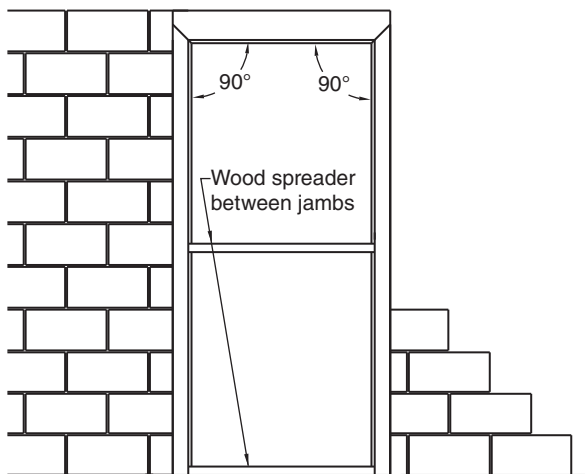


Figure 7 – New masonry construction

5.2 Erect, brace, square and plumb frame.

5.2.1 Fasten frame to floor through base anchors.

5.3 Set second spreader at the mid-height of the door opening to maintain the door opening size.

5.4 Install anchors (see Figure 8). Grout frame in the area of the anchors as block courses are laid up.

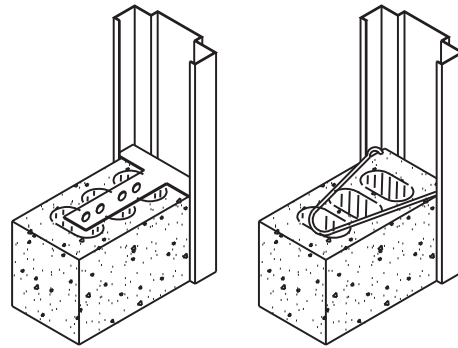


Figure 8 – Masonry anchors

5.4.1 Frames may also be supplied with anchors welded in place.

5.5 Continually check plumb and square as wall progresses.

6 Existing masonry construction (see Figure 9, Figure 10, and SDI 127F)

6.1 Rough openings for existing wall, structural steel framing, or retrofit installations utilizing a butted to wall application shall be no less than $\frac{3}{16}$ " (4.8 mm) larger the frame on all three sides.

6.1.1 The installer is responsible for any shimming or aligning required. Gaps are normally sealed as part of the installation or caulking/painting process.

6.1.2 Refer to Architectural specifications for the appropriate sealant material to be used at fire or smoke control doors.

6.2 Assemble frame per manufacturer's instructions.

6.3 Install snap-in anchors (see Figure 11) and tap with a hammer to align with pierced holes in jambs.

6.3.1 Frames may also be supplied with anchors welded in place.

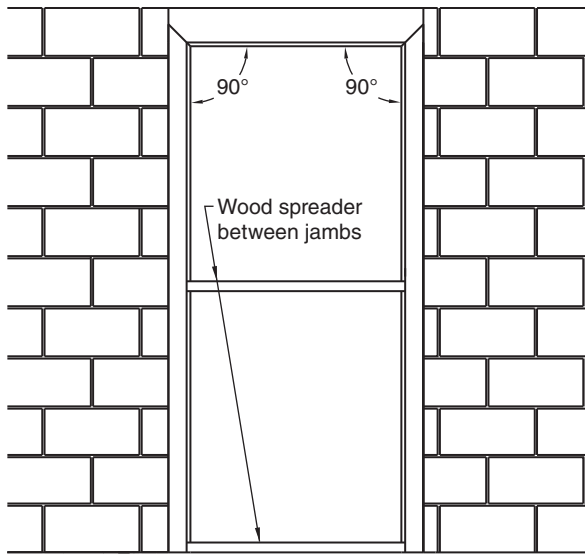


Figure 9 – Existing masonry construction

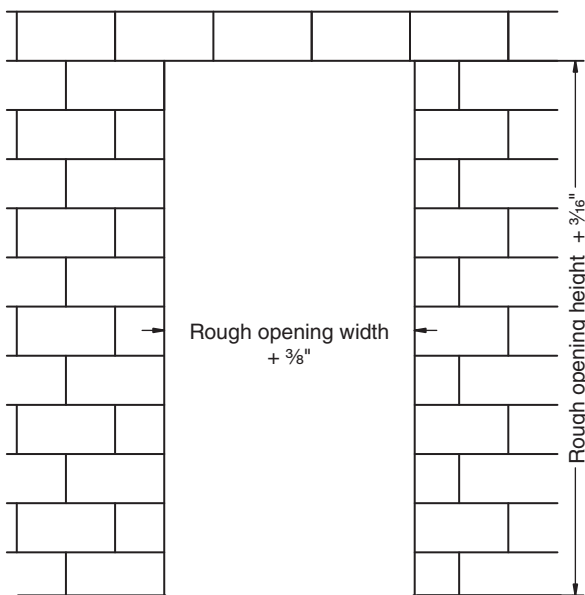


Figure 10 – Rough Opening

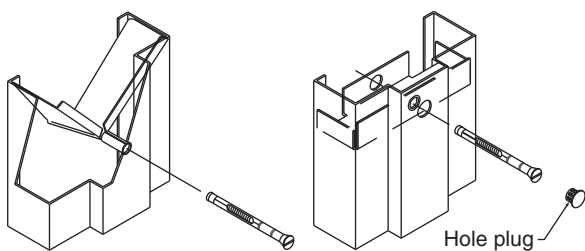


Figure 11 – Existing masonry or concrete wall anchors

6.4 Slide frame into wall opening; install wood spreaders.

6.5 Where possible, one jamb should be butted tightly to the wall.

6.6 Use tapered shims between anchors and wall and spreaders to maintain squareness and alignment of frame, and to maintain door opening sizes.

6.6.1 Drill appropriate size hole (per fastener manufacturer's instructions) for one-piece anchor bolts. Leave holes "rough" for added grip.

6.6.2 Backer rod or caulking shall be used where gaps occur between frame and wall.

6.7 Insert anchor bolts and tighten securely, checking for frame alignment periodically.

6.8 Install plugs to cover bolt heads (if so equipped).

7 Steel stud wall construction, studs erected with frame (see Figure 12)

7.1 Assemble frame per manufacturer's instructions.

7.2 Install snap-in anchors. Position anchors in frame through the throat and tap in with a hammer.

7.2.1 Frames may also be supplied with anchors welded in place.

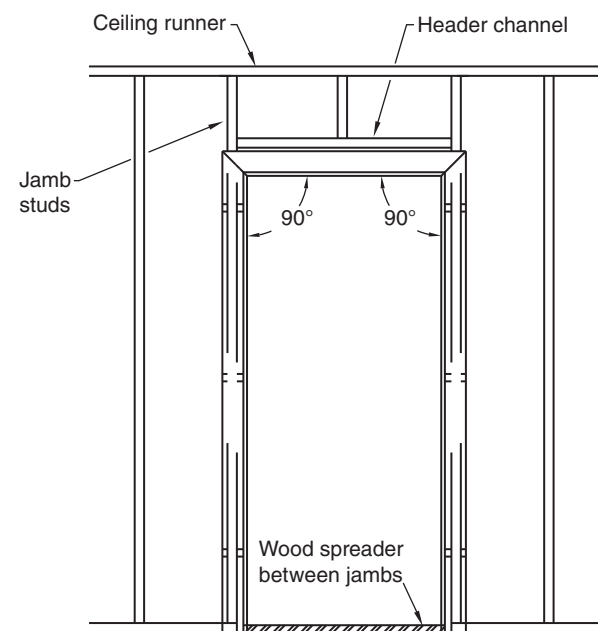


Figure 12 – Steel stud wall construction

7.3 Erect, brace, square and plumb frame as shown.

7.4 Install wood spreaders.

7.5 Attach jambs to floor through floor anchor or floor extension.

7.6 Install jamb studs to floor, header channels, and ceiling runners butted tightly against frame anchors and properly positioned in frame throat for wallboard.

7.6.1 Nesting or overlapping stud joints or other wall construction practices that will increase the overall wall thickness beyond the intended finished thickness are to be avoided.

7.7 Attach jamb studs to anchors with screws or weld.

7.7.1 If using screws, drill from the back side of the stud, through both the stud and anchor, then attach with (2) screws per anchor location (see Figure 13). Screws shall be #6 x $\frac{3}{8}$ " minimum steel sheet metal or self tapping type.

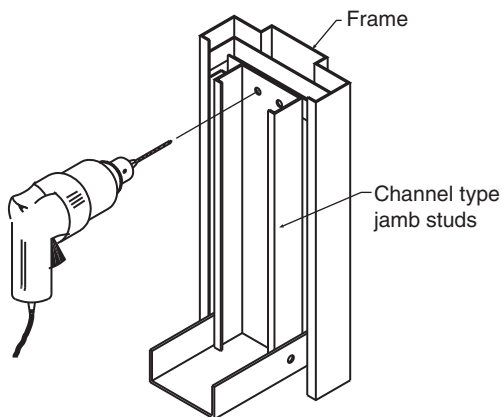


Figure 13 – Channel type steel stud

7.7.2 When attaching header stud to jamb studs, be sure the stud is above frame header. This will assure ample room for attaching plaster lath or drywall and will not interfere with installation of hardware attached to frame header.

7.7.3 At wrap-around installations in fire rated walls, drywall shall extend at least $\frac{1}{2}$ " (12.7 mm) into frame throat. See Section 12 for frame installations in butted or existing stud walls.

8 Double egress frames in steel stud wall construction

8.1 Generally, the installation of double egress frames in steel stud walls follows the same procedure as Section 7.

8.1.1 If frames are supplied knocked down, assemble per manufacturer's instructions.

8.1.2 Install anchors (if not supplied welded to frame) per manufacturer's instructions.

8.2 Erect, brace, square and plumb frame as shown (see Figure 14).

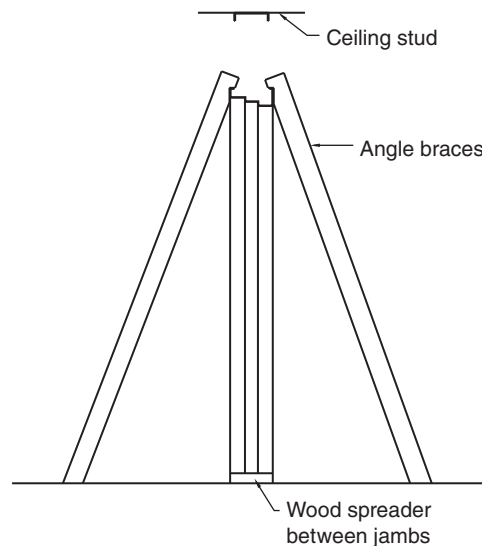


Figure 14 – Erect frame

8.2.1 Stand frame up in desired location. Anchor one jamb to floor and set wood spreader on floor from anchored jamb to loose jamb.

8.2.2 Install a vertical wood brace at center of frame.

8.2.3 Position and anchor second jamb to floor. Plumb, level and square frame, then install wood spreaders at mid-height.

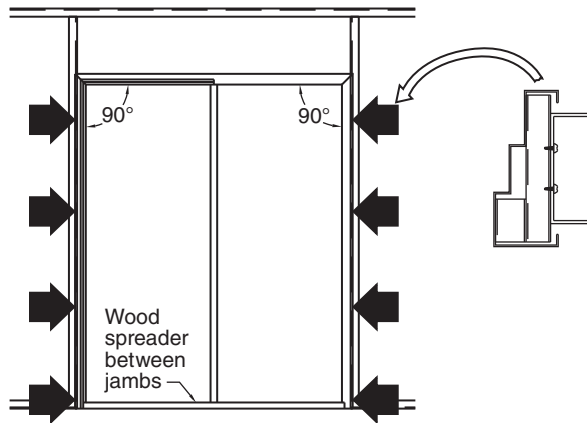


Figure 15 – Anchor jambs

8.3 Anchor jambs (see Figure 15)

8.3.1 Install jamb studs to floor, header channels, and ceiling runners butted tightly against frame anchors and properly positioned in frame throat for wallboard.

8.3.2 Nesting or overlapping stud joints or other wall construction practices that will increase the overall wall thickness beyond the intended finished thickness are to be avoided.

8.4 Attach jamb studs to anchors with screws or weld.

8.4.1 If using screws, drill from the back side of the stud, through both the stud and anchor, then attach with (2) screws per anchor location (see figure 15). Screws shall be #6 x $\frac{3}{8}$ " minimum steel sheet metal or self tapping type.

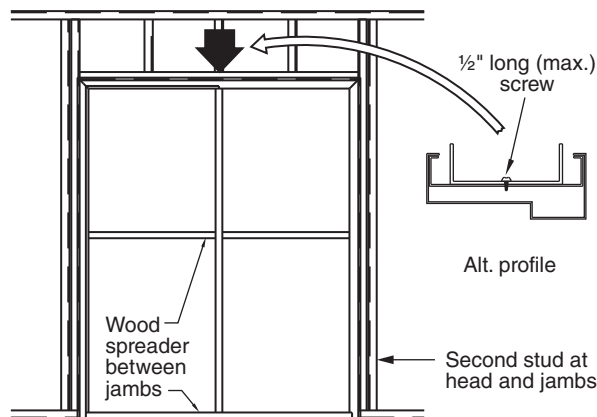


Figure 16 – Anchor header

8.5 Anchor header (see Figure 16)

Header anchor requirements will vary. The manufacturer's installation requirements should be followed.

8.6 At wrap-around installations in fire rated walls, drywall shall extend at least $\frac{1}{2}$ " (12.7 mm) into frame throat. See Section 12 for frame installations in butted or existing stud walls.

9 Wood stud construction (studs erected with frame)

9.1 Assemble frame per manufacturer's instructions.

9.2 Install snap-in anchors. Position anchors in frame through the throat and tap in with a hammer.

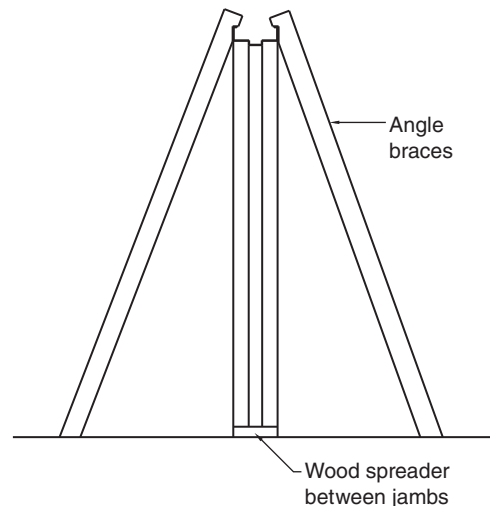


Figure 17 – Erect frame

9.2.1 Frames may also be supplied with anchors welded in place.

9.3 Square, brace and plumb frame as shown (see Figure 17).

9.4 Install wood spreaders (see Figure 18).

9.5 Attach jambs to floor through floor anchor or floor extension.

9.6 Install jamb studs (jack stud and king stud) butted tightly against anchors and properly positioned in frame throat for wallboard (see Figure 18).

9.6.1 Attach header stud(s) or header assembly between jamb studs making sure they are

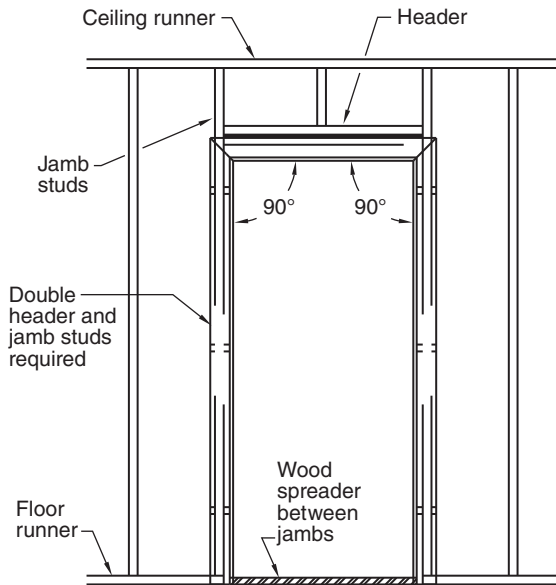


Figure 18 – Wood stud wall construction

above the frame head. This will assure ample room for attaching plaster lath or drywall and will not interfere with installation of hardware attached to frame head (see Figure 18).

9.7 Bend anchor straps around stud leaving sufficient clearance between frame return and stud for inserting finished wall material (see Figure 19 and Figure 20).

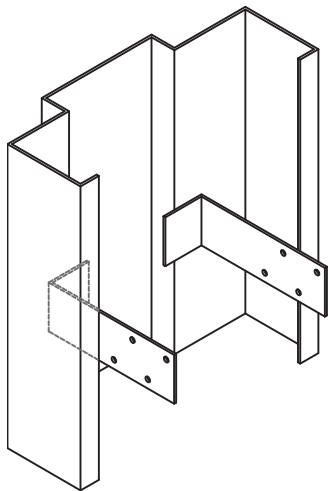


Figure 19 – Weld in strap anchors wood/steel studs

9.7.1 If there is insufficient room for wall finish, notch jamb studs no more than $\frac{1}{16}$ " (1.6 mm) deep for anchor straps.

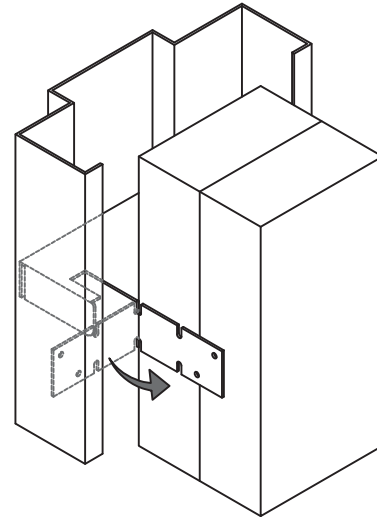


Figure 20 – Snap or weld in anchors wood/steel studs

9.8 Square and nail top anchor to stud on ONE JAMB ONLY. Check plumb and square and continue to nail balance of anchors to stud. Repeat for opposite jamb. For steel studs install screws from back of stud into Z anchor (see Figure 21).

9.8.1 At wrap-around installations in fire rated walls, drywall shall extend at least $\frac{1}{2}$ " (12.7 mm) into frame throat. See Section 12 for frame installations in butted or existing stud walls.

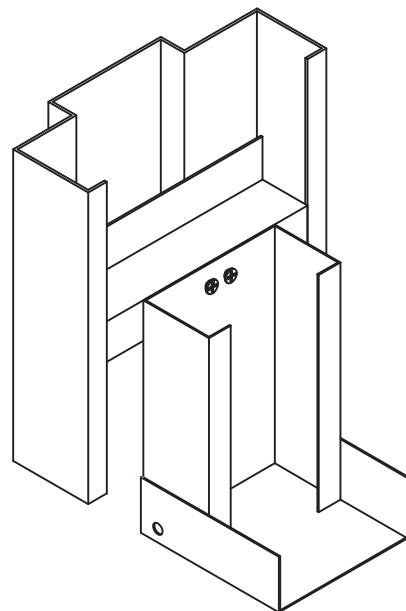


Figure 21 – Z Type weld in anchors steel studs

10 Wood/steel stud construction (studs erected before frame)

10.1 Build rough opening (see Figure 22) according to dimensions and clearances in manufacturer's installation instructions.

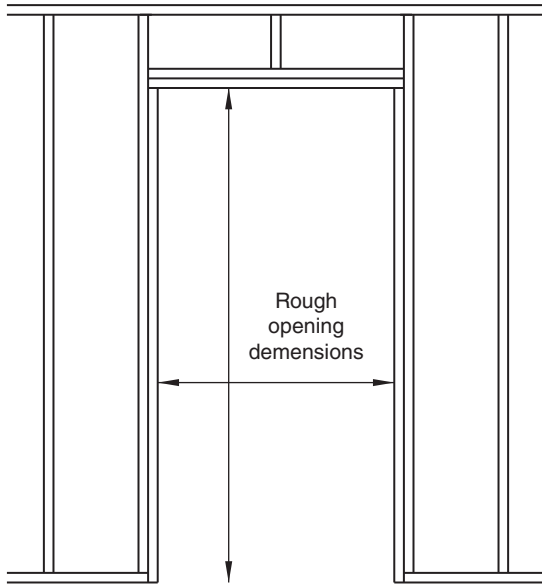


Figure 22 – Rough opening shown in wood stud.

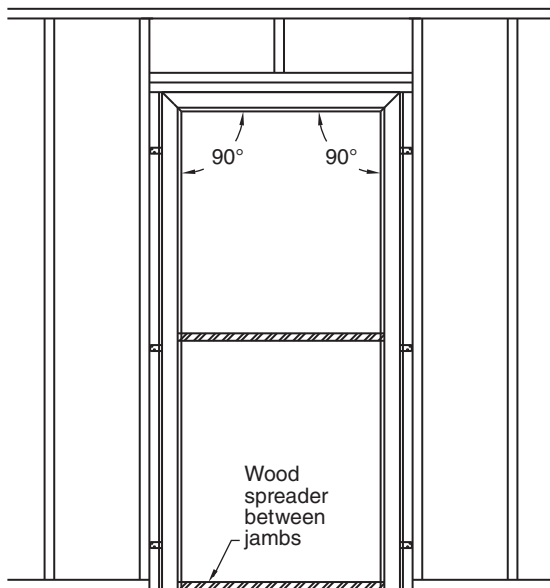


Figure 23 – Wood stud wall construction

10.1.1 Assure that rough openings are no less than those required in SDI 127F.

10.1.2 It is recommended that double studs be used at jambs and headers.

10.2 Assemble frame per manufacturer's instructions.

10.3 Install snap-in anchors. Position anchors in frame through the throat and tap in with a hammer.

10.3.1 Frames may also be supplied with anchors welded in place.

10.3.2 If base anchors cannot be used add one anchor per jamb at bottom.

10.3.3 Install fire rated frames with the anchor quantity and spacing as per the individual manufacturer's listings and instructions.

10.4 Slide frame into wall opening.

10.4.1 Install wood spreaders at bottom and mid-height. Square and level frame. Shim jambs if necessary (see Figure 23).

10.5 Bend anchor straps around stud leaving sufficient clearance between frame return and stud for inserting finished wall material (see Figure 24 and Figure 25).

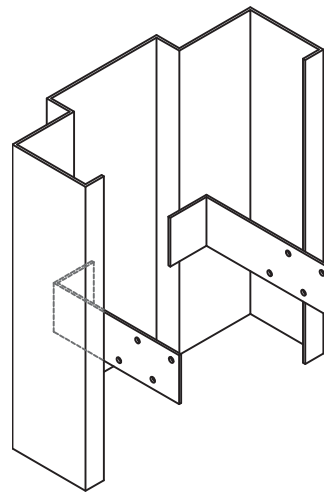


Figure 24 – Weld in strap anchors wood/steel studs

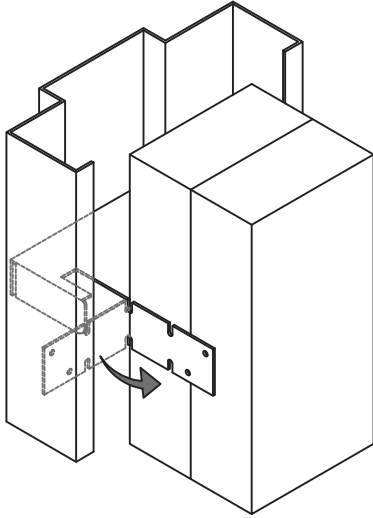


Figure 25 – Snap or weld in anchors wood/ steel studs

10.6 Square and nail top anchor to stud on ONE JAMB ONLY. Check plumb and square and continue to nail balance of anchors to stud. Repeat for opposite jamb. For steel studs install screws from back of stud into Z anchor (see Figure 26)

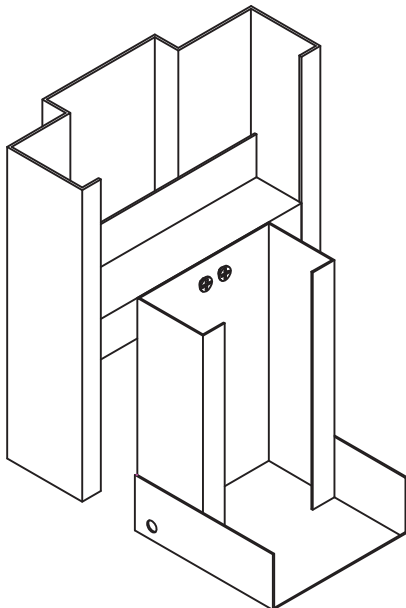


Figure 26 – Z Type weld in anchors steel studs

10.6.1 NOTE: At wrap-around installations in fire rated walls, drywall shall extend at least ½" (12.7 mm) into frame throat. See Section 12 for frame installations in butted or existing stud walls.

11 Slip-on drywall

11.1 Prepare rough opening (see Figure 27) per frame manufacturer's recommendations.

11.1.1 Nesting or overlapping stud joints or other wall construction practices that will increase the overall wall thickness beyond the intended finished thickness are to be avoided.

11.2 Install base anchors if not factory welded to jambs or if frame faces are not prepared for base anchor screws.

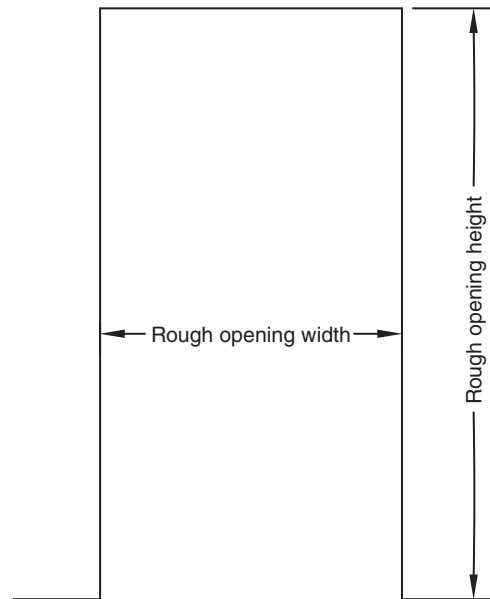


Figure 27 – Rough opening

11.3 Install jambs and header onto wall per manufacturer's instructions, taking care to align corner gussets (if so equipped). See Figure 28.

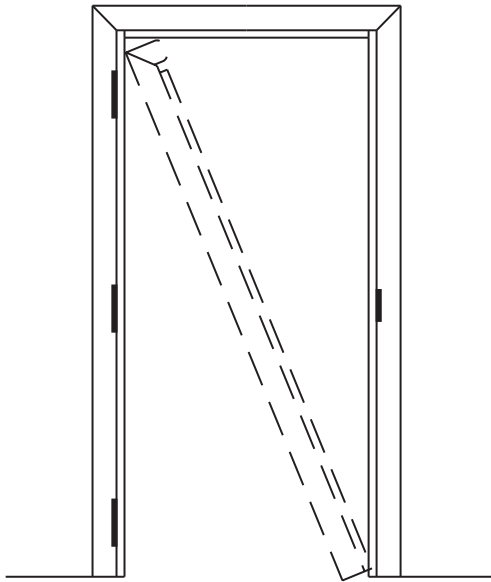


Figure 28 – Align corner gussets

11.4 Level and square frame (see Figure 29)

11.4.1 Install wood spreaders.

11.5 Turn adjusting screws hand tight (DO NOT USE SCREW GUN) until compression anchor contacts jamb studs. See Figure 30.

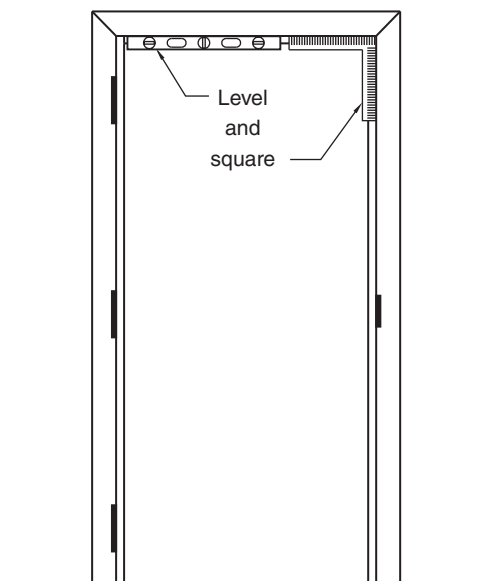


Figure 29 – Level and square frame

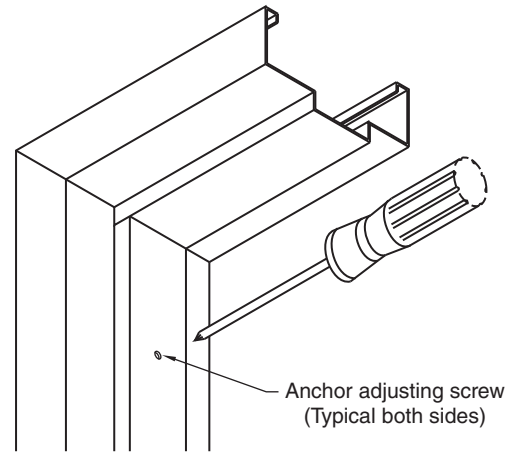


Figure 30 – Anchor adjusting screw

11.6 Re-check level and square. Adjust using anchor screws as needed.

11.7 Fasten base anchors to wall stud (see Figure 31) or fasten to wall studs through prepared holes in face of jambs at bottom.

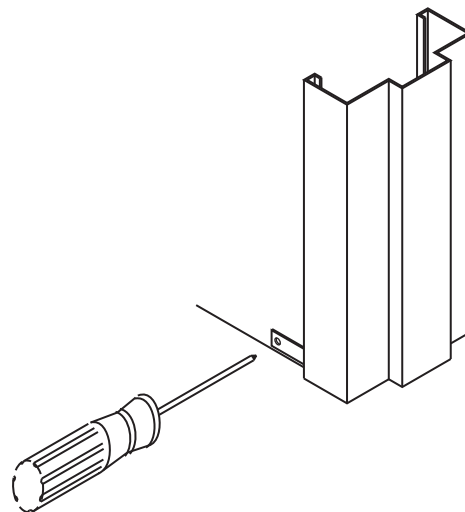


Figure 31 – Fasten base anchors to wall stud

12 Butted or Existing Steel or Wood Stud Wall Construction

12.1 Historically, frames installed in fire rated stud walls required frames to wrap around the wall and drywall must extend at least ½" (12.7 mm) into frame throat. Fire testing has

confirmed that fire door frames will perform satisfactorily to the acceptance criteria of UL 10C under positive pressure when butted to new or existing stud and drywall construction (see Figure 32 and Figure 33).

12.1.1 This installation has been incorporated into NFPA 80 as Figure A.6.3.1.3(a) and A.6.3.1.3(b).

12.1.2 Applicable Building Codes and individual manufacturers' product listings shall be consulted when these butted frames are used in fire rated walls.

12.1.3 This installation process DOES NOT apply to Slip-on Drywall frames in Section 11.

12.1.4 Listed fill, void or cavity material shall be used at the junction of frame faces and returns with the drywall surface. The bead of fill, void or cavity material shall be no wider than $\frac{1}{2}$ " (12.7 mm).

12.2 Assemble knock down frames per manufacturer's instructions.

12.3 Anchors are typically welded to frames and will either be a sleeve aligned with a countersunk hole or a plate between returns with an access hole and plug.

12.4 Assure that rough opening or opening between walls is plumb, square, and properly sized to fit overall frame dimensions and expansion capability of intumescent caulk or sealant. (See SDI 127F for further information).

12.5 Using a "stud finder" or similar tool, assure that studs will align with frame mounting screws.

12.6 Slide frame into wall opening; install wood spreaders at the floor and mid-height of opening.

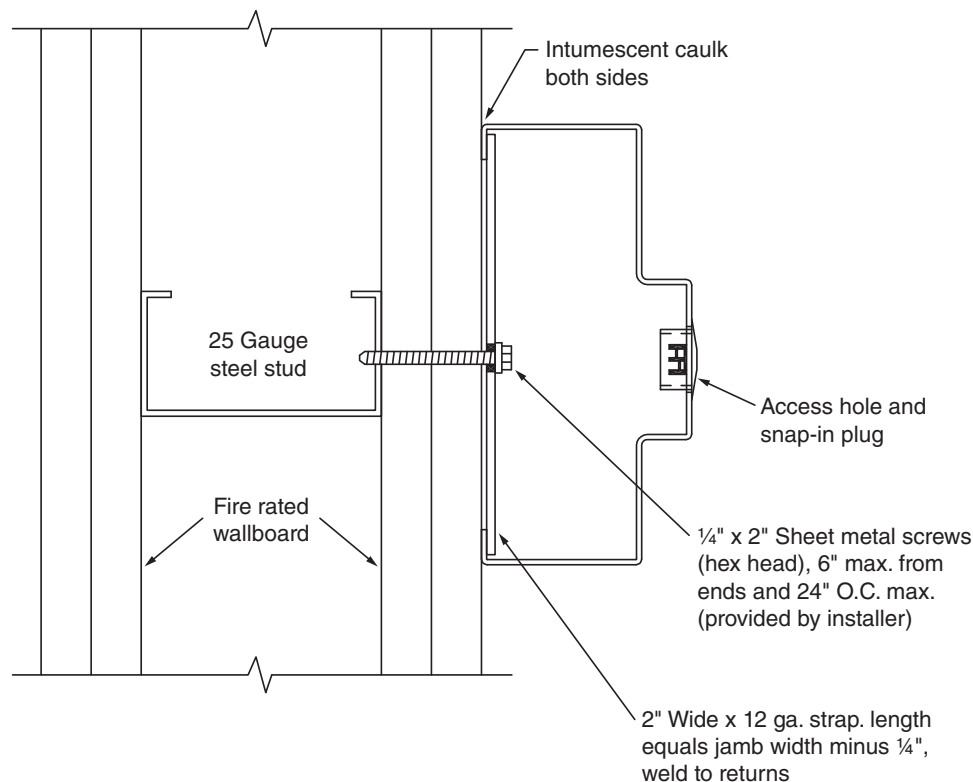


Figure 32 – Hole plug mount

12.7 Use tapered shims between anchors and wall and spreaders to maintain squareness and alignment of frame and to maintain door opening. Make sure that shims will not interrupt the sealant.

12.8 Insert $\frac{1}{4}$ " (6.4 mm) sheet metal screws of suitable length to engage studs through countersink or access hole in frame (see Figure 32 and Figure 33) and tighten securely. Check

for frame alignment periodically. (Frame profiles shown are for general details only. Anchors and profiles may vary).

12.9 Insert plugs to cover access holes if so equipped.

12.10 Install Listed intumescent caulk or sealant around perimeter of frame, making sure to cover any gaps caused by irregularities in walls.

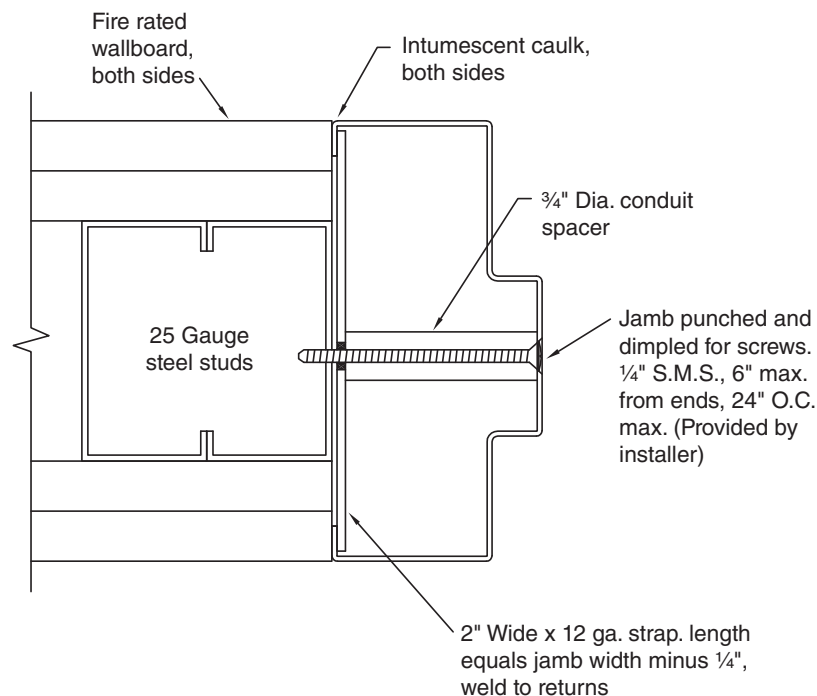


Figure 33 – Countersink mount

Annex A (informative)

Manufacturing Tolerances for Standard Steel Doors and Frames

A1 Introduction

It is the intent of this publication to inform users of standard steel doors and frames with definitive information regarding manufacturing tolerances. It is also intended to inform the installation contractor(s) of the tolerances to be considered to assure proper operation of the complete opening. It is intended for in-plant inspections. It may be used for on-site inspections where there is no evidence of damage to material or improper installation.

The information contained herein pertains to doors and frames manufactured in accordance with ANSI A250.8, *Recommended Specifications for Standard Steel Doors and Frames*. It is not intended to have reference to special or unusual door and frame conditions.

A2 Reference Documents:

ANSI/SDI A250.8-2003 (R2008) *SDI 100 Recommended Specifications for Standard Steel Doors & Frames*

ANSI/SDI A250.6-2003 (R2009) *Recommended Practice for Hardware Reinforcings on Standard Steel Doors and Frames*

ANSI/SDI A250.7-1997 (R2002) *Nomenclature for Standard Steel Doors & Steel Frames*

ANSI/SDI A250.3-2007 *Test Procedure & Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors & Frames*

ANSI/SDI A250.10-1998 (R2004) *Test Procedure & Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors & Frames*

ANSI/BHMA A156.115-2006 *Hardware Preparation in Steel Doors and Steel Frames*

ANSI/BHMA A156.115-W-2006 *Hardware Preparation in Wood Doors with Wood or Steel Frames*

ASTM A568-09 *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*

ASTM A653-10 *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM A924-10 *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process*

NFPA 80-2010 *Standard for Fire Doors and Other Opening Protectives*, 2007 Edition (National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269; www.nfpa.org)

SDI 122-07 *Installation and Troubleshooting Guide for Standard Steel Doors and Frames*

A3 Materials and Finishes

A3.1 Steel Thickness:

Manufacturers no longer order sheet and coil to a specific gage, but rather to a minimum decimal thickness. This thickness is the lowest of the range for a specific gage. The steel supplier is therefore permitted to exceed, but not be less than the specified decimal thickness. These minimum values meet the stringent requirements of both Underwriters Laboratories Inc. and ITS/Warnock Hersey. Examples of minimum allowable steel thickness:

Gage (MSG)	Minimum
20	0.032"
18	0.042"
16	0.053"
14	0.067"
12	0.093"
10	0.123"
7	0.167"

Gage (MSG) are for reference purposes only.

A3.2 Steel Coatings

Thickness of metallic coatings (generally zinc) are defined by ASTM A924, *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process* and A653, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*. The two most commonly used are designations A40 and A60. Minimum requirements for these designations are:

A40= 0.40 oz/ft² total both sides.

A60= 0.60 oz/ft² total both sides.

For reference, 1 oz/ft² = 1.7 mils thickness.

A3.3 Factory Applied Coatings:

Since factory applied coatings (primer, finish paint, etc.) are subject to performance standards rather than thickness, the dry film thickness is irrelevant. Such coatings must comply with performance criteria of:

ANSI/SDI A250.3 – *Test Procedure and Acceptance Criteria for Factory Applied Finished Painted Steel Surfaces for Steel Doors and Frames*

OR

ANSI/SDI A250.10 – *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*.

A4 Frame Tolerances

A4.1 Frame Cross Section Profile

Permissible tolerances in frame profile surfaces are as shown in Figure A.

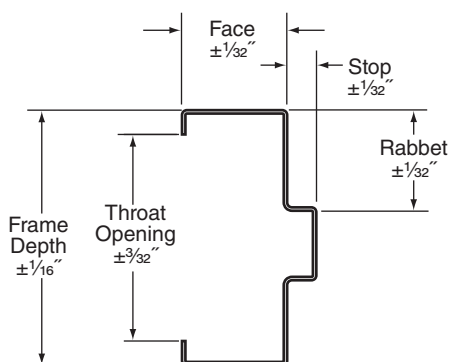


Figure A – Profile Tolerances

A4.2 Frame Opening & Vertical Locations

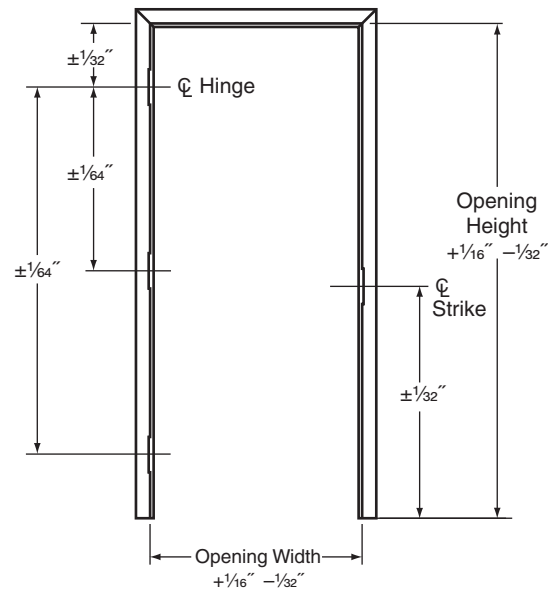


Figure B – Opening Tolerances

A4.3 Bow or Twist of Jambs or Header

Realizing that frames are somewhat “pliable”, and require bracing and alignment during installation, allowable deformation (bow, twist, etc.) of jambs or header of frame **prior to installation** shall not result in a reduction of opening sizes more than 1/16” beyond those shown in Figure B when measured at any point.

A4.4 Horizontal Alignment of Door Within Rabbet

Hinge and strike backsets shall allow the horizontal centerline of the door to be in line with the horizontal centerline of the frame rabbet $\pm 1/32$ ” **prior to installation**. Figure C is an example based on a 1 3/4” door in a 1 15/16” rabbet.

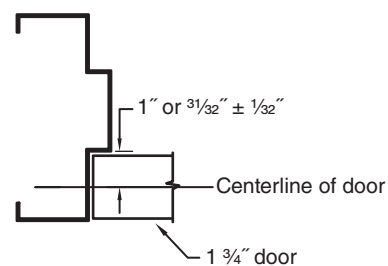


Figure C – Horizontal Alignment

4.5 Frames With Lights or Panels

Opening sizes (width or height) for side or transom lights or panels and for borrowed light frames shall be subject to a tolerance of $\pm 1/16$ " for each individual light or panel. These tolerances shall be non-accumulative so that the overall frame opening sizes are not increased by more than $1/8$ " (see Figure D).

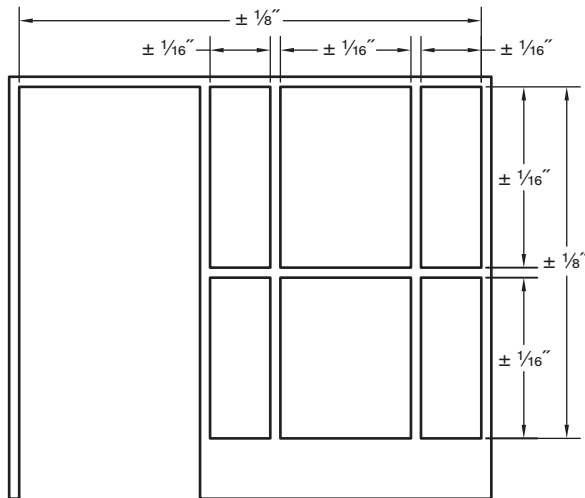


Figure D – Frames with Lights or Panels

A5 Door Tolerances

A5.1 Door Size, Thickness, and Vertical Locations (see Figure E)

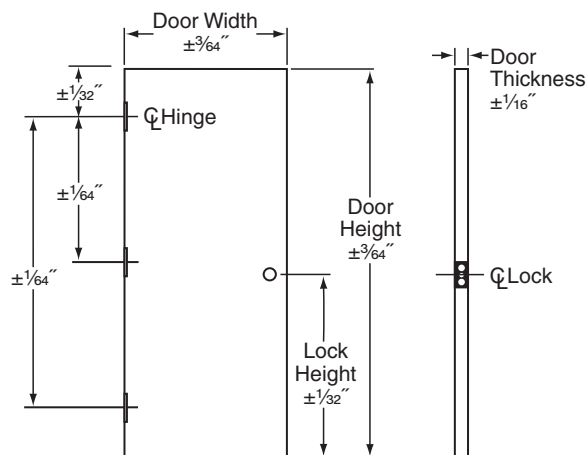


Figure E – Doors

A5.2 Door Squareness

When measured diagonally (see Figure F) from corner to corner along the same face, the measurements shall be within $1/16$ " of each other.

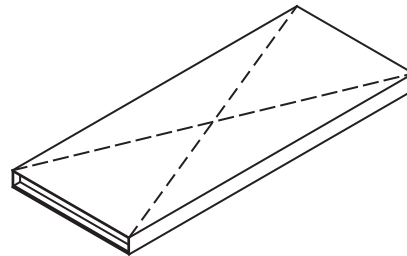


Figure F – Squareness

A5.3 Door Perimeter Flatness

When a suitable straightedge is laid against the door face at or within $1/4$ " of the top, bottom, hinge edge, and lock edge on both faces any deviation between the face and the straightedge shall not allow a 0.0625" rod or block to pass (see Figure G). **Note:** The straightedge shall be allowed to "rest" naturally on the door surface, not pulled down at one end to meet the door.

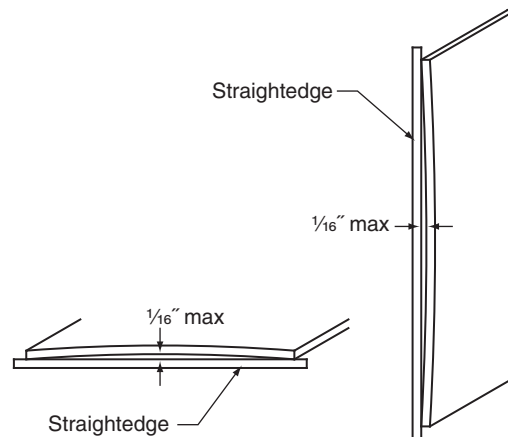


Figure G – Flatness

A5.4 Door Face Bow or Crown

When a suitable straightedge is laid diagonally against the door face at least $1/2$ " from corners any deviation between the face and the straightedge shall not allow a 0.125" rod or block to pass (see Figure H). **Note:** The straightedge

shall be allowed to “rest” naturally on the door surface, not pulled down at one end to meet the door.

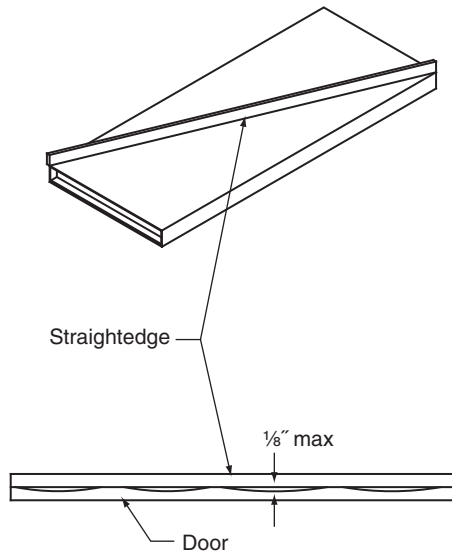


Figure H – Door face bow or crown

A5.5 Door Twist

The door is laid onto a suitable, flat fixture or surface that is free of any warp, bow, or twist. Support blocks of identical heights shall be

inserted between the fixture and the door face at all four corners of the door. Any deviation between the face and the support blocks shall not allow a 0.0625" rod or block to pass (see Figure I). Note: The door shall be allowed to “rest” naturally on the support blocks, not pulled down at any corner to meet the blocks.

A5.6 Doors With Lights or Panels

Opening sizes (width or height) for lights or panels cut into doors shall be subject to a tolerance of $\pm \frac{1}{16}''$ for each individual light or panel.

A6 Hardware Preparations

A6.1 Vertical Locations

Tolerances for vertical locations are as noted in Paragraphs A4.2 and A5.1.

A6.2 Horizontal Alignment

Tolerances for horizontal alignment of door and rabbet are as noted in Paragraphs 4.4.

A6.3 Mortise Depth

The depth of hardware items mortised into edges of doors (such as hinges, strikes, lock fronts, flushbolts) shall be as defined on manufacturer's templates and/or ANSI A156.115 documents subject to an additional tolerance of $\pm \frac{1}{64}''$

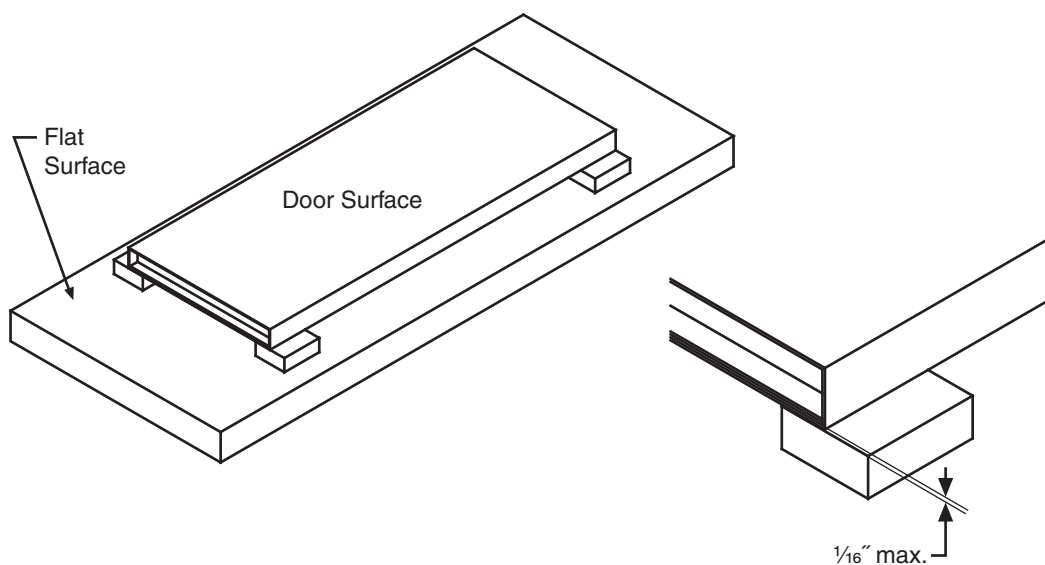


Figure I – Door Twist

A6.3.1 Cutout Depth at Frame or Door Faces

In order to allow for field adjustment, usually accomplished by shimming, hardware cutouts (such as hinges) that extend from door edges around to faces are allowed to exceed mortise depth by $\frac{1}{16}$ ". See Paragraph A7 for examples of common hinge shimming procedures.

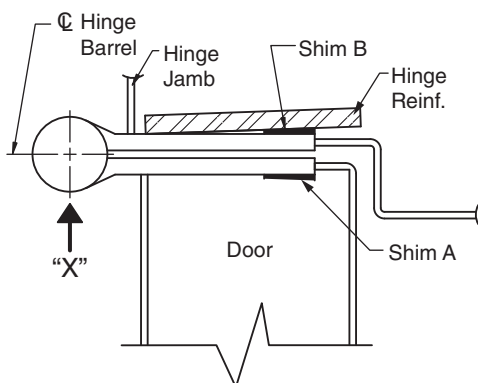
A6.3.2 Depth For Recessed or Concealed Hardware

The depth for hardware items recessed into top or bottom of doors or edges of doors (such as pocket pivots, floor closers, top pivots, concealed closers or holders, etc) shall be as defined on manufacturer's templates subject to an additional tolerance of $+\frac{1}{16}$ ", -0 ". Notches in door faces shall have similar tolerances.

A7 Frame Installation And Door Adjustments

A7.1 Adjusting Pivot Point by Shimming

Providing extra depth along door or frame faces allows for hinge knuckles to be offset, thus changing the pivot point of the opening.



- Using shim A only, door will be relocated in the direction of arrow "X".
- Using shim B only, will move both door and centerline of hinge barrel in direction of Arrow "X".
- Using both shims A and B will relocate the door in direction of Arrow "X" by a greater amount than by using shim "B" alone.

Figure J – Hinge Bind

Shims are usually thin strips of $\frac{1}{4}$ " wide material approximately equal to the hinge height.

A7.1.1 Figure J shows how to relocate the pivot point toward the jamb.

A7.1.2 Figure K shows how to relocate the pivot point away from the jamb.

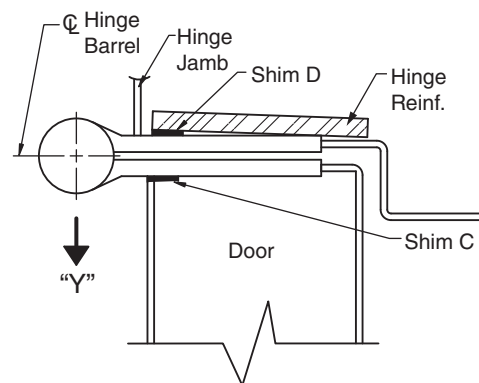
A7.2 Frame Installation Tolerances

While this document is mainly concerned with tolerances relating to the manufacturing process, openings will not function properly if the frame is not installed within recognized tolerances.

Figures L, M, N, and O show examples of the accuracy to be maintained while setting frames.

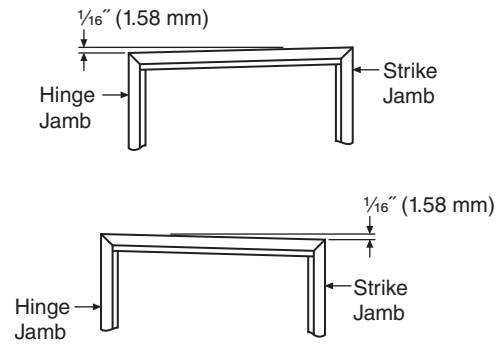
A7.3 Troubleshooting

Further information regarding corrective actions for of door & frame openings may be found in SDI-122.



- Using shim C only, door will be relocated in direction of Arrow "Y".
- Using D only, both door and centerline of hinge barrel will move in the direction of Arrow "Y".
- Using both shims C and D will relocate the door in direction of Arrow "Y" by a greater amount than by using either C or D alone. The centerline of hinge barrel will be relocated the same as by using shim D alone.

Figure K – Hinge Bind



Maximum $\frac{1}{16}$ " allowable tolerance on total opening.

Figure L – Squareness

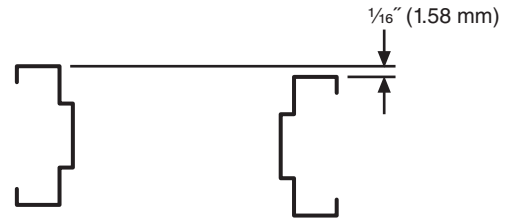


Figure N – Alignment

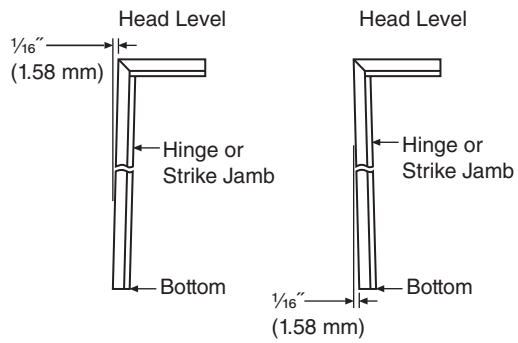


Figure M – Plumbness

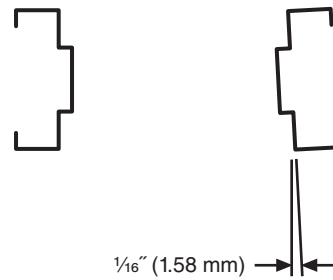


Figure O – Twist

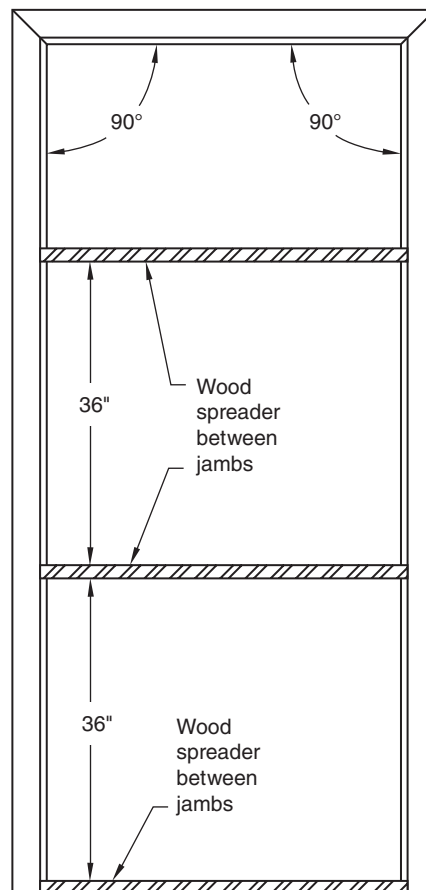
Annex B (informative)

Installation Exceptions

The installation instructions contained in ANSI A250.11 are intended to apply to most typical frame installations. There are, however, certain types of frames for which additional wood spreaders are recommended during the frame installation to ultimately assure the proper door operation.

Three-sided frames with face dimensions of 1-½" or less of any opening size, frames for doors that weigh over 9 lbs. per square foot and/or frames of heights greater than 8'-0" are more prone to variations in installed tolerances. Under most conditions, frames such as these require more support during the installation process.

For installations such as these, the SDI recommends the use of wood spreaders at the bottom of frames **AND** at 36" intervals between the top and bottom as indicated in the illustration below.



AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

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

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(Not applicable for FEMA 320/361 or ICC-500 Shelters)**

Secretariat

Steel Door Institute

Approved February 25, 2014

American National Standards Institute, Inc.

American National Standard

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Foreword (This Foreword is not part of American National Standard A250.13-2014)

The material contained in this document has been developed under the auspices of the Technical Committee of the Steel Door Institute.

Suggestions for improvement gained in the use of this standard will be welcome and should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, Ohio, 44145-1967.

The organizations that have approved this standard are as follows:

American Institute of Architects/ARCOM
Architectural Testing
Builders Hardware Manufacturers Association
Canadian Steel Door Manufacturers Association
Cedar Valley Associates
Door and Hardware Institute
Door Control Services
FM Approvals
HMMA/Division of NAAMM
Intertek Testing Services
National Wind Institute / Texas Tech
Steel Door Institute
Underwriters Laboratories LLC
Vetrotech / Saint Gobain
Therma-Tru

The Accredited Standards Committee A250 TC-1 developed this standard had the following personnel at the time of approval:

James Urban, Chairman
J. Jeffery Wherry, Secretary

<i>Organization Represented</i>	<i>Name of Representative</i>
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American National Standard

Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes (Not applicable for FEMA 320/361 or ICC-500 Shelters)

1 Scope

1.1 This standard provides procedures for testing and establishing load ratings (design pressure in pounds per square foot or design load in pounds force) for components of exterior swinging door assemblies for purposes of protection of openings in building envelopes during severe windstorm conditions, such as a hurricane, that produces sustained wind speeds or gusts in a range of 110 to 150 miles per hour as defined by ASCE 7. It is not intended to simulate wind forces generated by tornadoes. These products are for non-life safety installations and not for use in storm shelters. Life Safety/Shelter products must meet FEMA 320/361 and/or ICC-500.

1.2 The procedures cover all components normally assembled to form an exterior swinging door system. This includes door frames, hardware mullions, thresholds, frame anchorage, hinges, locksets, latches and bolts, doors, sidelights, transoms and glazing systems. This procedure applies to both single swing and pair assemblies and also includes procedures for testing and rating components for both in-swing and out-swing installations.

1.3 The evaluations required by this standard are based on the performance tests specified in ASTM E1886, ASTM E1996 and ASTM E330.

1.4 Evaluations under this procedure are designed to determine the ability of exterior doors to remain closed under conditions present in severe windstorms, including high, fluctuating wind speeds and the presence of wind-born debris. Assemblies meeting these requirements are less likely to open during a storm, preventing potentially large pressure differentials which may cause or contribute to major structural damage. This procedure does not consider it necessary for the door assembly to be capable of preventing water intrusion as a result of severe windstorm exposure conditions.

It is recognized that products and assemblies meeting these requirements will not necessarily prevent all forms of damage associated with hurricanes and other severe windstorms. It is also assumed that these assemblies themselves might be damaged in a severe windstorm to an extent that would require repair or replacement after such an event.

2 Definitions

Building Envelope: Windows, doors, curtain walls, wall and roof assemblies.

Classified: Products or materials of a specific group category that are constructed, inspected, tested and subsequently reinspected in accordance with an established set of requirements. The classification process is performed by an organization acceptable to the authority having jurisdiction.

Component: Any of several manufactured items, classified/listed and labeled, used in the construction and installation of a swinging door assembly. Components include door frames, doors, hardware, glazing systems and similar products normally supplied separately to a job-site where they are assembled and/or installed to form a complete assembly.

Design Load: The specified point force applied to a product. Units of measure are pounds force (lbf).

Design Pressure: The specified force applied to a specified unit area of product surface. Units of measure are pounds-force per square foot (psf).

Impact Energy (Kinetic Energy - KE): The specified dynamic load applied to a product. Units of measure are foot-pounds (ft-lbf).

In-Swing Door: A door with the push side on the exterior or that swings into the building when

opened. Negative pressure acts to close this door and positive pressure acts to open this door.

Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction (AHJ) and concerned with product evaluation, that maintains periodic inspections of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Listed: Equipment materials or services included in a list published by an organization that is acceptable to the Authority Having Jurisdiction (AHJ) and concerned with evaluation of products or services, that maintains periodic evaluation of services and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

Operable: Capable of being opened by the application of ordinary levels of applied force to the latch operator and door assembly.

Note: Door assemblies that have been subjected to the severe conditions of the tests involved in this method are not expected to be undamaged and thus will normally not operate with the low force levels generally required for undamaged assemblies. The goal is to provide an assembly that will remain closed during the windstorm, but not be damaged to the extent that it requires the use of tools to be opened after the event.

Out-Swing Door: A door with the pull side on the exterior or that swings away from the building when opened. Negative pressure acts to open this door and positive pressure acts to close this door.

Severe Windstorm: A weather event such as a hurricane that produces sustained wind speeds or gusts in a range of 110 to 150 miles per hour.

Stiffness Classification: A measure of a door's resistance to bending as determined by a twist test under a prescribed loading condition.

3 General

3.1 Units of Measurement

3.1.1 When a value for measurement is followed by a value in other units in parentheses, the second value is only approximate. The first stated value is the requirement. The primary units are inch-

pound. Appendix A contains a table of the Imperial values used in this standard and corresponding SI values.

3.1.2 Unless specifically indicated otherwise, tolerances shall be in accordance with Appendix A.

3.1.3 Where load ratings are to be applied in units of pounds per square foot (psf), these values shall be expressed in 5-pound-per-square-foot increments. For components that are rated in terms of pounds force, values shall be expressed in 10-pound increments. All rated values shall be determined by rounding down from values derived from tests.

3.2 Referenced Standards

3.2.1 ANSI/ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures*

3.2.2 ANSI/SDI A250.4-2011, *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings*

3.2.3 ASTM E330-02 (2010), *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*

3.2.4 ASTM E1886-05, *Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials*

3.2.5 ASTM E1996-12a, *Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes*

3.2.6 ASTM F476-84 (2002) *Standard Test Methods for Security of Swinging Door Assemblies*

3.2.7 ANSI/BHMA A156.1-2013, *Butts and Hinges*

3.2.8 ANSI/BHMA A156.16-2008, *Auxiliary Hardware*

4 Overview

4.1 The procedures in this document are designed to evaluate each critical component used in a swinging door assembly for the component's ability to perform its intended function. The evaluation is conducted under the conditions of stress and loading the component would be subjected to in the testing of a complete assembly under the

assembly test methods commonly specified for severe windstorm resistance.

4.2 The tests and evaluations required by this procedure include both the application of engineering safety factors and worst-case analysis to ensure that component substitutions in field assemblies will perform to the minimum levels expected.

4.3 Components evaluated by this method are classified into various strength categories that can be used to determine assembly ratings. A single component may have multiple ratings depending on various parameters such as size, number and location of anchors or fasteners, type of surrounding construction and other factors. Proper application of these ratings allows for the determination of an assembly's design pressure rating and minimum impact energy resistance. These ratings are intended to be used to determine compliance with code requirements developed for complete assemblies.

4.3.1 Doors are rated for design pressure in pounds per square foot (psf), impact energy in foot-pounds (ft-lbf) and stiffness classification. Stiffness is required in determining the interaction between the door bending under load, transmission of impact energy to latching hardware and frames, and latching engagement.

4.4 Proper application of this standard requires a basic level of understanding of physics, mechanics and materials science.

4.5 This procedure provides specific tests and rating methods for the following components:

Section 5 – Door Frames

Section 6 – Hinges

Section 7 – Latching Hardware

Section 7.1 – Locksets (Bored, Mortise, Deadbolts)

Section 7.2 – Single Point Rim or Mortise Exit Devices

Section 7.3 – Multi-point Latches (including flush and surface bolts)

Section 8 – Doors

Section 9 – Door Vision Light Kits

Section 10 – Sidelight and Transom frames

Section 11 – Miscellaneous Components

Section 11.1 – Hardware Mullions

Section 11.2 – Thresholds

5 Door Frames

5.1 Frames are to be evaluated in the largest door opening sizes, minimum jamb depth and minimum frame material thickness for which a design rating is to be determined. Frames intended for use in both single swing and pair assemblies shall be tested in both configurations. Frames are to be installed following the manufacturer's written instructions which are to include:

- a) Wall substrate – wood/steel stud, concrete, masonry, structural steel.
- b) Anchors – number, size, type and spacing of anchors, anchor or bolt embedment, and number and type of fasteners required at each anchor location.
- c) Reinforcements – location and attachment.
- d) Gasketing – location, type and attachment.
- e) Hinges – number, type, size and locations.
- f) Latching Hardware – type and location.

5.2 Test Procedure

5.2.1 Static Pressure Test

5.2.1.1 The frame shall be installed into a test unit constructed to simulate the wall design specified by the frame manufacturer. The frame installation shall be in accordance with the frame manufacturer's written instructions (refer to figure 1 for typical details). For wall designs that differ significantly from those shown, the test installation shall simulate actual intended wall design and anchorage.

A flush door rated for not less than the desired frame design pressure shall be mounted with the number of hinges specified by the frame manufacturer. For single-swing frames, a single-point simulated latch and a stainless steel strike shall be installed between 38" and 42" above the bottom of the frame (see figure 2.) The door and latching hardware shall be of sufficient strength so that they do not fail at the required test load. Door(s) shall be installed in the direction of swing for the desired listing.

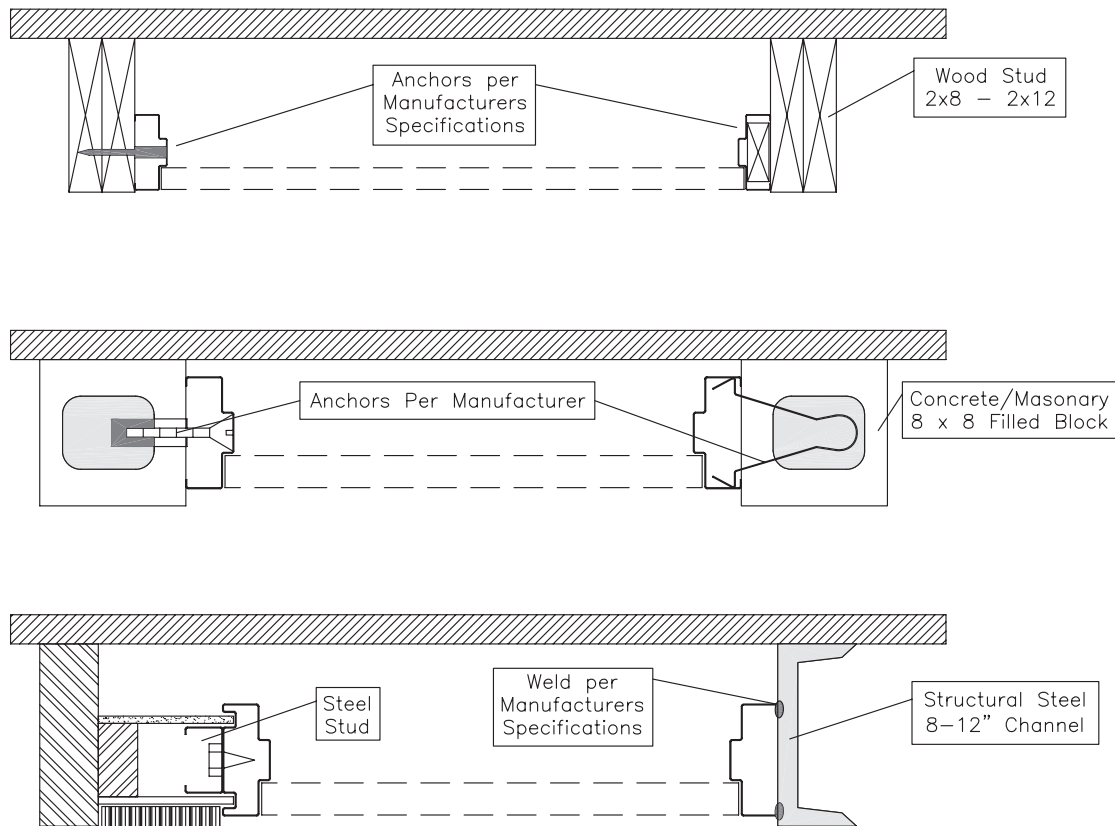


Figure 1 – Wall Substrates for Frame Tests

5.2.1.2 For pair frames, two flush doors rated for not less than the desired frame design pressure shall be installed with a simulated latching arrangement with a top and bottom bolt on the inactive door and a single point latch on the active door latching into the inactive door. The doors used are to be reinforced as described in 5.2.1.2.1 and latched as shown in figure 2.

If the manufacturer specifies other latch/lock locations, tests shall be conducted under specified conditions and the resulting rating shall specify the latching requirements.

5.2.1.2.1 The flush door used shall be reinforced along the latch or meeting edge by bolting a 1-1/4 inch by 1-1/4 inch by 3/16 inch structural steel angle to both faces of the door with 1/4-20 bolts at 16 (±) 1 inches on center and within 6 (±1) inches of the corners. The angle shall be placed such that the free leg of the angle is oriented toward the edge of the door and is located at 3 inches from the door latch edge (see figure 2).

5.2.1.3 The frame and door assembly shall be installed in a static pressure test chamber per the requirements of ASTM E330.

5.2.1.4 The assembly shall be subjected to a static pressure equal to 1.5 times the design pressure rating specified by the frame manufacturer under both positive and negative pressure. Each pressure cycle shall be applied for a minimum of 30 seconds, then released and reduced to zero.

5.2.1.5 At the conclusion of this test, the frame shall not prevent the door(s) from operating after the simulated latch bolt(s) has been retracted and a 15 pound force is applied at the mid-height of the door, horizontally 1 inch from the lock edge. The frame shall remain in the opening.

5.2.2 Impact Test

5.2.2.1 Upon completion of the static pressure test an identical assembly shall be subjected to impacts with an impact energy of 350 foot-pounds.

The impact energy shall be delivered by one of the following two methods:

Method 1 – Deliver impact energy by a 100-pound total weight pendulum impactor fitted with a number 2 or better, 12-inch-long Douglas Fir or Southern Yellow Pine, nominal 2 by 4 striking face. The pendulum is to be suspended in a manner that assures a direct normal impact to the door assembly. Refer to ASTM F476 for details of a comparable pendulum impact device (see figure 3).

Method 2 – Deliver the impact energy in accordance with the impact method defined in ASTM E1996 using a 9 pound 2 x 4 missile impacting end-on at a velocity of 50 feet per second.

5.2.2.2 Impacts are to be delivered to the exterior side of the door(s) per ASTM E1886. Impact locations as described below and as shown in figure 4).

5.2.2.2.1 Single Frames

Five impacts in accordance with Figure 4.

5.2.2.2.2 Pair Frames

Six impacts in accordance with Figure 4.

5.2.3 At the conclusion of this test, the frame shall not prevent the door(s) from operating after the simulated latch bolt(s) has been retracted and a 15-pound force is applied at the mid-height of the door, 1 inch horizontally from the lock edge. The frame shall remain in the opening.

5.3 Cycle Test

5.3.1 Upon completion of the impact tests specified in 5.2, the same assembly shall be subjected to the pressure cycling test specified in ASTM E1886.

5.3.2 At the conclusion of this test, the frame shall not prevent the door(s) from operating after the simulated latch bolt(s) has been retracted and a 15-pound force is applied at the mid-height of the door, 1-inch horizontally from the lock edge. The frame shall remain in the opening.

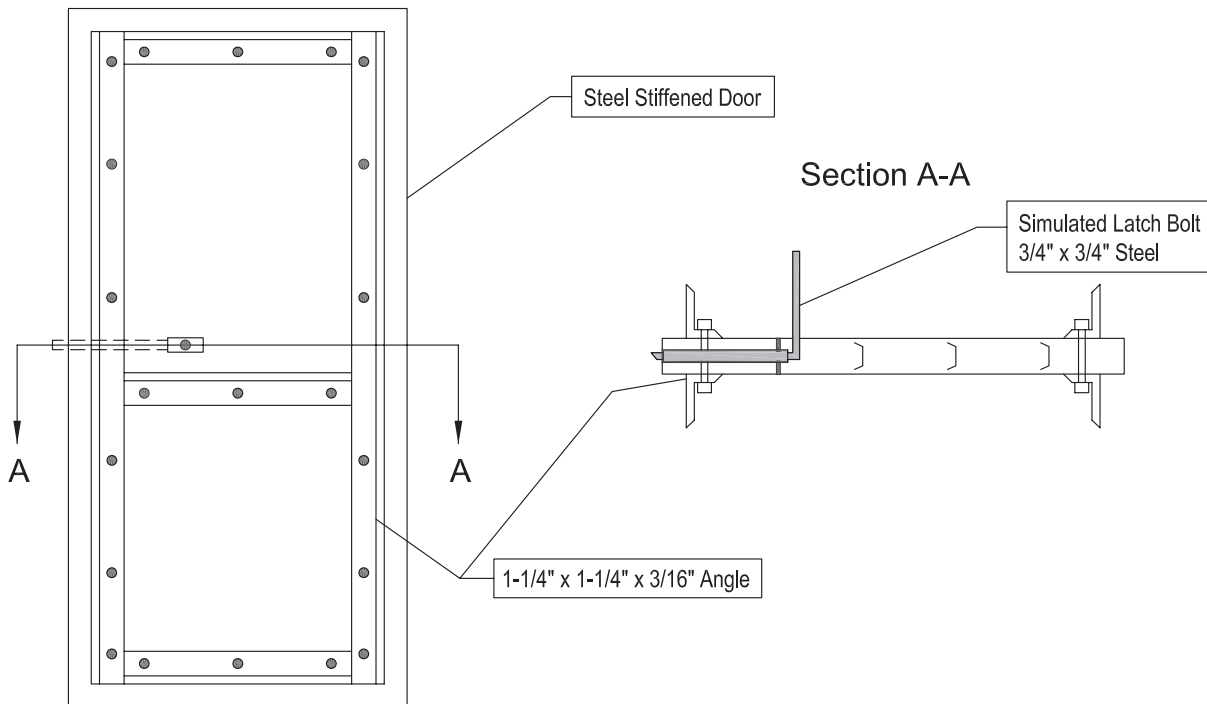


Figure 2 – Door Reinforcement for Frame Tests

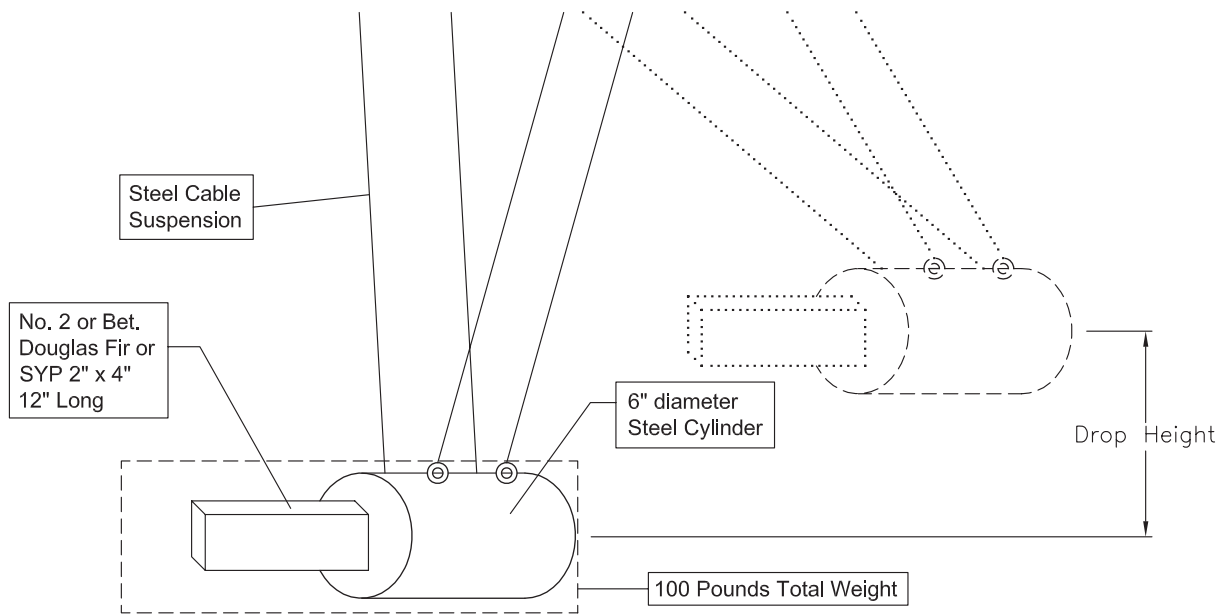


Figure 3 – Pendulum Impactor

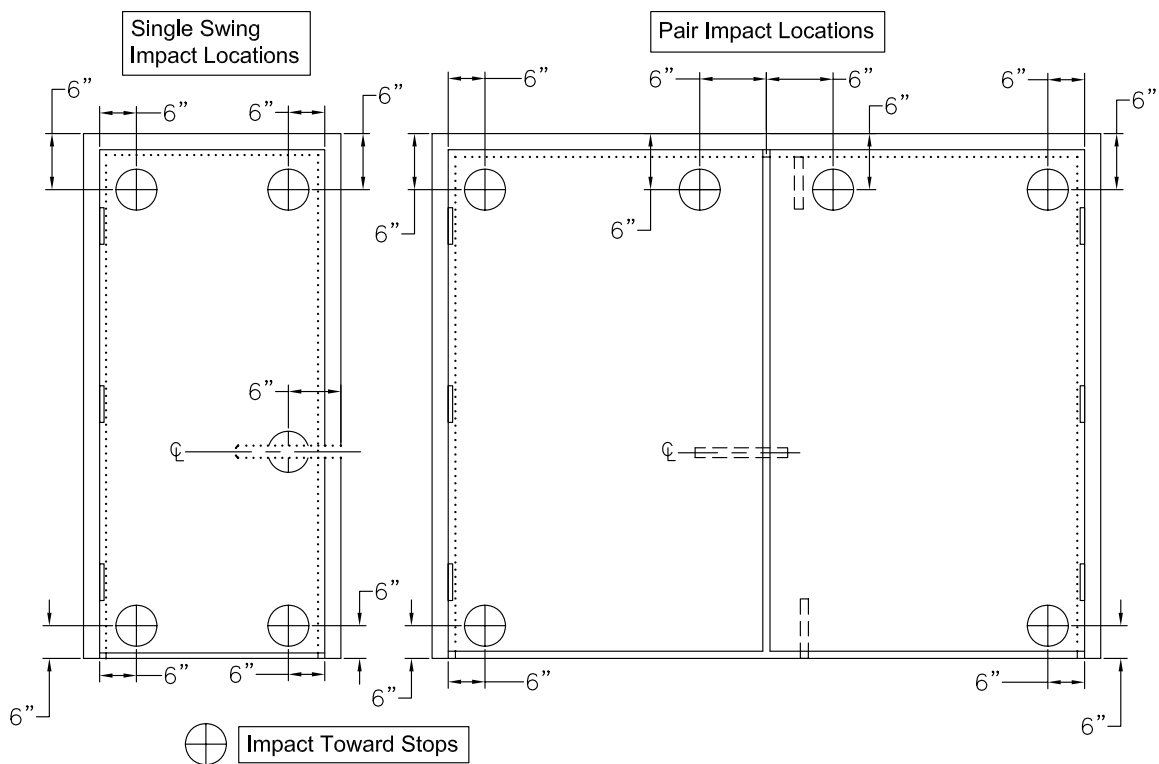


Figure 4 – Impact Locations for Frame Tests

5.4 Frame Ratings

5.4.1 Frames that meet the criteria specified in this section shall be rated for the design pressure attained in the evaluation and for impact energy resistance. Ratings shall be specific to positive and negative design pressure configuration (single/pair, in-swing/out-swing) and shall apply to all overall frame sizes (not to exceed either height or width of frame tested) equal to or smaller than the frame tested.

6 Hinges

6.1 Leaf Hinges

Three representative specimens shall be tested. Ratings shall be based on the lowest load successfully sustained by all three specimens.

6.1.1 Impact Test

6.1.1.1 Hinges shall be mounted for testing in the test fixture shown in figure 5. Hinges are to be mounted to the simulated frame and door sections using screws provided by the hinge manufacturer.

6.1.1.2 One 125 foot-pound impact shall be delivered to the simulated door section at a point 6

inches from the hinge centerline using the pendulum impactor specified in figure 3. Shearing of any fastener or deformation of the hinge which renders the hinge inoperable shall constitute a failure. The simulated door section shall be tested as an in-swinging door.

NOTE: Impact energy specified delivers approximately twice the energy to the hinge as occurs in a typical door assembly test using a 9 pound 2 x 4 missile at 50 feet-per-second.

6.1.1.2.1 Exception

Hinges listed only for use in out-swing door assemblies do not require an impact test.

6.1.2 Structural Load Test

6.1.2.1 The test assembly described in 6.1.1.1 shall be mounted in a testing machine and loaded at a rate of 0.05 inches per minute until failure. The load shall be applied through a 3/4-inch diameter roller and 1/4-inch thick by 3-inch wide steel plate in a manner that places the attachments in shear on the push side of the simulated door section. The load at failure shall be recorded.

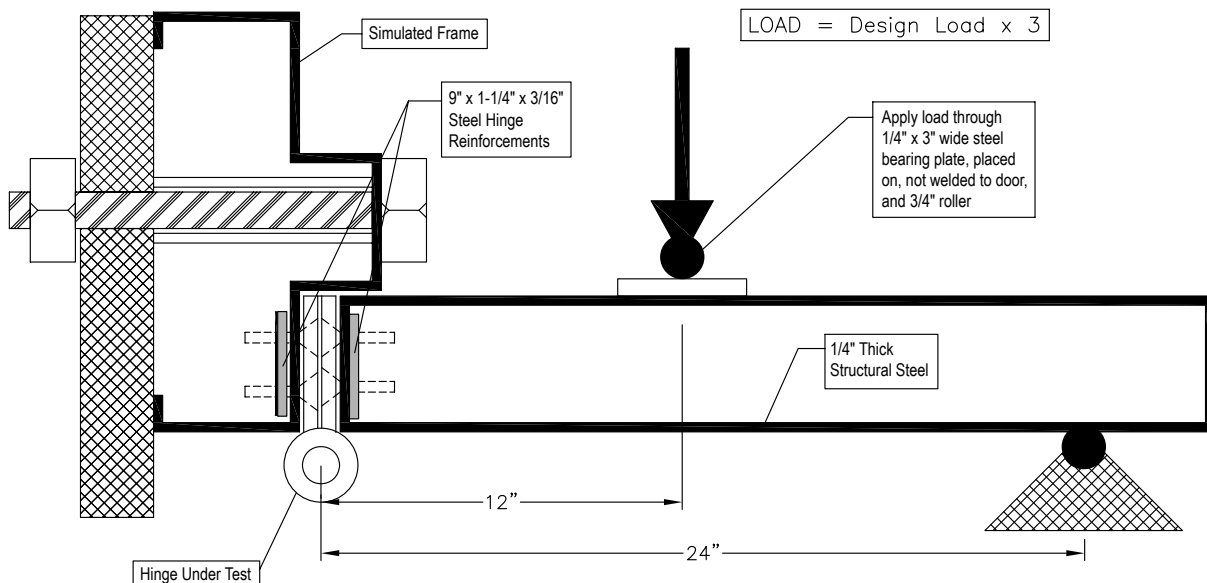


Figure 5 – Hinge Structural Load Test Fixture

6.1.3 Rating

6.1.3.1 Hinges shall be rated for a design load based on the lowest ultimate load value determined in 6.1.2.1, divided by a safety factor of 1.5.

6.2 Continuous Hinges and Pivots

6.2.1 Continuous hinges and/or pivots shall be tested in the maximum length with the minimum number of fasteners supplied by the manufacturer. Continuous hinges and/or pivots are to be tested applied to a simulated door as described in section 5.2.1.1 and a frame assembly designed to withstand the loads required to evaluate the hinge and/or pivots to the level required. A simulated frame constructed from 4-inch to 6-inch wide structural steel channel and with a solid steel stop 1-inch wide by $\frac{5}{8}$ -inch high is suitable for this purpose. Pivots and continuous hinges shall be tested using the maximum size of door for which a rating is desired.

6.2.2 Static Pressure Test

6.2.2.1 Apply a pressure equal to 1.5 times the hinge manufacturer's specified design pressure per ASTM E330 in both positive and negative directions. Hold each load for a minimum of 30 seconds, then release.

6.2.3 Impact Test

6.2.3.1 Using either the same assembly used for the static pressure test or an identical assembly, at the manufacturer's option, conduct three impact tests using one of the impact test methods described in 5.2.2.1 at the following locations against the push side of the door.

6.2.3.1.1 Impact 6 inches down from the top and 6 inches horizontally from the hinge edge of the door.

6.2.3.1.2 Impact the mid-height of the door 6 inches from the hinge edge.

6.2.3.1.3 Impact 6 inches up from the door bottom and 6 inches from the hinge edge.

6.2.4 Cycle Test

6.2.4.1 Upon completion of the impact tests, the same assembly shall be cycled per ASTM E1886.

6.2.5 Throughout the tests described in section 6.2 the door shall remain secured in the frame and shall be operable at the conclusion of the tests.

6.2.6 Rating

6.2.6.1 Continuous hinges and pivots shall be rated for the impact energy resistance in foot-pounds and design pressure in pounds per square foot and maximum size, based on the tested assembly size for which they successfully complete the required testing.

7 Latching Hardware

7.1 Locksets

7.1.1 Impact Test

7.1.1.1 Locksets shall be mounted in the test fixture described in figure 6. Mounting shall be in accordance with the lock manufacturer's instructions. Locksets are to be in the locked mode for all tests.

7.1.1.2 Strikes shall be mounted to the simulated frame section using the screws provided by the lock manufacturer.

7.1.1.3 One 125 foot-pound impact shall be delivered to the test fixture (push side) at a point 6 inches from the simulated door edge using the pendulum impactor specified in figure 3. If the lockset handle or other parts are in the indicated impact area, the impact location shall be moved upward sufficiently to avoid hitting the parts.

NOTE: Impact energy specified delivers approximately twice the energy to the latch as occurs in a typical door assembly test using a 9 pound 2 x 4 missile at 50 feet-per-second.

7.1.2 Structural Load Test

7.1.2.1 Upon completion of the impact test specified in section 7.1.1, the test fixture and the same specimen (figure 6) shall be mounted in a testing machine. A load shall then be applied equal to 1.5 times the manufacturers' designated design load. The load shall be applied through a $\frac{3}{4}$ -inch roller and $\frac{1}{4}$ -inch by 3-inch steel loading plate of sufficient width to span the simulated door portion of the test fixture. This load shall be held for 30 seconds and then released.

7.1.2.2 Upon completion of the structural test the lockset shall be operable.

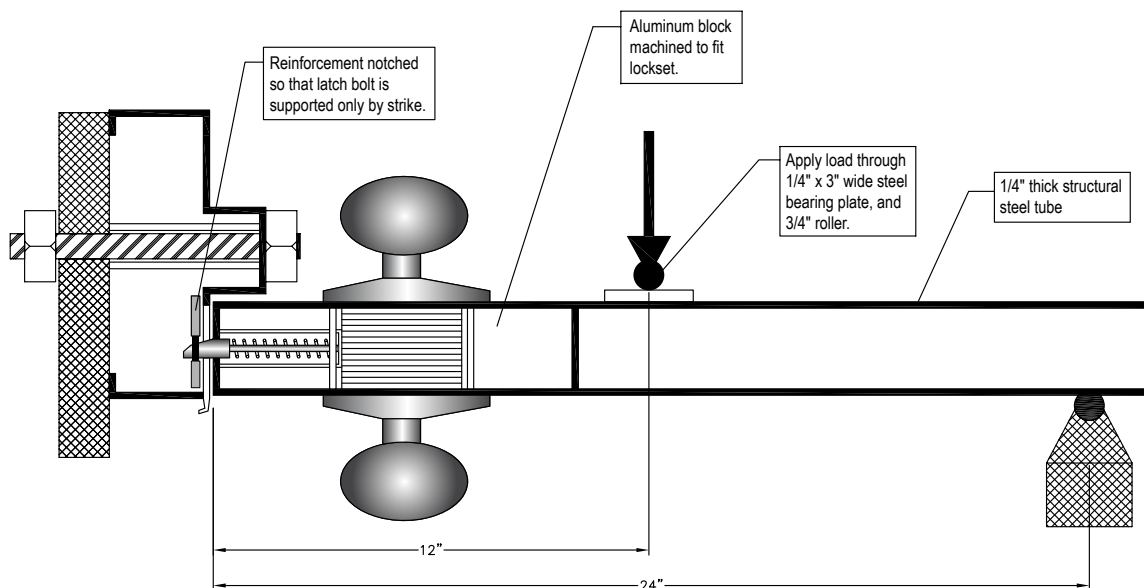


Figure 6 – Lockset Test Fixture

7.1.3 Lockset Rating

7.1.3.1 The lockset rating shall be the design load and impact energy specified by the manufacturer and verified by acceptable results in the impact and structural load test described in this section.

7.2 Single Point Rim and Mortise Exit Devices

7.2.1 Single point rim and mortise exit devices shall be mounted on a door of the stiffness classification and maximum size for which a rating is to be determined. Mounting shall be in accordance with the device manufacturer's instructions.

7.2.2 Impact Test

7.2.2.1 One 350 foot-pound impact shall be delivered to the pull side of the door using one of the impact test methods described in section 5.2.2.1. If hardware location interferes with the specified locations for impacts the impact shall be located as close to the specified location as possible in a manner that avoids impact on the hardware.

7.2.2.2 Upon completion of the impact tests the door shall remain latched and the single point rim or mortise exit device shall be operable.

7.2.3 Static Pressure Test

7.2.3.1 Upon completion of the impact tests specified in 7.2.2.1, the same assembly shall be mounted in a static pressure test chamber and tested per ASTM E330.

7.2.3.1.1 Apply 1.5 times the manufacturer's specified design pressure to the push side of the door. Hold for a minimum of 30 seconds and release.

7.2.3.1.2 Upon completion of the test the single point rim or mortise exit device shall be operable.

7.2.4 Rating of Single Point Rim and Mortise Exit Devices

7.2.4.1 Single point rim or mortise exit devices shall be rated for the design pressure in pounds per square foot, impact energy resistance in foot-pounds, maximum pair or single door leaf size, and door stiffness classification specified by the device manufacturer and verified by acceptable results in the impact and structural load test described in this section.

7.3 Multi-Point Latches

7.3.1 Multi-point latches shall be mounted on the maximum size pair of the minimum stiffness class doors specified by the manufacturer for testing.

Note: Since many exterior doors are used as a required “means of egress”, building codes do not generally allow the use of additional manual bolts and locks on these doors. That is, it must be possible, under emergency conditions, for these doors to be opened with a single manual operation. The use of auxiliary latching devices as a means of increasing the windstorm resistance rating of an assembly should be verified for acceptability under prevailing building code requirements.

7.3.2 Impact Test

7.3.2.1 The door containing the device under test (active leaf) shall be subjected to three 350 foot-pound impacts using one of the impact test methods described in Section 5.2.2.1 to the pull side of the door. One impact is to be made at the upper meeting edge of the door 6 inches below the top edge of the door and 6 inches from the meeting edge. The second impact is to be made at the lower meeting edge of the door 6 inches above the bottom and 6 inches from the meeting door edge. The third impact is to be made at the center of the door opposite and 5 inches below the push bar. If hardware location interferes with the specified locations for impacts the impact shall be located

as close to the specified location as possible in a manner that avoids impact on the hardware.

7.3.2.2 When other hardware is being evaluated simultaneously with bolts (surface or flush type) to increase the overall rating, then a fourth impact is to be made at the centerline of the other hardware and 6 inches from the meeting door edge.

7.3.2.3 Upon completion of the impact tests the multi-point latch shall be operable.

7.3.3 Static Pressure Test

7.3.3.1 Upon completion of the impact test, the same assembly shall be tested on the impact assembly or mounted in a test chamber and tested per ASTM E330 under uniform static pressure.

7.3.3.2 Starting at the design pressure specified by the manufacturer, apply the pressure in 5 psf increments in both positive and negative directions until failure occurs. Each pressure increment shall be held for a minimum of 10 seconds in each direction.

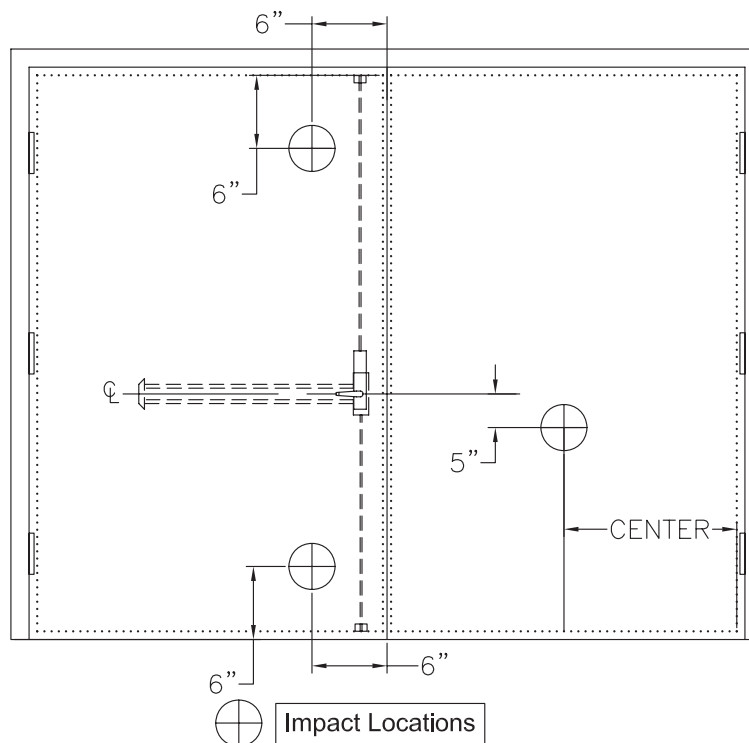


Figure 7 – Impact Locations for Multi-Point Latch Test

7.3.3.3 After each pressure increment, remove the pressure and check the hardware for operability. One pressure increment consists of both a positive and negative pressure.

7.3.3.4 Record mode of failure and pressure increment at failure.

7.3.4 Multi-Point Latch Rating

7.3.4.1 Multi-Point latches shall be rated for the design pressure in pounds per square foot, impact energy resistance in foot-pounds, maximum pair or single door leaf size, and door stiffness classification specified by the device manufacturer and verified by acceptable results in the impact and structural load test described in this section as follows:

7.3.4.1.1 For pairs of doors with four or more points of latching, the design pressure is the maximum test pressure increment that did not result in failure as determined by 7.3.3.3 divided by a safety factor of 1.5.

7.3.4.1.2 For pairs of doors with single point latching on the active leaf and multi-point latching on the inactive leaf as described in 7.3.2.1, the design pressure is the maximum test pressure increment that did not result in failure as determined by 7.3.3.3 divided by a safety factor of 1.5.

7.3.4.1.3 For pairs of doors with single point latching on the active leaf and multi-point latching on the inactive leaf as described in 7.3.2.2 with surface or flush bolts per ANSI/BHMA A156.16 Auxiliary Hardware, mounted on the inactive leaf, the design pressure is the maximum pressure increment that did not result in failure as determined by 7.3.3.3 divided by a safety factor of 3.0.

8 Doors

8.1 Doors shall be tested in the largest size (overall area, greatest width, greatest height) for which a design pressure rating is to be applied. Requirements for framing systems or other reinforcements in doors shall be specified as defined in the manufacturer's follow-up inspection procedures. All doors of the same design with smaller dimensions shall be given the same rating as the test door(s).

8.2 Stiffness Classification

8.2.1 Doors shall be classified for stiffness by performing the following twist test on a 3'0" by 7'0"

sample of the full flush panel (no hardware preparations) door construction under investigation.

8.2.1.1 Mount the door panel in a rigid test frame and clamp the bottom two corners and one top corner securely to the frame.

8.2.1.2 Apply a load of 300 lbf through a 2.5 inch diameter by 1/4-inch thick steel pad to a point centered 3 inches down and 3 inches horizontally from the free corner of the door per ANSI A250.4.

8.2.1.3 Measure the door deflection at the free corner, as described in ANSI A250.4, to the nearest 0.01 inch.

8.2.2 Classifications

8.2.2.1 Doors shall be classified for stiffness as follows in Table 1 based on the results of the twist test.

Table 1 – Stiffness Classification

Corner Deflection	Stiffness Class
≤ 0.5 inch	I
> 0.5 inch and ≤ 1.0 inch	II
> 1.0 inch and ≤ 2.0 inches	III
> 2.0 inches and ≤ 3.0 inches	IV
> 3.0 inches	V

8.3 Assembly Tests

8.3.1 Doors shall be installed in each assembly configuration for which a rating is to be determined. The following list shall be used to select the test configurations.

8.3.1.1 Single-swing with cylindrical single-point latch.

8.3.1.2 Single-swing with mortise single-point latch.

8.3.1.3 Single-swing with rim or mortise exit device.

8.3.1.4 Pairs of doors swinging in the same direction with 4-point latching – surface rods.

8.3.1.5 Pairs of doors swinging in the same direction with 4-point latching – concealed rods.

8.3.1.6 Pairs of doors swinging in the same direction with 3-point latching – surface rods by cylindrical latch.

Table 2 – Example Door Rating Data

Door Model: 1234		Stiffness Class II			
Configuration	Maximum Size	Latch Throw Min. (in)	Latch Strength Min. (lbf)	Impact (ft-lbf)	Design Pressure (psf)
Single Out-swing (cylindrical)	4-0 x 8-0	1/2	1600	350	100
Single In-swing (mortise)	4-0 x 8-0	1/2	1600	350	100
Single Out-swing (Rim)	3-0 x 8-0	(1)	(1)	350	80
Pair w/ 4-Point (CVR by CVR)	8-0 x 8-0	(1)	(1)	350	80
Pair w/ 3-Point	8-0 x 8-0	(1)	(1)	350	80
Pair w/ 4-Point (CVR by CVR)	6-0 x 7-0	(1)	(1)	350	140
(1) Components are rated in design pressure (psf) not latch strength (lbf)					

8.3.1.7 Pairs of doors swinging in the same direction with 3-point latching – flush bolts or CVR by mortise latch.

8.3.1.8 Pairs of doors swinging in the same direction with 3-point latching-mortise exit device by surface or concealed exit device.

8.3.1.9 Pairs of doors swinging in the same direction with 2-point latching – rim exit device with removable mullion.

8.3.2 A minimum of 3 assemblies shall be tested for single-swing configurations and a minimum of three assemblies shall be tested for pair configurations. Latching hardware configurations can be varied between the individual assemblies to provide coverage per 8.3.1. This includes combining surface and concealed-rod type hardware in one pair assembly to cover configurations from 8.3.1.4 and 8.3.1.5. The resulting ratings will be determined separately for pair and single-swing configurations. When the three assemblies of one swing type vary, the rating for the door is to be based on the highest design pressure test passed by all three assemblies.

8.3.3 Qualifying Doors for Vision Light Kits – Where doors are to be qualified to receive light kits, at least one assembly shall be tested with maximum light kit size desired. This assembly shall be an assembly or at least one of the assemblies from 8.3.2. Multiple light kit designs and sizes may be tested for multiple ratings. The rating for the door is to be based on the highest design pressure test passed by the glazed assembly, but shall not exceed the rating of the opaque assemblies.

The largest size (maximum area, height, and width of exposed light) of the light kit and the minimum stile and rail dimensions shall be defined. Requirements for framing systems or other reinforcements in doors shall be specified as defined in the vision light kit manufacturer's follow-up inspection procedures.

8.3.4 Doors are to be tested installed in frames using latching hardware and hinges with a design pressure rating greater than or equal to the specified design-pressure rating of the door.

8.3.5 Assemblies which incorporate manual surface bolts or other latching hardware intended only for use in severe storm conditions (hurricanes) shall be evaluated for design pressure strength per ASTM E330 with the additional hardware engaged. The ratings for such assemblies shall indicate design pressure for the assembly with the additional hardware.

8.4 Test Procedure

8.4.1 Each assembly configuration shall be tested to 1.5 times the design pressure per ASTM E330.

8.4.2 Each assembly shall be tested to impact and cyclic load tests as specified in ASTM E1886 and ASTM E1996. (At the discretion of the test sponsor the same or an identical assembly shall be permitted for the structural test.) For doors designated by the manufacturer as either in-swing only or out-swing only, the impact test shall be conducted only from the outdoor side of the assembly. For doors designated as either in-swing or out-swing, the impact tests shall be conducted from the out-

side (push side) of in-swinging assemblies on two samples and from the outside (pull side) of an out-swinging assembly on the third sample.

8.4.3 Assemblies shall remain closed and latched during the tests specified and the active leaf shall be operable at the conclusion of the tests.

8.5 Ratings of Doors

8.5.1 Ratings of doors shall include the following information (see Table 2):

1. Maximum Size;
2. Stiffness Classification;
3. Design Pressure Rating for each configuration type; (this provides consistency in language);
4. Impact Energy Resistance Classification;
5. Minimum Latch Throw for single point lock sets;
6. Minimum Latch Strength for single point lock sets.

9 Door Light Kits

9.1 Door vision light kits shall be evaluated as complete glazing systems designed for installation into specific doors. These doors shall have been qualified to receive light kits in accordance with paragraph 8.3.3. Glazing systems shall include all parts necessary to install the glazing in the door. This shall normally include at least a glazing panel, frame, sealant or glazing compound and fasteners. Requirements for framing systems or other reinforcements in doors shall be specified as defined in the vision light manufacturer's follow-up inspection procedures.

9.1.1 Glazing systems shall be tested in the largest size (maximum area, height, width of exposed light) to be rated in the smallest standard door size (minimum 3'0" x 7'0") that can accommodate the glazing system.

9.1.2 Alternately, glazing systems shall be tested as part of door assemblies as defined in paragraph 8.3.3. In this case, the largest size (maximum area, height, and width of exposed light) of the light kit and the minimum stile and rail dimensions shall be defined.

9.2 Test Procedure

9.2.1 Static Pressure Test

9.2.1.1 Each assembly configuration shall be tested to 1.5 times the design pressure, per ASTM E330.

9.2.1.2 Install the glazing system into the type and size of door specified by the glazing system manufacturer. Three identical assemblies are required. The doors shall be mounted in frames and bucks as required for the standard door test procedure.

9.2.2 Impact Test

9.2.2.1 Test the assembly per ASTM E1886 with the impacts required applied to the center and one corner of the glazing panel in each assembly.

9.2.3 Cycle Test

9.2.3.1 Cycle test each assembly per ASTM E1886.

9.2.3.2 Upon completion of the impact and cycle tests there shall be no failure of the glazing system as defined in the referenced standard ASTM E1996.

9.3 Glazing System Ratings

9.3.1 Glazing systems shall be rated at the design pressure used in the evaluation and shall include specific doors, minimum door size, and maximum glazing dimensions (maximum area, maximum height and maximum width).

10 Sidelights and/or Transoms

10.1 Sidelights and/or transoms shall be tested with doors, to the largest total size (maximum area, height and width) to be rated. Testing shall be performed in accordance with ASTM E1886 and ASTM E1996. Doors used in the evaluation assembly shall be rated per this method for at least the design pressure specified for the side-light/transom assembly.

10.2 Installation of sidelight and/or transom assemblies shall be per manufacturer's instructions. Frames for these assemblies shall be evaluated for installation in each wall type for which the product is intended. Installation instructions shall include: glazing material, sealants or glazing compounds, installation procedures, and details of frame anchoring methods.

10.3 Ratings for Sidelight and/or Transom Assemblies

10.3.1 Sidelight and/or transom assemblies that meet the criteria specified in this section shall be rated for the design pressure attained in the evaluation and for impact energy resistance. Ratings shall be specific to positive and negative design pressure configuration (single/pair, in-swing/out-swing) and shall apply to all overall assembly sizes (not to exceed either height or width of assembly tested) equal to or smaller than the assembly tested.

11 Miscellaneous Components

11.1 Center Mullions Prepared for Hardware

11.1.1 Center mullions prepared for hardware shall be tested at the maximum height specified by the manufacturer. Install the mullion in a frame of the maximum width for which a rating is desired following the manufacturer's instructions. Doors

used for this test shall be stiffened as described in section 5.2.1.2.1, except that surface applied reinforcements are to be removed in areas required for mounting the latching device. Doors are to be equipped with rim exit devices or other hardware as specified by the manufacturer.

11.1.2 Static Pressure Test

11.1.2.1 Load the assembly to 1.5 times the design pressure in accordance with ASTM E330 in both positive and negative directions. The pressure load shall be maintained for a minimum of 30 seconds.

11.1.3 Impact Test

11.1.3.1 On the same assembly used in the structural test or an identical assembly, at the manufacturer's option, apply four impacts of 350 ft-lbf using one of the impact test methods described in section 5.2.2.1. One impact is to be applied at the meeting edge of the doors 6 inches down from the head jamb. The second impact is to be applied at the meeting edge of the doors 6 inches up from

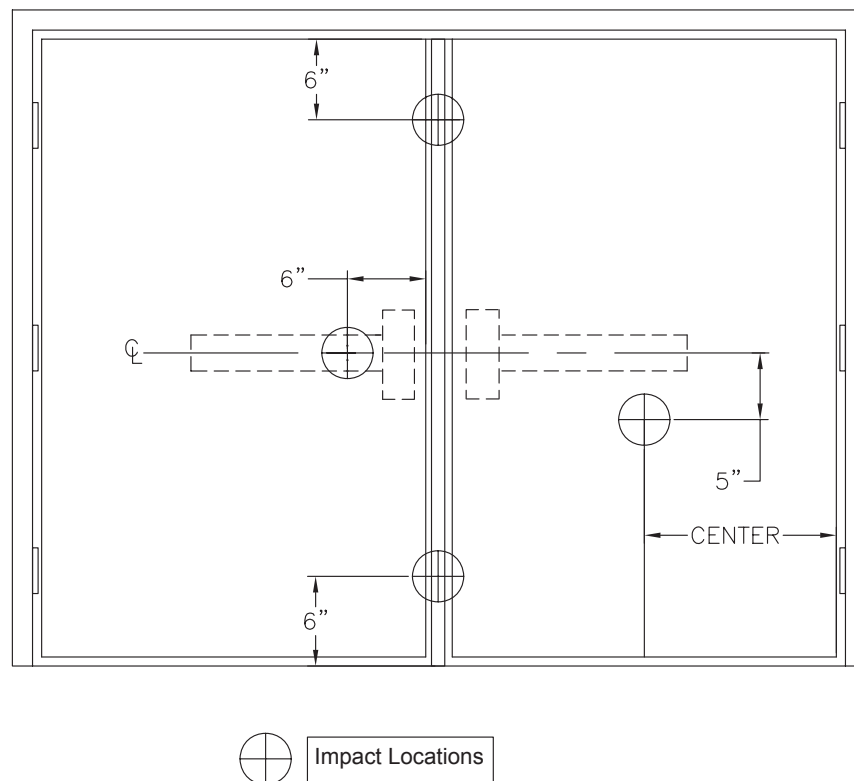


Figure 8 – Impact Locations for Center Mullion Test

the sill and the third impact applied at the centerline of the latch and 6 inches horizontally from the latch edge of the door. Apply a fourth impact at the center of the other door 5 inches below the latch. Upon completion of the impact tests, conduct cycle testing as specified in ASTM E1886. At the completion of these tests the hardware mullion shall remain in place and the door assembly shall be operable.

11.1.4 Hardware mullions shall be rated for the impact energy successfully passed and for the design pressure tested in the static pressure and cycle tests.

11.2 Thresholds

11.2.1 Thresholds are only evaluated for their ability to retain latch bolts and strikes and remain secured to underlying construction when subjected to anticipated structural and impact energy loads.

11.2.2 Thresholds are to be tested in conjunction with hardware mullions as described in section 11.1 when applicable. Thresholds that are designed for direct attachment of latching devices shall be tested as follows.

11.2.3 Thresholds shall be tested at the maximum door opening width to which the resulting rating is to be applied. Thresholds shall be installed in a test assembly using a frame and stiffened doors (per 5.2.1.2.1) known to be capable of sustaining the required test pressure. Thresholds shall be attached to a simulated floor using the number, size and location of fasteners specified by the manufacturer. The set-up shall be for single-point latching on the active leaf and two-point latching on the inactive leaf with the bolt and strike specified by the manufacturer.

11.2.4 Static Pressure Test

11.2.4.1 The test assembly shall be subjected to 1.5 times the design pressure specified by the manufacturer in both positive and negative directions as required by ASTM E330. The pressure in each direction shall be maintained for a minimum of 30 seconds.

11.2.5 Impact Test

11.2.5.1 The same assembly or an identical assembly which has not been subjected to the 1.5 times design load test shall be used for this test at the manufacturer's option. Impacts (350 ft-lb) shall be applied using one of the impact test methods

described in section 5.2.2.1 to a location on the centerline of any latching device that engages into the sill at a point 6 inches up from the sill. If the assembly includes two latching locations, two impacts are required.

11.2.6 Cycle Test

11.2.6.1 The same assembly used for the impact test in 11.2.3 shall be subjected to the cyclic pressure test prescribed by ASTM E1886.

11.2.7 Upon completion of these tests, the door assembly shall be operable and the threshold shall remain in place.

11.2.8 Thresholds shall be rated for the impact energy successfully passed and for the latching load established in the structural load and cycle tests. Latching load (lbf) shall be calculated as design pressure (psf) times the area (square feet) of the opening divided by 4 (the equivalent of one-quarter of the total load).

12 Selection Criteria

12.1 The following process is used to determine Swinging Door Assembly Ratings for Severe Windstorm Resistance from Component Ratings.

12.1.1 The first step in determining if an assembly meets a code requirement for severe windstorm resistance is for the building designer to determine the required performance level for the opening. This shall include a calculation of the required minimum design pressure in pounds per square foot and the determination of whether or not impact resistance is required. In most cases ASCE 7 is specified by the applicable building code and requires a thorough analysis of the building design and location to determine design pressure for each opening. State and local building codes will generally specify when impact resistance is required and at what level.

12.1.2 If impact resistance is required, each component of the opening shall have an impact rating equal to or greater than the impact energy required for the opening.

12.1.3 Determine the wall construction type for the opening (masonry, wood frame, steel, etc.). The selected frame and anchorage method must meet or exceed the design pressure and impact energy requirements for the opening. The size at which

the frame is rated must be equal to or greater than the size requirement for the opening.

12.1.4 Determine the type of hinge needed for the application. Leaf and butt hinges are expressed in lbs force. To select leaf or butt hinges, multiply the design pressure by the tributary area in square feet for each hinge to determine the required hinge design load in pounds force (lbf). Select a hinge that meets or exceeds the design load and impact energy requirements for the opening (see examples in Appendix B).

12.1.4.2 Continuous hinges and pivots are rated for design pressure, impact energy and door leaf size. The design pressure and impact energy rating for the selected continuous or pivot hinge must meet or exceed the requirements for the opening. The required door size for the opening must be equal to or less than the door size listed for the hinge.

12.1.5 To select cylindrical lock or mortise lock for a door leaf, determine the latch bolt design load (lbf) required, by multiplying one-half of the nominal door leaf area in square feet by the design pressure. Select a lock with a design load rating (lbf) equal to or greater than the calculated latch design load (see examples in Appendix B).

12.1.6 To select a rim exit, mortise exit, hardware mullion, or multi-point latch configuration, compare the rated hardware design pressure, impact energy requirement, stiffness classification, and door size with the opening requirements.

12.1.7 If a light kit is to be installed, select a light kit with a design pressure and impact energy rating equal to or greater than the required values.

12.1.8 To select a door leaf compare the rated design pressure, desired hardware configuration, impact energy, and size requirements with the opening requirements. Obtain the design pressure rating for the specified hardware configuration by checking the door rating data (see example in table 2). The rated door panel design pressure for the desired hardware configuration, impact energy, and size must meet or exceed the requirements for the opening. If rim exits or mortise exits are specified, the door panel must meet or exceed the door stiffness classification for the rim or mortise exit device being used.

12.1.9 All components must be installed in accordance with the component manufacturer's instructions. The assembly rating is equal to the lowest design pressure rating of the selected components and must be equal to or greater than the design pressure required for the opening.

Appendix A

(normative)

Tolerances and Conversion of Measurements to SI

Imperial Value	Imperial Unit	Imperial Tolerance	SI Value	SI Unit	SI Tolerance
110	MPH	NA	177	KMH	NA
150	MPH	NA	241	KMH	NA
5	PSF	±0.5	239	Pa	±24
10	PSF	±0.5	479	Pa	±24
60	in	±0.25	1524	mm	±6
30	in	±0.25	762	mm	±6
40- ⁵ / ₁₆	in	± ¹ / ₈	1024	mm	±3
1- ¹ / ₄	in	± ¹ / ₈	1024	mm	±3
³ / ₁₆	in	± ¹ / ₃₂	4.8	mm	±1
16	in	±1	406	mm	±25
6	in	±1	152	mm	±25
3	in	± ¹ / ₈	76	mm	±3
15	lbf	±0.5	67	N	±2
1	in	± ¹ / ₁₆	25	mm	±2
350	ft-lb	±3.5	475	N-M	±5
100	lb	±1	45.4	Kg	±0.5
12	in	± ¹ / ₈	305	mm	±3
24	in	±1/8	610	mm	±3
50	ft/sec	NA	1.52	Km/Sec	NA
0.05	in/min	±0.005	1.3	mm/min	±0.1
300	lbf	±3	1334	N	±13
2.5	in	±0.1	64	mm	±2.5
1/4	in	±0.03	6	mm	±1
0.01	in	NA	0.25	mm	NA
0.5	in	NA	12.7	mm	NA
1.0	in	NA	25.4	mm	NA
2.0	in	NA	50.8	mm	NA
3.0	in	NA	76.2	mm	NA

Appendix B (informative)

Example 1

Opening design pressure: per ASCE 7 = 67 psf, requires 350 ft-lb impact energy per local code.

Opening size: 3'0" x 7'0" — Single In-Swing

Wall type: 2 x 6 wood stud 16 in o.c. with ½ inch exterior sheathing — design pressure rating 75 psf.

Frame: 16 ga. pressed steel with ⅝ inch stops.

Frame rating: for 3'0" x 7'0" with ¼" x 3-½" lag screw anchors to wood studs at 24" o.c. = 75 psf. & 350 ft-lb — OK.

Hinges: (ABC Co. Model 1— 500 lbf – 350 ft-lb rating) 3 – 4" x 0.135" centered at 8" from top, center of door and 8" from bottom.

Latch: (XYZ Co. Model 2 – 1000 lbf – 350 ft-lb rating for class II doors) single point mortise, ⅝" throw.

Door: 3'0" x 7'0" Hollow Metal — Stiffness class II, 70 psf, 350 ft-lb rating. — OK.

Location	Area (ft²)	Load @ 70 psf (lbf)
A Top Hinge	3.125	219 < 500 OK.
B Middle Hinge	4.25	298 < 500 OK.
C Bottom Hinge	3.125	219 < 500 OK.
D Latch	10.5	735 < 1000 OK.

Opening Design Pressure Rating = 70 psf based on door.

Tested for Impact Energy Rating of 350 ft-lbf.

Example 2

Opening Design Pressure: Per ASCE 7 = 80 pounds per square foot (PSF), requires 350 ft-lbf impact energy per local code.

Opening Size: 8'0" x 8'0" – Pairs of Doors

Wall Type: Masonry – design pressure rating 90 PSF – OK (Meets opening design pressure requirement)

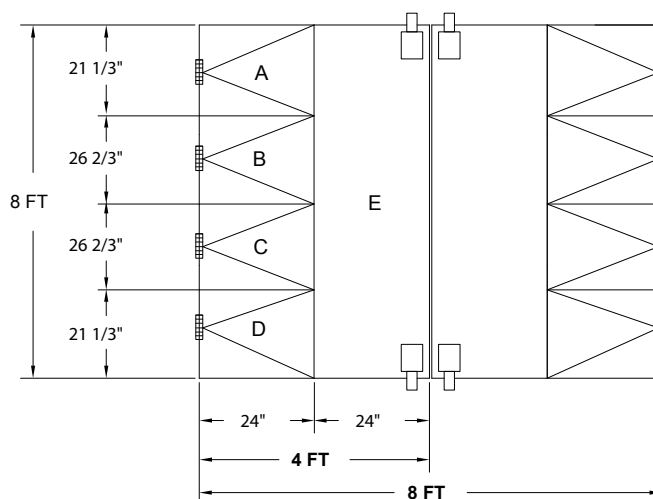
Frame: 14 ga. Pressed steel with $\frac{5}{8}$ inch stops

Frame Rating: For a 8'0" x 8'0" with masonry T anchors is 80 PSF & 350 ft-lbf – OK (Meets opening design pressure requirement)

Hinges: (ABC Co. Model 1 - 4" x 0.125", 300 lbf, 350 ft-lbf rating): 4 req'd per leaf - centered at 8" from top of door, centered at 34- $\frac{2}{3}$ " from top of door, centered at 34- $\frac{2}{3}$ " from bottom of door, & centered at 8" from bottom of door.

Latch: (XYZ Co. Model 2 – Surface Vertical rod exit device, 85 PSF, 350 ft-lbf impact rating, two latchbolts per exit device per door leaf, $\frac{3}{4}$ " latch throw – OK (Meets opening design pressure req.)

Door: 4'0" x 8'0" hollow metal – stiffness class I, 80 PSF & 350 ft-lbf Rating – OK (Meets opening design pressure requirement)



Hinge Location / Door Area	Area Calculation	Load Calc	Load vs Product Rating	Pressure vs Rating	Criteria Met?
Top Hinge / A	$(21 \frac{1}{3}" \times 24")/144 = 3.555 \text{ ft}^2$	$80 \text{ PSF} \times 3.555 \text{ ft}^2 = 284 \text{ Lbf}$	$284 \text{ Lbf} < 300 \text{ Lbf}$	N/A	YES
Middle Upper Hinge / B	$(26 \frac{2}{3}" \times 24")/144 = 4.444 \text{ ft}^2$	$80 \text{ PSF} \times 4.444 \text{ ft}^2 = 356 \text{ Lbf}$	$356 \text{ Lbf} > 300 \text{ Lbf}$	N/A	NO
Middle Upper Hinge / B	$(26 \frac{2}{3}" \times 24")/144 = 4.444 \text{ ft}^2$	$80 \text{ PSF} \times 4.444 \text{ ft}^2 = 356 \text{ Lbf}$	$356 \text{ Lbf} > 300 \text{ Lbf}$	N/A	NO
Bottom Hinge/ C	$(21 \frac{1}{3}" \times 24")/144 = 3.555 \text{ ft}^2$	$80 \text{ PSF} \times 3.555 \text{ ft}^2 = 284 \text{ Lbf}$	$284 \text{ Lbf} < 300 \text{ Lbf}$	N/A	YES
Latches / D	N/A	N/A	N/A	$80 \text{ PSF} < 85 \text{ PSF}$	YES

Result: Opening does not meet the design pressure requirement due to hinge product rating. In order to meet it, the hinges need to be replaced with higher load rated hinges ($\geq 300 \text{ Lbf}$).

Appendix C
(informative)

Door Component Impact Energy Research Project



Door Component Impact Energy Research Project

Intertek Testing Services has completed a study on the large missile impact test specified by ASTM E1886/E1996 and its affects latches on in-swinging doors. The study was conducted to quantify the energy that would tend to shear the latch bolt in fully assembly tests and compare it to the energy delivered to the latch bolt in the ANSI A250.13 component test procedure which uses a relatively rigid fixture and a pendulum type impactor.

Background

Since ANSI A250.13 was published, tests of single point (mortise and cylindrical) latches have consistently produced failures in latches that have a history of acceptable performance when tested in full assemblies. It has been clear that much of this difference in results is due to the fact that, in assembly tests, only a fraction of the energy contained in the impactor is actually delivered to the latch and bolt.

Just before the impact event, it is known that the impacting body represents about 350 ft-lbs of kinetic energy. During the impact all this energy must be conserved. We know that some energy is accounted for by several processes:

- Energy is absorbed by the door through deformation, bending, crushing and/or tearing of the door materials.
- Energy is absorbed by deflection and movement of the assembly mass.
- Energy is absorbed and returned to the impactor (it bounces back).
- Energy is absorbed by deformation or crushing of the impactor striking surface.
- Energy is absorbed in the mounting and supporting fixture and construction.
- There are several other smaller areas of energy distribution, e.g. the sound make by the impact.

The large and obvious disparity in results between full assembly impact tests and the latch component test led to the design of an experiment that is described in this report as a means of quantifying the energy distributed to the latch bolt in a typical door assembly.

Theory

Energy, when it causes movement or deformation, is termed 'work'. If one strikes a lump of lead with a hammer it will cause it to flatten and the 'work' thus done is a direct result of the energy delivered by the hammer. Thus, by creating a test arrangement that

uses a material that will deform and retain its shape after an impact and making sure that the energy is delivered through a consistent arrangement of striking surface, test body and supporting surface the deformation of the test body provides and measurement of the energy required to cause the deformation.

This deformation relationship to energy can be quantified by testing the same test body material and form in a compression testing machine. As the machine loading platen compresses and deforms the test body, the load increases. For any given point in deformation, the area under the stress/strain curve can be integrated to determine the work done on the test body and hence the equivalent amount of energy that would need to be delivered in an impact event to cause the same deformation.

Procedure

The experiment was conducted in four phases.

Phase I was to use a 3'-0" by 7'-0" complete door assembly with a simulated latch bolt and anvil assembly. The simulated latch bolt consisted of a 1.5" by 3/4" steel bar securely attached to the door and projecting 1.25" at the normal latch location. Immediately behind the simulated latch bolt a heavy structural steel anvil was placed with a horizontal gap of 1.57". A solid lead test body was mounted on the anvil so that when the door was struck by the impactor the energy absorbed in the latch area would result in deformation of the lead test body. The lead test body was shaped in the form of a 4 sided pyramid 1.57 inches high with a square base with each side measuring 0.875". After each impact the height of the test body was measured and the deformation from its original height determined. The impact was delivered to the door 6 inches from the latch edge centered on the latch bolt location.

Phase II involved using the single point latch test fixture specified in ANSI A250.13 with a simulated latch bolt and anvil set up as described above for the door test and the 100 pound pendulum impactor with a 2 x 4 by 12" long wood striking surface. The level of impacts started as 350 foot pounds and was stepped down until the deformation of the lead test body was approximately equal to that observed for the door assembly test in phase I.

Phase III involved direct impact of the lead test body with the 9 pound 2 x 4 and air canon as specified in ASTM E1886/E1996 except that a 3/16 thick steel plate was affixed to the striking end of the 2 x 4 (overall weight was still 9 pounds). The pendulum impactor was also used with a 350 ft-lbf impact to compare the energy delivered between the two methods directly.

Phase IV was a series of compression tests of the lead test body using a universal testing machine in order to determine the relationship between deformation and work or energy required to produce specific levels of deformation.

Throughout these tests the deformation was determined by measuring the overall height of the pyramidal test body before and after the test. The deformed height was determined from the average of four measurements made at each of the four corners of the deformed specimen.

Multiple trials were conducted where deemed necessary and it was found that the results were repeatable to within 3-5% for all conditions of the tests.

Results

Chart 1. shows the relationship between test deformation of the lead test body used and the load applied. Integration of the area under this curve for a given deformation provides the value for 'work' required to produce the deformation observed.

Chart 1.

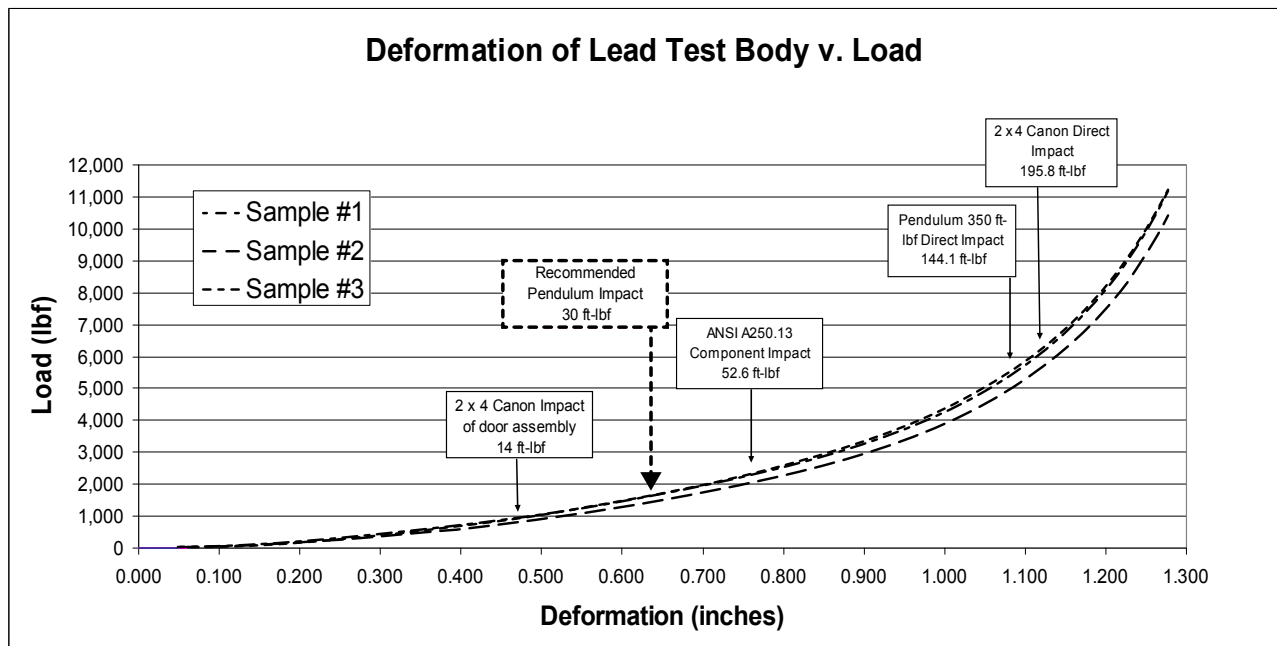


Chart 2 shows the relationship between the deformation and work for the specific test body used. The relationship is approximated mathematically as:

$$\text{Work} = 120 \times D^3 \text{ (ft-lbf)}$$

Where: D is the deformation in the test body in inches.

The R^2 correlation coefficient is 0.99.

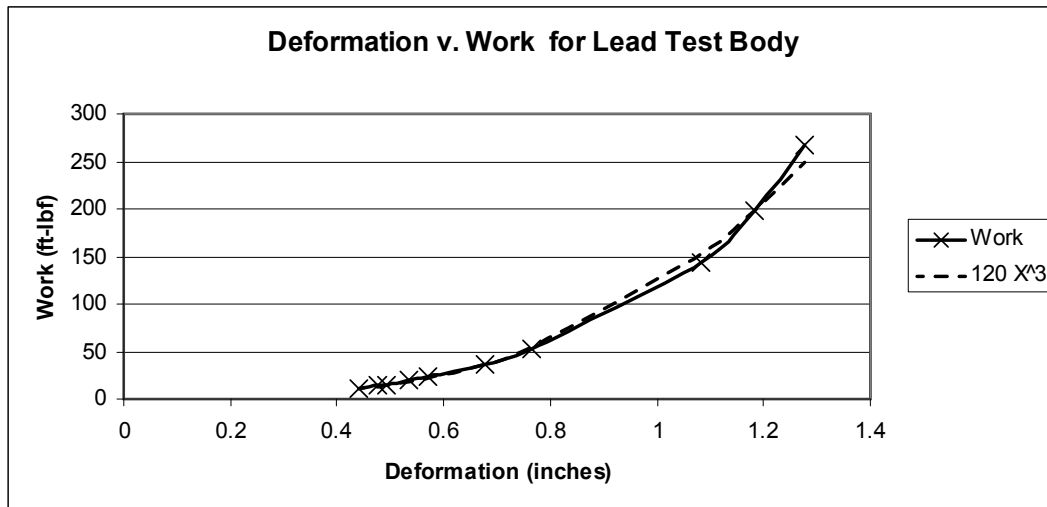


Table 1. shows the results of phase I through III of this experiment.

Table 1.

Test Condition	Impactor	Number of Trials	Average Deformation (inches)	Average Impact Energy (ft-lbf)	Work Done on Test Body (ft-lbf)
20 Gauge Steel Stiffened Door	9# 2 x 4 @ 50 ft/s	3	0.475	354	14.0
Pendulum Direct to test body	100# w/ 12" 2 x 4	5	1.083	350	144.1
2 x 4 Cannon Direct to test body	9# 2 x 4 @ 50 ft/s	5	1.181	355.8	195.8
Pendulum w/ A250.13 Fixture	100# w/ 12" 2 x 4	1	0.765	350	52.6
Pendulum w/ A250.13 Fixture	100# w/ 12" 2 x 4	1	0.677	150	37.2
Pendulum w/ A250.13 Fixture	100# w/ 12" 2 x 4	1	0.570	100	23.1
Pendulum w/ A250.13 Fixture	100# w/ 12" 2 x 4	2	0.535	75	19.4
Pendulum w/ A250.13 Fixture	100# w/ 12" 2 x 4	10	0.491	60	15.4
Pendulum w/ A250.13 Fixture	100# w/ 12" 2 x 4	2	0.440	50	11.4

Analysis

The results indicate that a surprising small amount of energy from the 350 foot-pound impact of the 9 pound 2 x 4 is actually delivered to the latch in a full size door assembly test. Only about 14 foot-pounds or 4% of the available energy needs to be withstood by a typical latch bolt. In the case of the ANSI A250.13 fixture and pendulum impact at 350 ft-lbf, the energy delivered to the latch bolt is over 52 ft-lbf – about 15% of the available energy and 3.7 times the energy delivered by the 2 x 4 impact in the full test assembly.

This confirms the observation that the small scale A250.13 test of latches is much more severe than the assembly test with the 2 x 4 cannon.

Phase II indicates that, in the small scale test, a pendulum impact energy of 60 ft-lbf results in approximately equivalent shearing energy delivery to that of the full scale assembly test method.

It was observed that in the direct impact tests conducted in Phase III, the 2 x 4 cannon procedure produced 51 ft-lbs (196 vs. 144 ft-lbf) or 35% greater work on the test body than the pendulum. This is most likely due to the difference in velocity and the duration of the actual impact event. The 2 x 4 moves at a velocity of 50 ft/sec up to the point of impact whereas the pendulum velocity at impact is 15 ft/sec. This means that the 2 x 4 cannon event takes place in about 4 milliseconds while the pendulum impact event takes about 12 milliseconds or 3 times as long.

If the support structure were perfectly rigid (i.e. would not move or deflect at all) this difference would not affect the energy transfer. However, in the real world, the supporting structure is not perfectly rigid and therefore it absorbs some of the energy delivered to it through movement and deflection. However, since the support is relatively massive and is subject to inertia, the time involved in the impact event has a significant influence on the outcome. Therefore the relatively shorter duration of the higher speed 2 x 4 impact allows less time for the support structure to absorb energy and hence a greater proportion of the energy delivered ends up doing work on the test body.

An example of this effect can be seen at the target range. A high speed rifle bullet will penetrate a ¼” thick suspended steel plate without noticeably moving it, but a 20 gauge shotgun slug, with equivalent energy, but traveling much slower will not penetrate but will cause a violent deflection of the same target.

Recommendations

This study has demonstrated that the small scale test specified in ANSI A250.13 for latches is indeed much more severe than the exposure provided in door assembly tests conducted per ASTM E1886/E1996 and similar wind borne debris impact tests. The level of energy transmitted to the lockset should be reduced to a value closer to 15 ft-lbs.

Use of the small scale test fixture remains viable and a simple adjustment to the pendulum energy used in the test is all that would be required to better simulate the full scale test.

Since the size, materials and stiffness of doors is variable, it is recommended that the energy level used in the small scale test be approximately twice that determined from this study. A pendulum energy of 125 ft-lbf (vertical drop height of 15") would provide approximately 30 ft-lbf to the latch bolt and would therefore be appropriate.

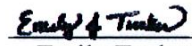
A nearly identical test is specified in ANSI A250.13 for leaf hinges and these results should apply equally to the hinge component test.

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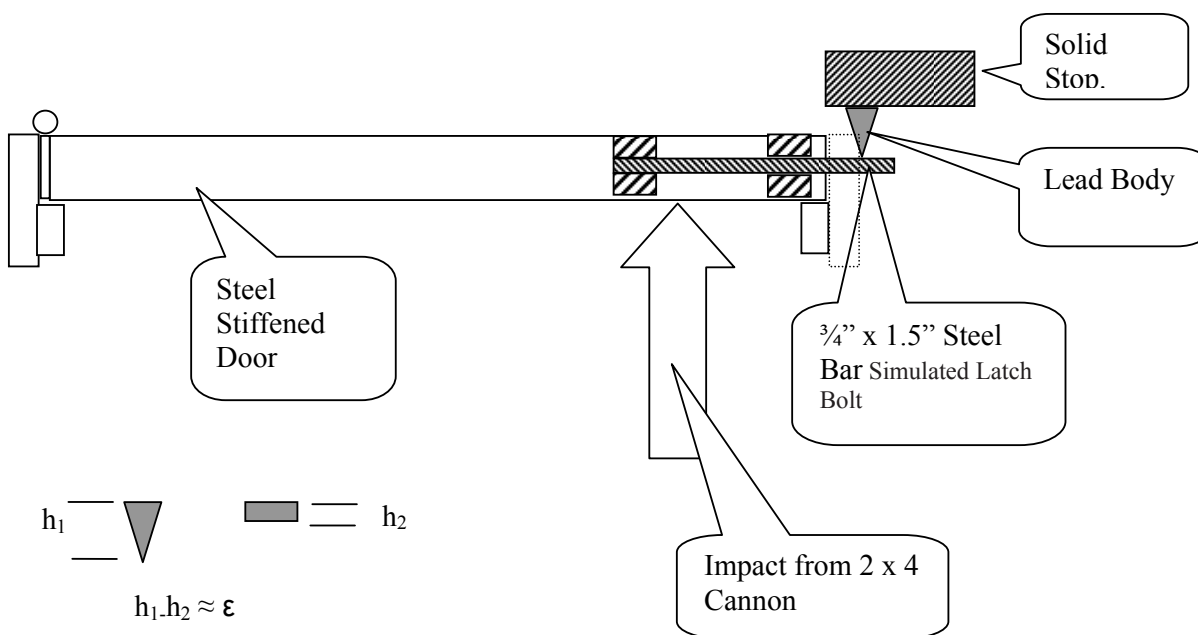
Appendix I Experimental Design

ANSI A250.13 Latch Impact Test Energy Transfer Experiment

Problem: The simulated latch impact test using a rigid fixture and pendulum impactor should deliver the same force and energy into the latch as occurs in an assembly when the door is impacted by the 2 x 4 missile.

Experiment:

Principle: A given amount of energy delivered by a single impact will cause a specific amount of deformation in a solid lead body such as a cylinder, pyramid or cone. Similar deformation resulting from different methods of delivering the impact indicate similar energy transfer.



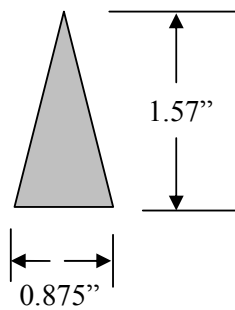
First phase is to run a series of tests using a door and the set-up as shown above to establish the effect of the standard test energy as transmitted to the test body.

Phase II - Once the level of deformation produced is established, the same test body will be used in the latch impact fixture and the level of impact energy will be increased in increments until the deformation of the test body equals that established in the first phase of the experiment. Ten replicates will be performed at this level to establish the degree of repeatability.

Phase III will be direct impact of the test body with the 9 pound 2 x 4 at 50 feet per second and with the 100 pound pendulum with the 3.5 foot drop height to evaluate the relative direct energy transfer.

Phase IV will be to compression test the lead test body in a universal testing machine to determine the work (or energy) required to produce a specific level of deformation.

The test bodies will be solid lead pyramids that produce a deformation of 25 to 75% of the initial height at impacts within the range being studied.



Lead Test Body – 4- Sided Pyramid

AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

- SDI-112** Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- SDI-117** Manufacturing Tolerances for Standard Steel Doors and Frames
- SDI-124** Maintenance of Standard Steel Doors & Frames
- SDI-127** Industry Alert Series (A-L)
- SDI-130** Electronic Hinge Preparations
- SDI-134** Glossary of Terms for Hollow Metal Doors and Frames
- SDI-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

AUDIO-VISUAL PROGRAMS ALSO AVAILABLE

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