

# 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

<b>Summary of Documents</b>	Provides a description of each technical document
<b>ANSI/SDI 100-91</b>	<i>See ANSI A250.8</i>
<b>SDI 108-23</b>	Recommended Selection and Usage Guide for Standard Steel Doors
<b>SDI 110-23</b>	Standard Steel Doors and Frames for Modular Masonry Construction
<b>SDI 111-09</b>	Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components
<b>111-A</b>	Recommended Standard Steel Door Details
<b>111-B</b>	Recommended Standard Details for Dutch Doors
<b>111-C</b>	Recommended Louver Details for Standard Steel Doors
<b>111-D</b>	Recommended Door, Frame and Hardware Schedule for Standard Steel Doors and Frames
<b>111-E</b>	Recommended Guidelines for the Use of Gasketing and Thresholds for Standard Steel Doors and Frames
<b>111-F</b>	Recommended Existing Wall Anchors for Standard Steel Doors and Frames
<b>111-G</b>	Recommended Standard Preparation for Double Type (Interconnected) Locks on Standard Steel Doors and Frames
<b>111-H</b>	High Frequency Hinge Preparations for Frames
<b>SDI 112-08 (R23) *</b>	Zinc-Coated (Galvanized/Galvannealed) Steel Doors and Frames
<b>SDI 113-23</b>	Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies
<b>SDI 117-23</b>	Manufacturing Tolerances for Standard Steel Doors and Frames
<b>SDI 118-21</b>	Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements
<b>SDI 122-21</b>	Installation Troubleshooting Guide for Standard Steel Doors and Frames
<b>SDI 124-22</b>	Maintenance of Standard Steel Doors and Frames
<b>SDI 127</b>	Series - Industry Alerts (A through L)
<b>127A-06 (R19) *</b>	End Closure
<b>127B-19</b>	Door Edge Cutouts
<b>127C-19</b>	Frame Cutout Limits
<b>127D-14</b>	Electric Strikes and Electric Hinges in Stud Walls
<b>127E-06 (R19) *</b>	Prime Painted Materials Alert

<b>127F-19</b>	Butted Frames Rough Opening Sizes
<b>127G-06 (R14) *</b>	Environmental Considerations Relating to Factory Painted Steel Doors and Frames
<b>127H-10 (R14) *</b>	Water Penetration
<b>127I-14 (R19) *</b>	Grouting Frames in Drywall
<b>127J-14</b>	Bituminous Back-Coating of Frames
<b>127K-09 (R14) *</b>	Improper Wedges as Hold-Opens
<b>127-L09 (R14) *</b>	Buyer Beware: Steel Doors with Lead-Based Primer
<b>SDI 128-19</b>	Guidelines for Acoustical Performance of Standard Steel Doors and Frames
<b>SDI 129-22</b>	Hinge and Strike Spacing
<b>SDI 130-19</b>	Electrified Hinge Preparations
<b>SDI 131-15</b>	Accelerated Physical Endurance Test Procedure for Steel Doors
<b>SDI 133-22</b>	Guideline for Specifying Steel Doors and Frames for Blast Resistance
<b>SDI 134-20</b>	Glossary of Terms for Hollow Metal Doors and Frames
<b>SDI 135-18</b>	Guidelines to Measure for Replacement Doors in Existing Frame Openings
<b>SDI 136-19</b>	Guideline for Specifying Windstorm Products
<b>ANSI/SDI A250.3-2019</b>	Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames
<b>ANSI/SDI A250.4-2022</b>	Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
<b>ANSI/SDI A250.6-2020</b>	Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
<b>ANSI/SDI A250.8-2023</b>	Specifications for Standard Steel Doors and Frames (SDI-100)
<b>ANSI/SDI A250.10-2020</b>	Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
<b>ANSI/SDI A250.11-2022</b>	Recommended Erection Instructions for Steel Frames
<b>ANSI/SDI A250.13-2014 (R2018) *</b>	Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes
<b>ANSI/SDI A250.14-2023</b>	Hardware Preparation in Steel Doors and Steel Frames

\*Document was reviewed by the Steel Door Institute Technical Committee and approved for reaffirmation, i.e., 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.

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#### **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, which 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.

**A250.14 – Hardware Preparation in Steel Doors and Steel Frames**

This standard covers all significant dimensional attributes for mounting common hardware products in steel doors and frames. All dimensions shall be as shown on the accompanying drawings. This standard was developed to show only the most commonly used preparations for door hardware and provide targets for standardization. Where multiple configurations are in common usage, separate drawings are provided. For other configurations, it is recognized that these standards may be used in part, or with exceptions, while still providing some degree of basic guidance and standardization.

*Recommended*  
**Selection and Usage Guide**  
*for*  
**Standard Steel Doors**



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**STEEL DOOR INSTITUTE**

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## 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 door 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 for 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  $\pm 2$  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 levels 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.

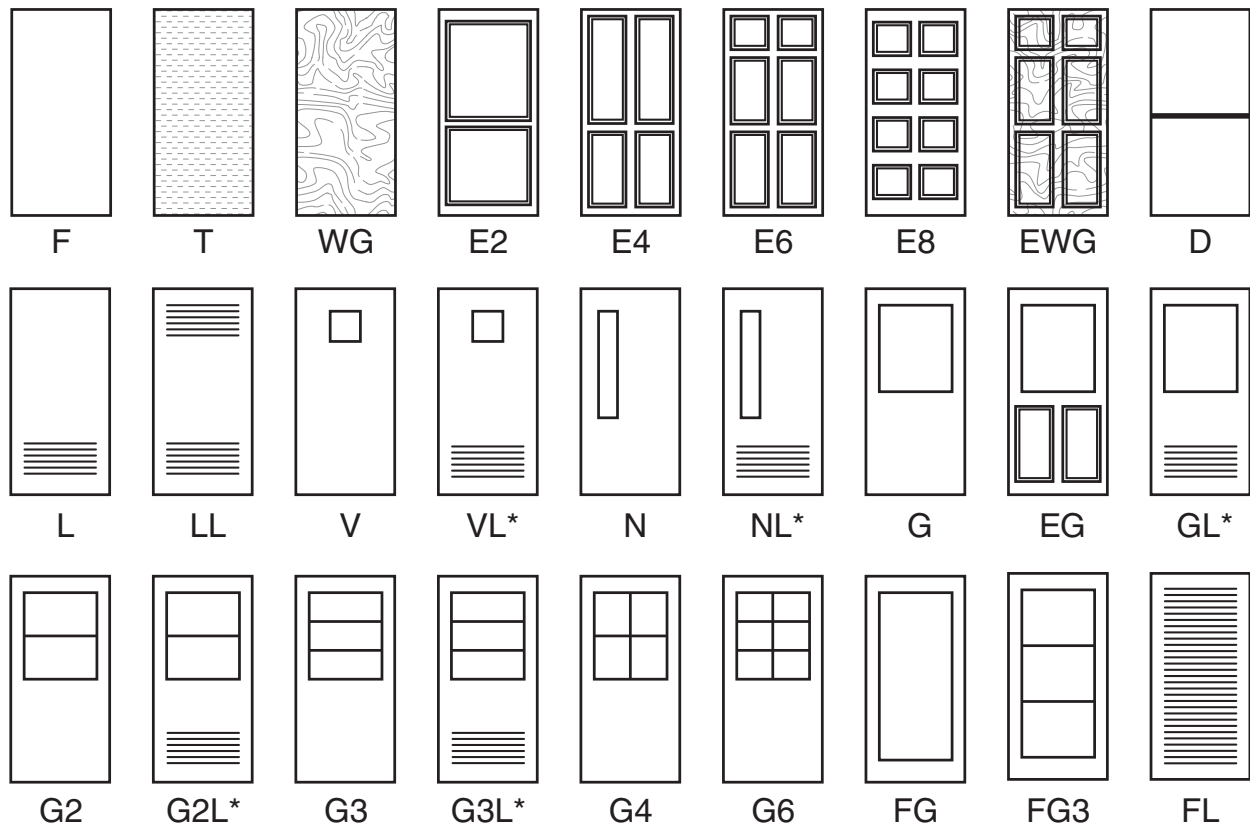
For complete standard steel door construction specifications and available sizes, refer to ANSI/SDI A250.8-2017, *Specifications for Standard Steel Doors and Frames (SDI-100)* and ANSI/SDI A250.4-2022 *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors*.

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
<b>Apartment</b>										
Main Entrance		•	•		•	•		•	•	
Unit Entrance	•	•	•		•					
Bedroom	•				•					
Restroom	•				•					•
Closet	•				•					•
Stairwell		•	•				•		•	
Mechanical		•	•		•					•
<b>Dormitory</b>										
Main Entrance		•	•	•		•		•	•	
Unit Entrance	•	•			•					
Bedroom	•	•			•					
Restroom	•	•			•					•
Closet	•	•			•					•
Stairwell		•	•				•		•	
<b>Hotel – Motel</b>										
Unit Entrance	•	•			•					
Restroom	•				•					
Closet	•				•					•
Stairwell		•	•				•		•	
Storage & Utility		•	•		•					•
<b>Medical</b>										
Main Entrance			•			•		•	•	
Patient Room		•			•					
Stairwell		•	•				•		•	
Operating & Exam.		•	•		•		•		•	
Restroom		•	•		•					•
Closet	•	•			•					•
Recreation		•			•		•			
Kitchen		•	•				•			
Mechanical/Storage/ Utility		•	•		•					•
<b>Industrial</b>										
Entrance & Exit			•	•		•		•	•	
Office	•	•			•	•				
Production			•			•			•	•
Restroom		•	•		•					•
Tooling/Maintenance			•	•	•					
Shipping/Receiving			•	•		•				
Monorail			•	•	•					
<b>Office</b>										
Entrance			•			•		•	•	
Individual Office	•				•	•				
Closet	•				•					•
Restroom		•	•		•					
Stairwell		•	•				•		•	
Equipment		•	•		•					
Boiler		•	•		•					•
<b>School</b>										
Entrance & Exit			•	•		•		•	•	
Classroom		•				•			•	
Restroom		•	•		•					•
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.

## 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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*Recommended*  
**Selection and Usage Guide**  
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## 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  $\pm 2$  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
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		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.

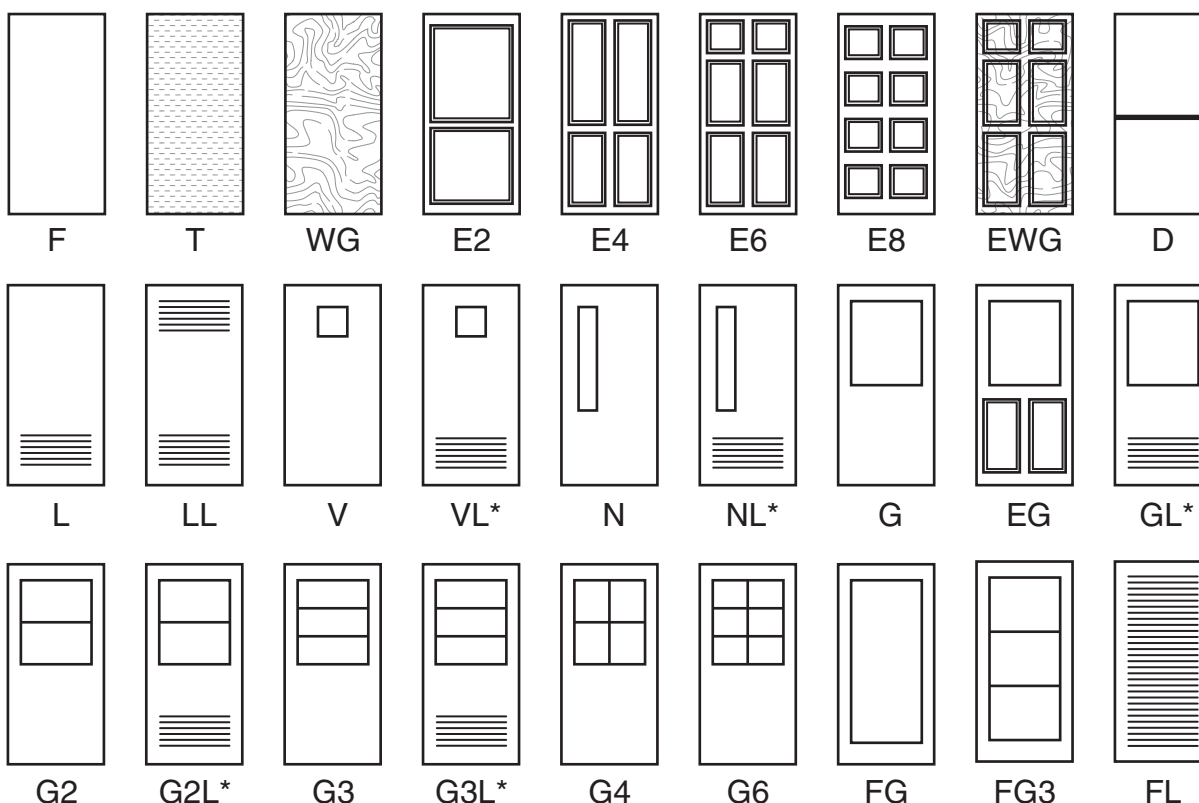
For complete standard steel door construction specifications and available sizes, refer to ANSI/SDI A250.8-2017, *Specifications for Standard Steel Doors and Frames (SDI-100)* and ANSI/SDI A250.4-2018 *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors*.

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
<b>Apartment</b>										
Main Entrance		•	•		•	•		•	•	
Unit Entrance	•	•	•		•					
Bedroom	•				•					
Bathroom	•				•					•
Closet	•				•					•
Stairwell		•	•				•		•	
Mechanical		•	•		•					•
<b>Dormitory</b>										
Main Entrance		•	•	•		•		•	•	
Unit Entrance	•	•			•					
Bedroom	•	•			•					
Bathroom	•	•			•					•
Closet	•	•			•					•
Stairwell		•	•				•		•	
<b>Hotel – Motel</b>										
Unit Entrance	•	•			•					
Bathroom	•				•					
Closet	•				•					•
Stairwell		•	•				•		•	
Storage & Utility		•	•		•					•
<b>Medical</b>										
Main Entrance			•			•		•	•	
Patient Room		•			•					
Stairwell		•	•				•		•	
Operating & Exam.		•	•		•		•		•	
Bathroom		•	•		•					•
Closet	•	•			•					•
Recreation		•			•		•			
Kitchen		•	•				•			
Mechanical/Storage/ Utility		•	•		•					•
<b>Industrial</b>										
Entrance & Exit			•	•		•		•	•	
Office	•	•			•	•				
Production			•			•			•	•
Toilet		•	•		•					•
Tool			•	•	•					
Trucking			•	•		•				
Monorail			•	•	•					
<b>Office</b>										
Entrance			•			•		•	•	
Individual Office	•				•	•				
Closet	•				•					•
Toilet		•	•		•					
Stairwell		•	•				•		•	
Equipment		•	•		•					
Boiler		•	•		•					•
<b>School</b>										
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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## 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)
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- 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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
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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.

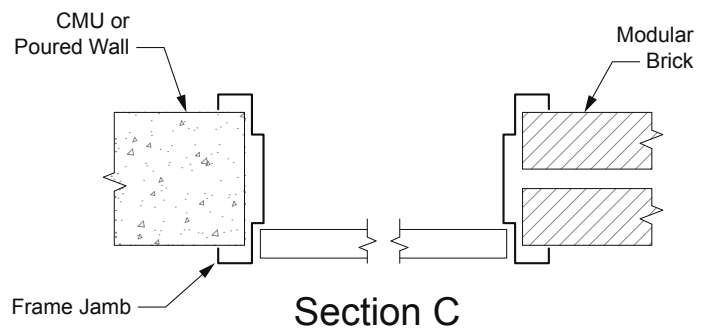
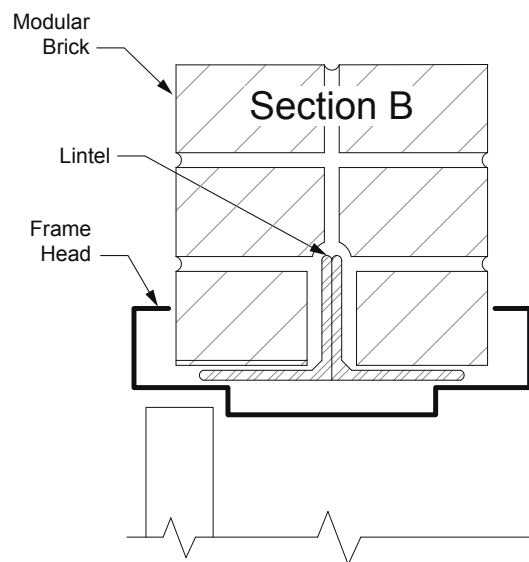
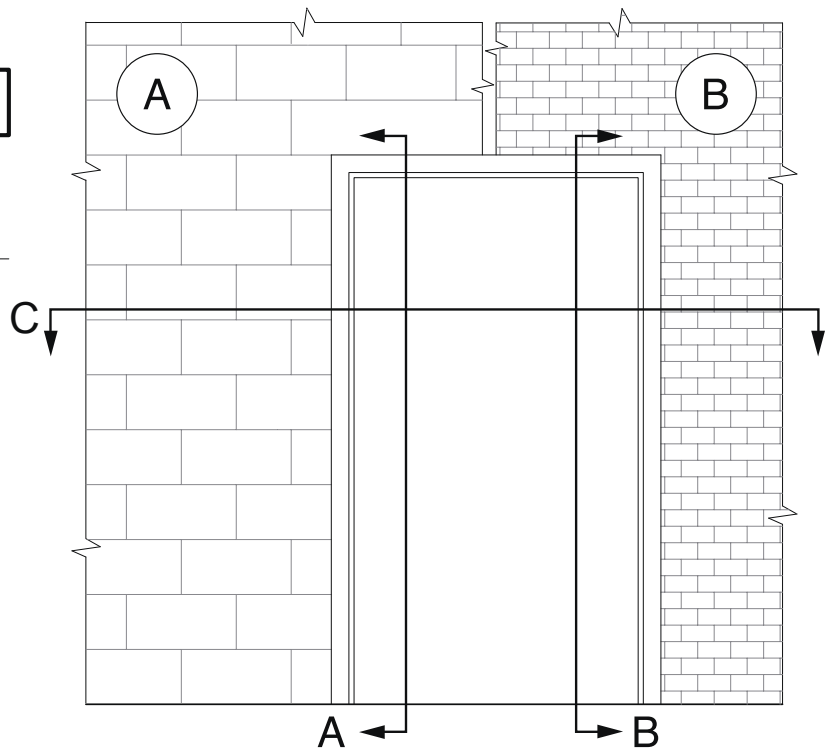
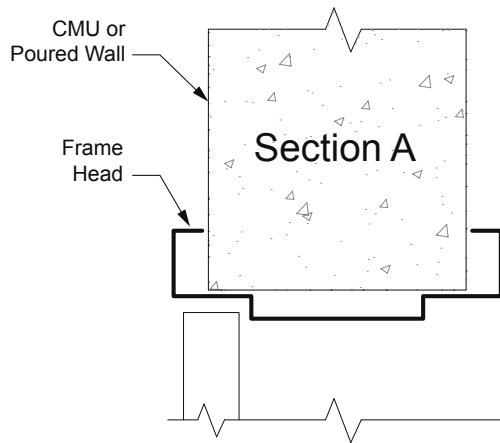
#### **Dimensions:**

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.

# Wrap Around Frame

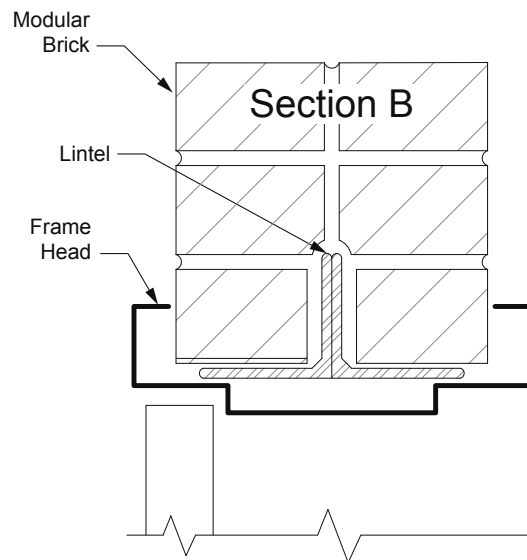
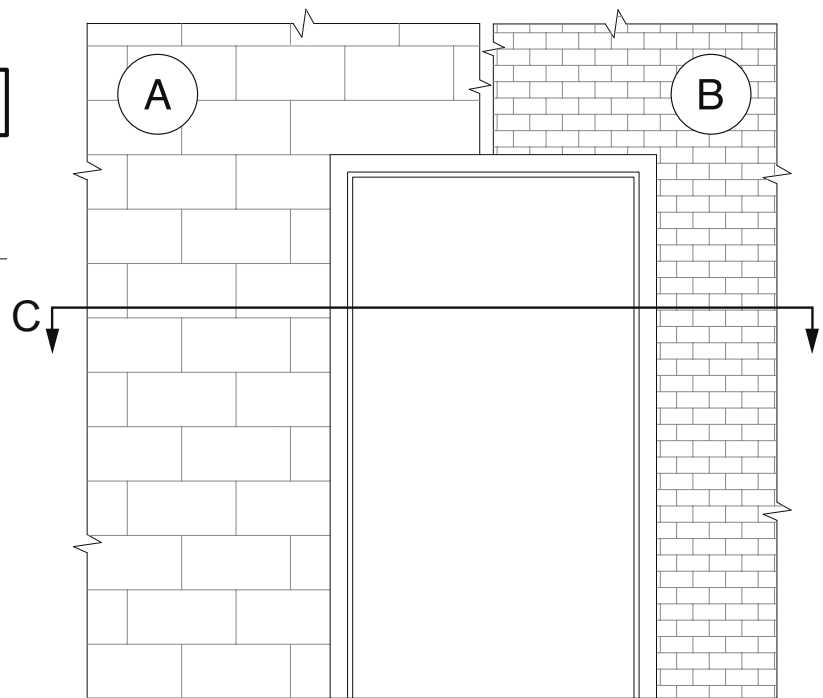
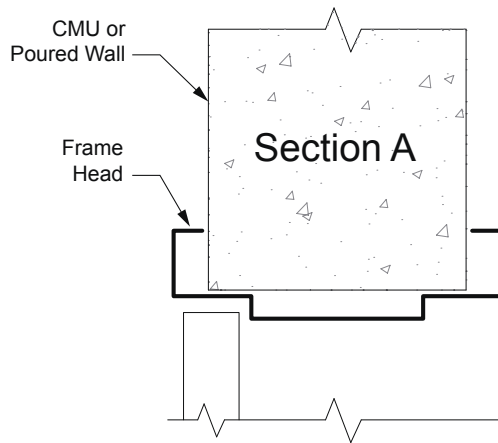
6' 8" or 8' 0" Door



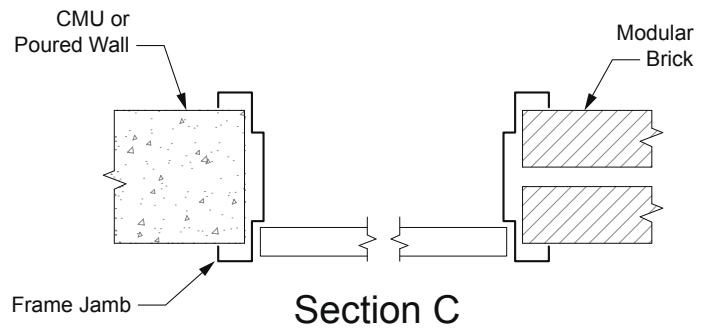


# Wrap Around Frame

## 7' 0" Door

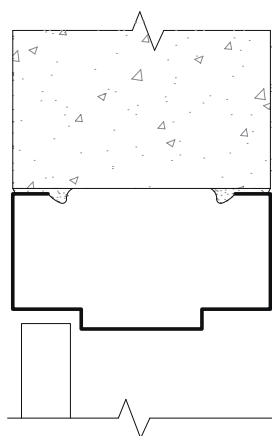
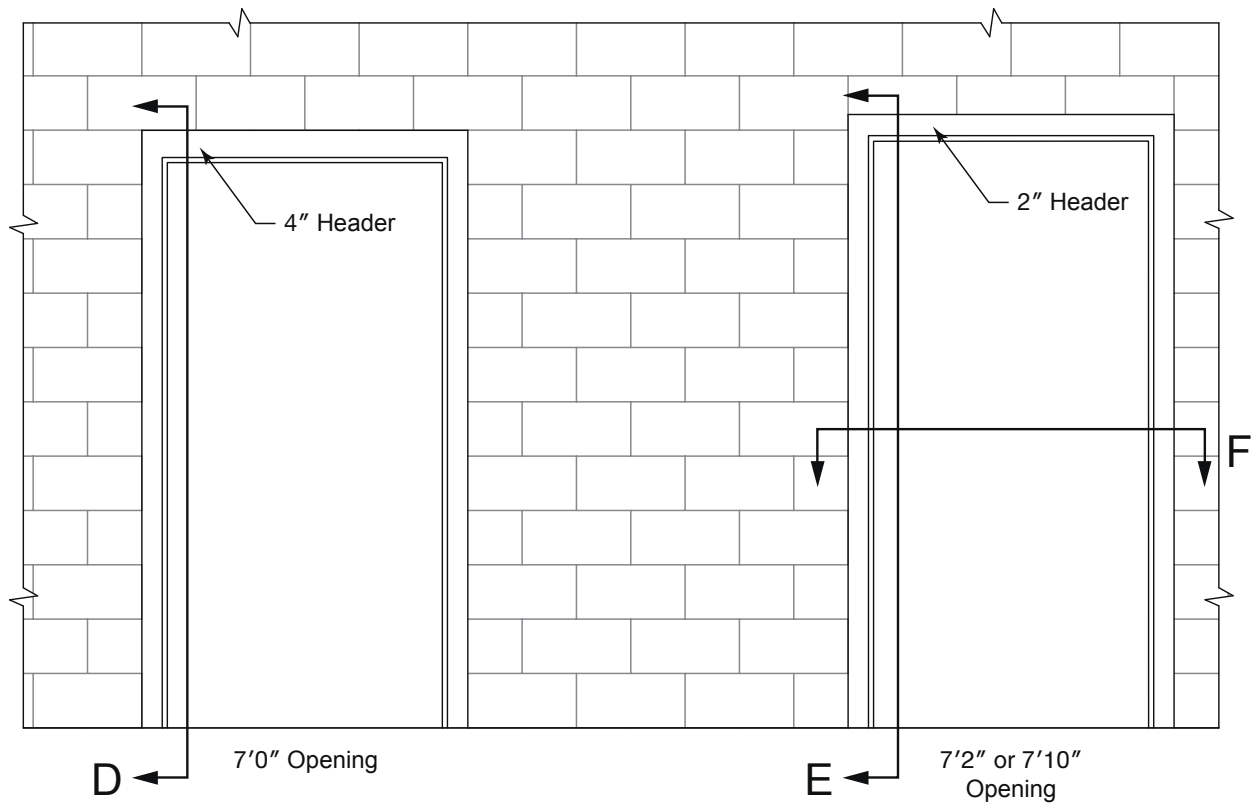


**Note:** A starter course of 4" modular masonry may be used to create alignment of the frame head with the masonry joints.

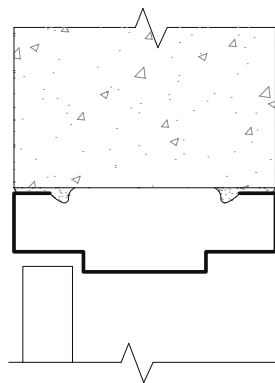


# Butt Type Frame

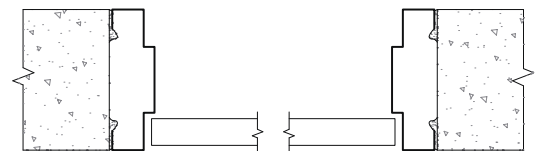
**7' 0" Door with 4" Header or  
7' 2" and 7' 10" Doors with 2" Header**



Section D



Section E



Section F

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*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**



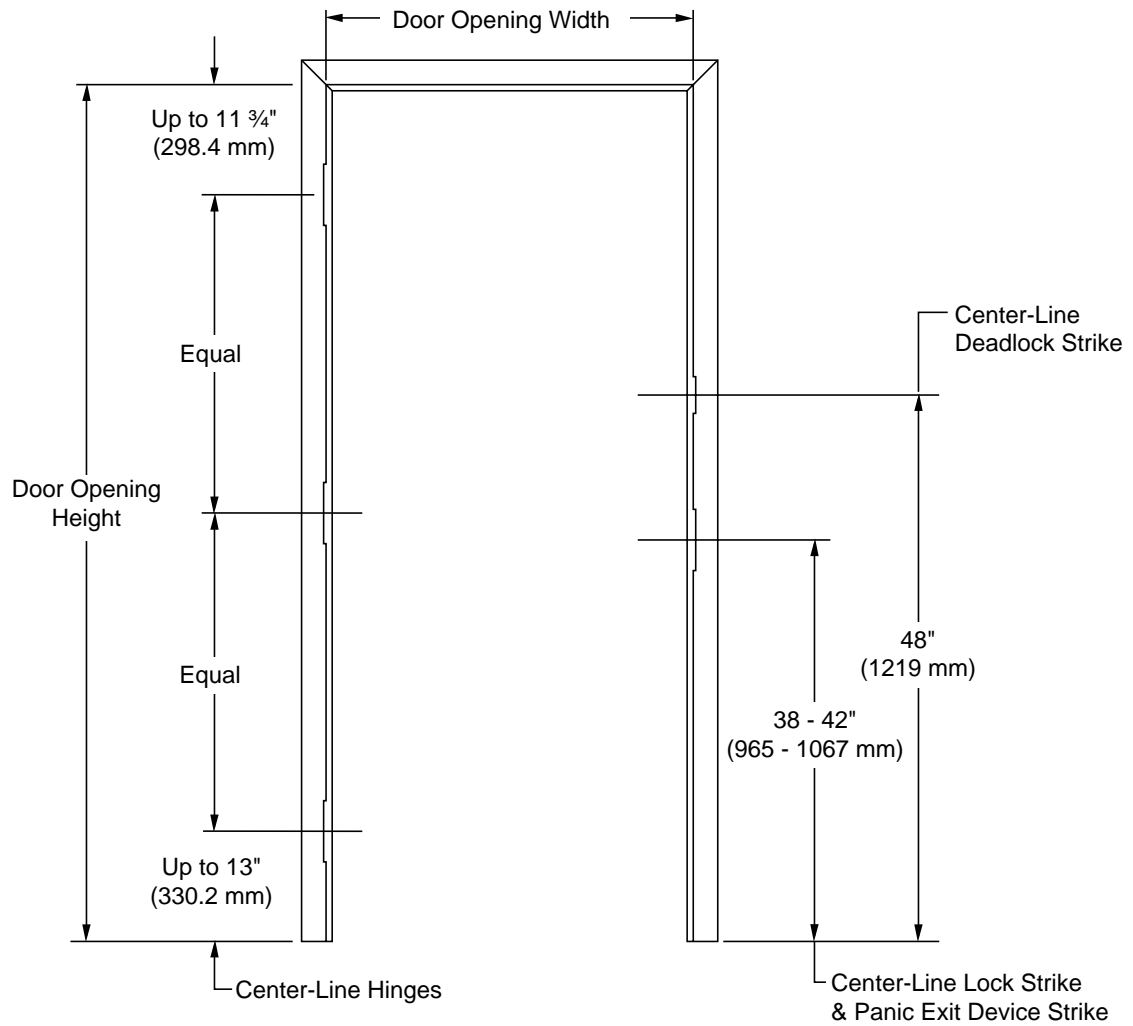
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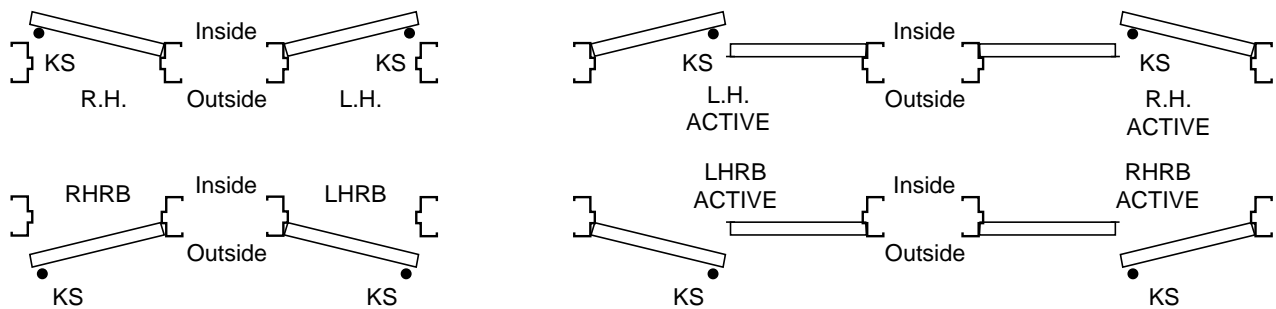
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## Hardware Locations



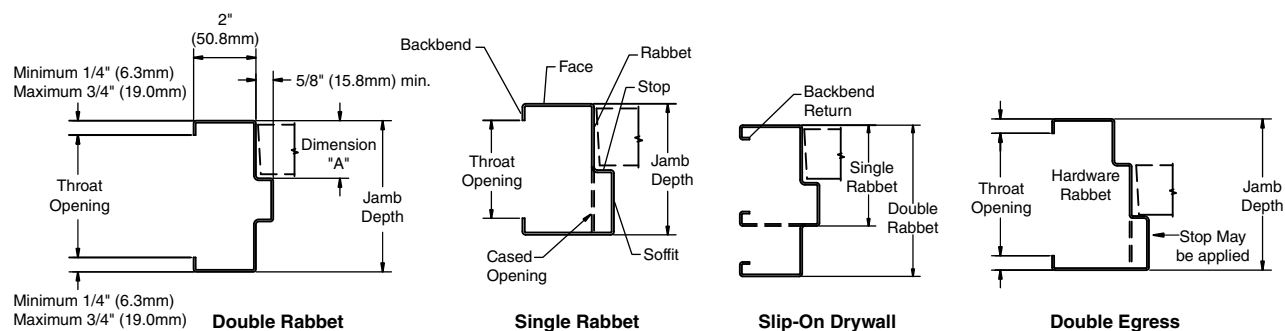
Note: Center Hinge Omitted on 6' 8" (2032mm), 1 3/8" (34.5mm) Doors, Unless Specified.

## Handing Chart



## Standard Frame Details

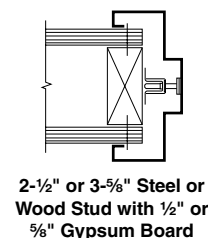
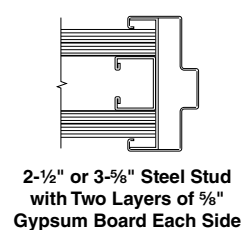
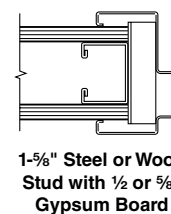
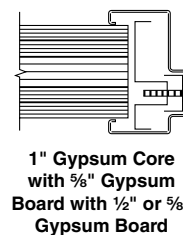
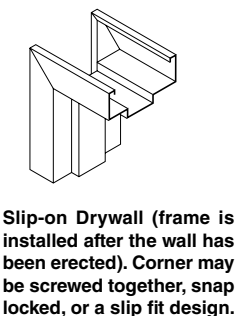
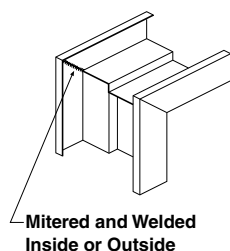
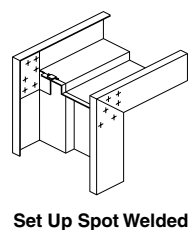
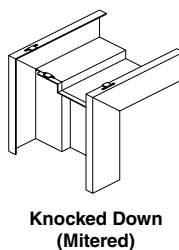
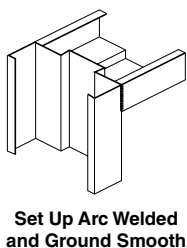
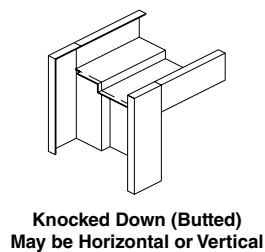
### Standard Profiles



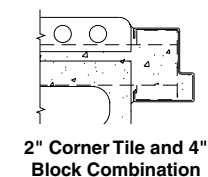
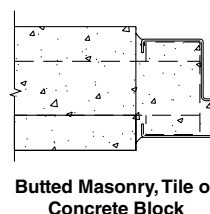
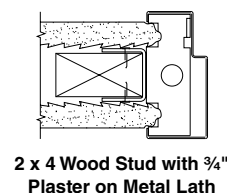
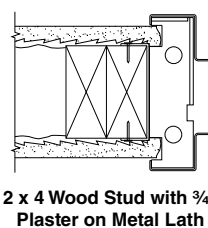
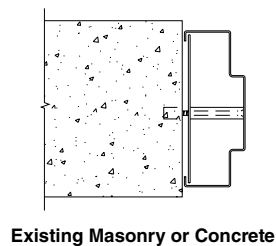
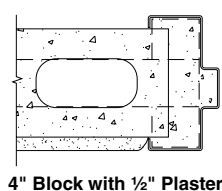
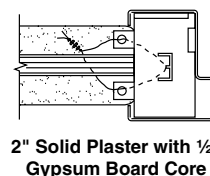
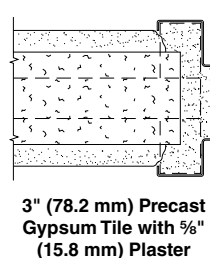
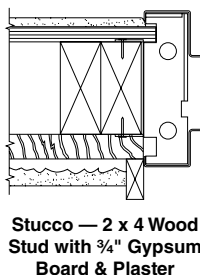
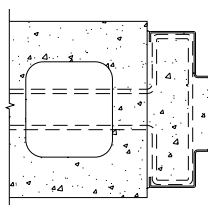
Door Thk.	Dim. "A"
1-3/8" (34.9mm)	1-9/16" (39.6mm)
1-3/4" (44.4mm)	1-19/16" (49.2mm)

### Drywall

#### Corners



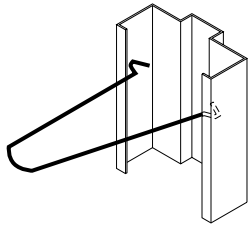
### Common Wall Conditions



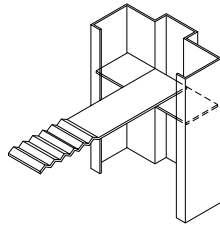


# Special Frame Construction Details and Typical Hardware Preparations

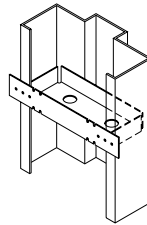
## Anchor Details



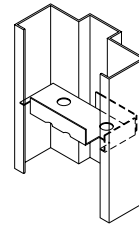
**Masonry Wire Anchor**



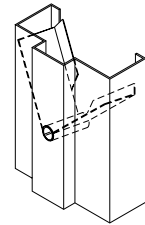
**Masonry Tee Anchor**



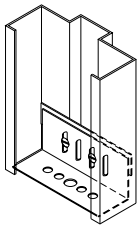
**Wood Stud Anchor**



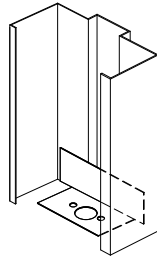
**Steel Stud Anchor**



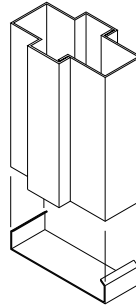
**Existing Wall Anchor**



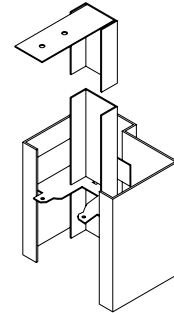
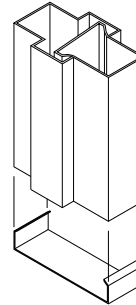
**Adjustable Base Anchor**



**Standard Base Anchor**

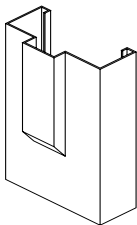


**Typical Mullion Sections  
with Base Anchor**

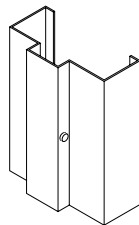


**Plaster Partition Anchor  
(Ceiling Strut Optional)**

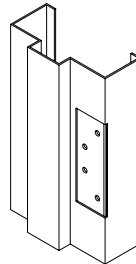
## Special Frame Details



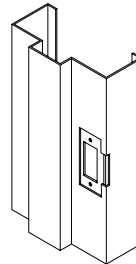
**Hospital Stop**



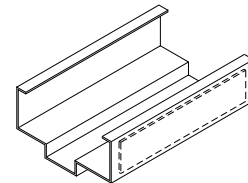
**Rubber Silencers**



**Mortise Hinge**



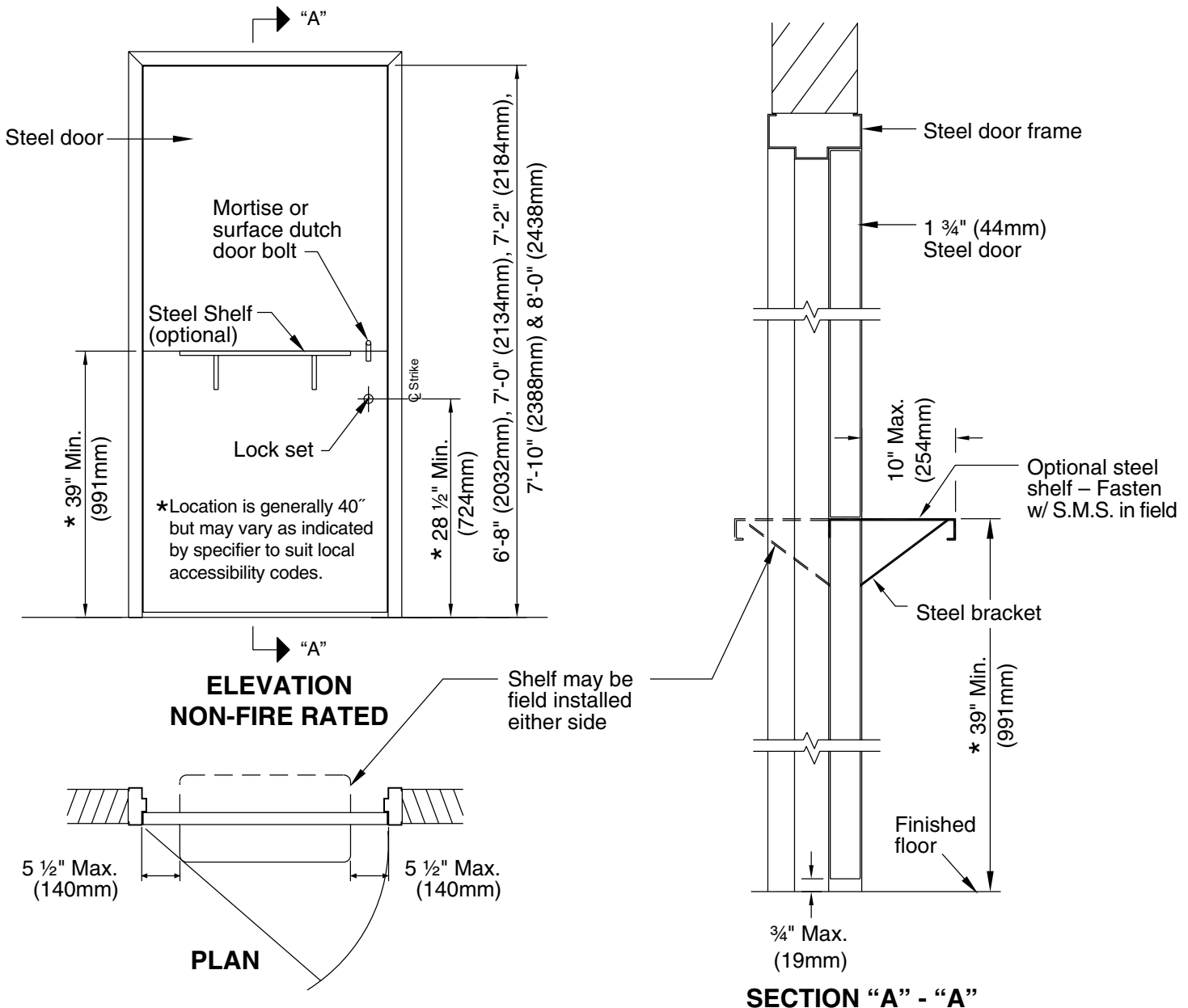
**Strike**

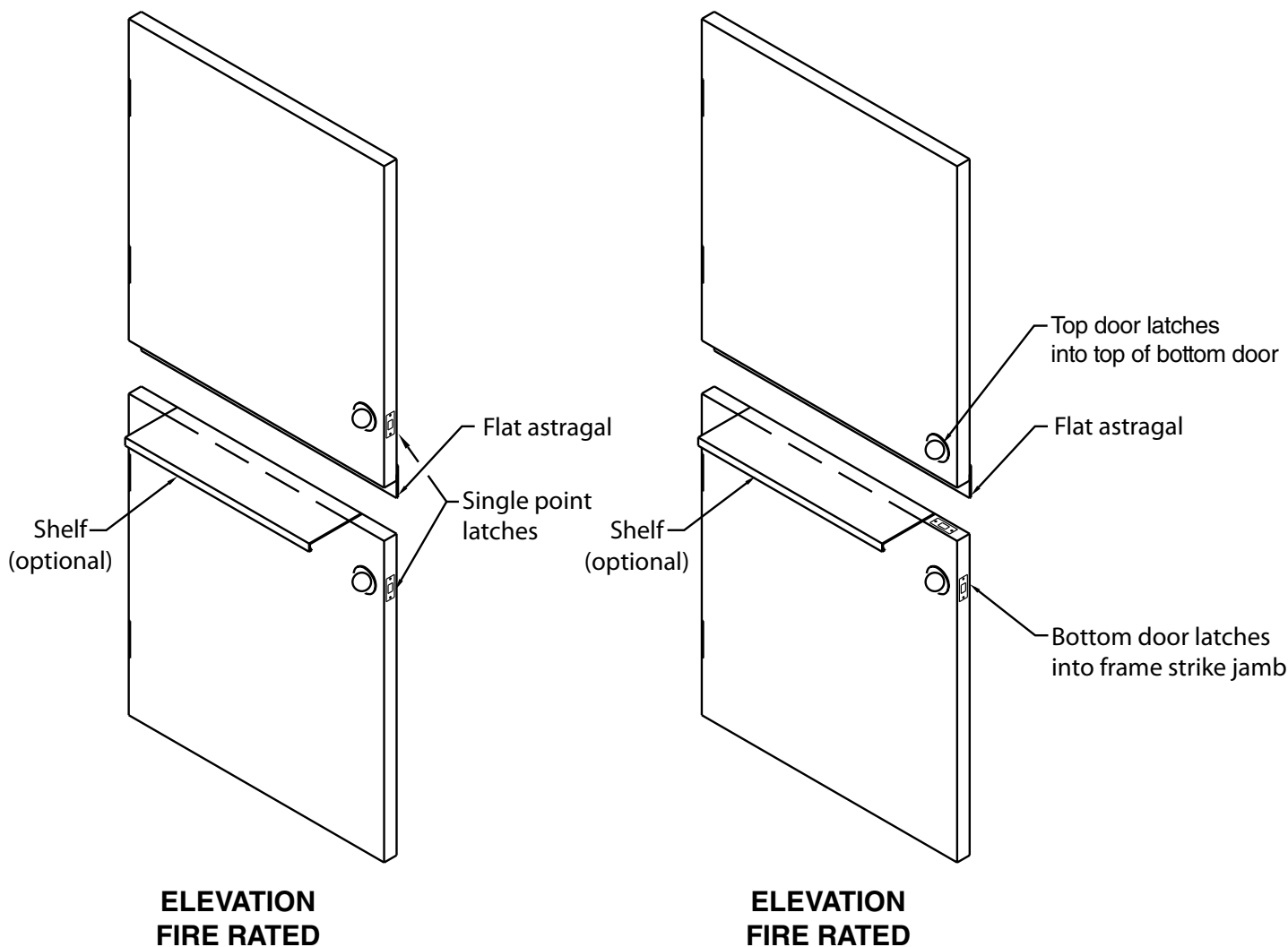


**Surface Hardware Reinforcement.  
Weld-in Reinforcement Shown,  
Loose Reinforcing Sleeve Available  
for Field Installation.**

## Hardware Preparations

## Recommended Standard Details for Dutch Doors





*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.

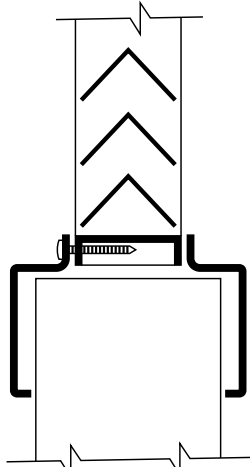
The percentages noted above are approximates. Consult the individual manufacturer’s literature for the specific sizes and ratings normal to their program.

**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.

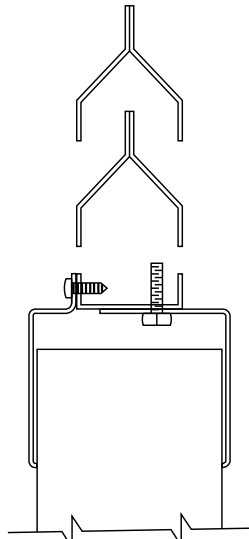
**Full louver doors** – A minimum 5” (127.0mm) rail occurs at the top and at the vertical stiles and an 8” (203.2mm) minimum rail occurs at the bottom of these doors (Consult door manufacturer for exact stile/rail dimensions). Stile and top rail sizes must be coordinated with closer dimensions, lock 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.

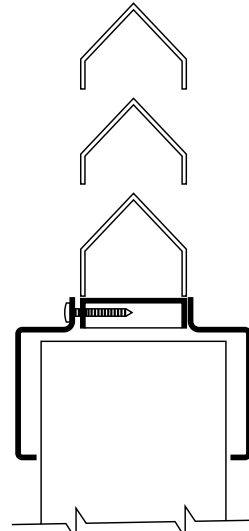
## Cross Section Details



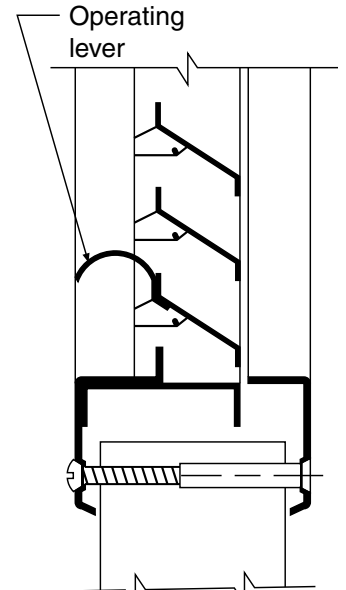
Inverted "V" Blade



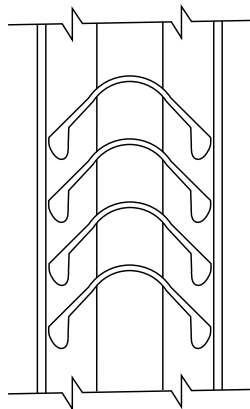
Inverted "Y" Blade



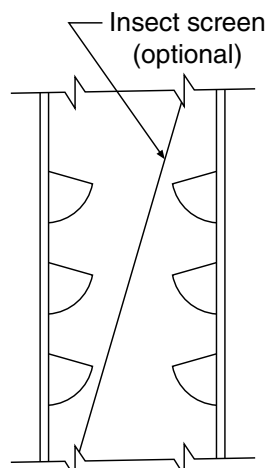
Chevron or Hood-Type  
Blade



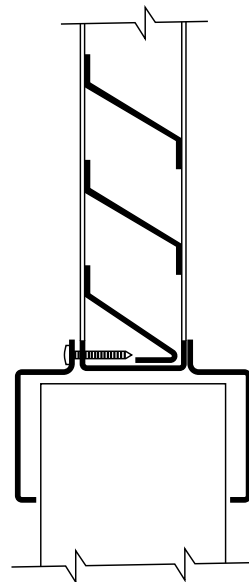
Fusible Link



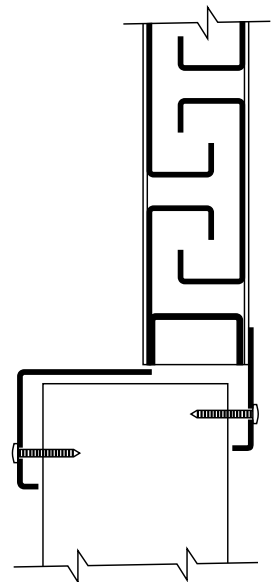
Grille



Pierced



"Z" Blade



Lightproof

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

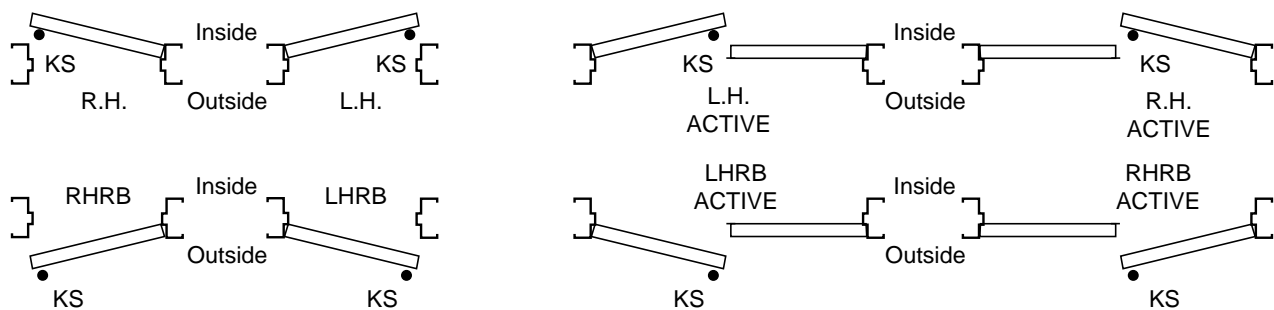
The purpose of this publication is to establish a guide for architects and those responsible for scheduling doors, frames, and hardware requirements.

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.

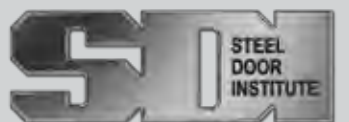
Items not specifically covered in the schedule may be listed in the "Remarks" and extra columns near the end.

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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[illegible]

**(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.

- (2) Thresholds, when required, are to be noted in "Hardware" column of schedule.
- (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](http://www.buildershardware.com)

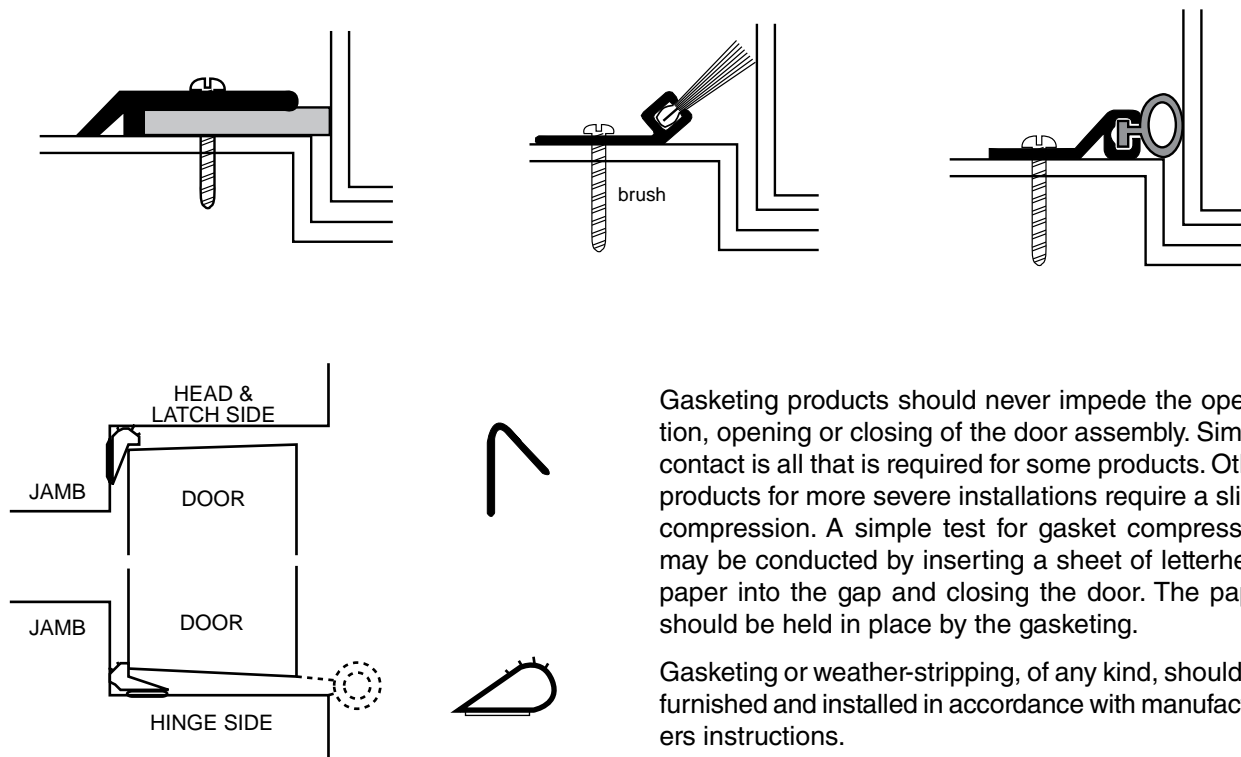
# Recommended Guidelines for the Use of Gasketing and Thresholds for Standard Steel Doors and Frames

## 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.



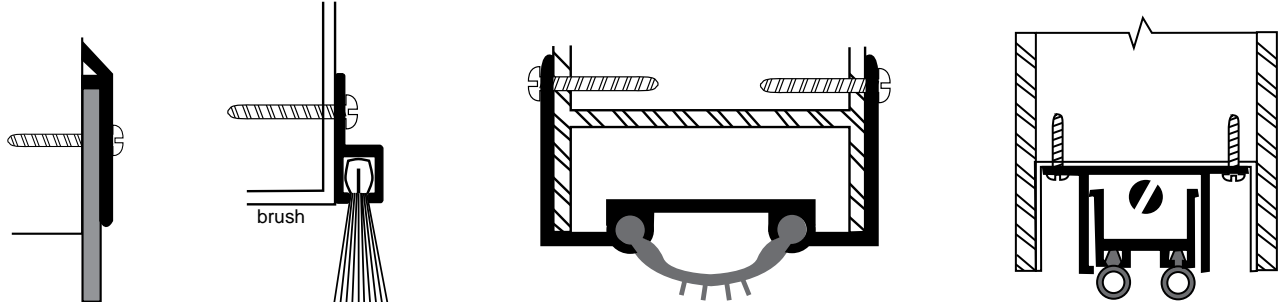
Gasketing products should never impede the operation, opening or closing of the door assembly. Simple contact is all that is required for some products. Other products for more severe installations require a slight compression. A simple test for gasket compression may be conducted by inserting a sheet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

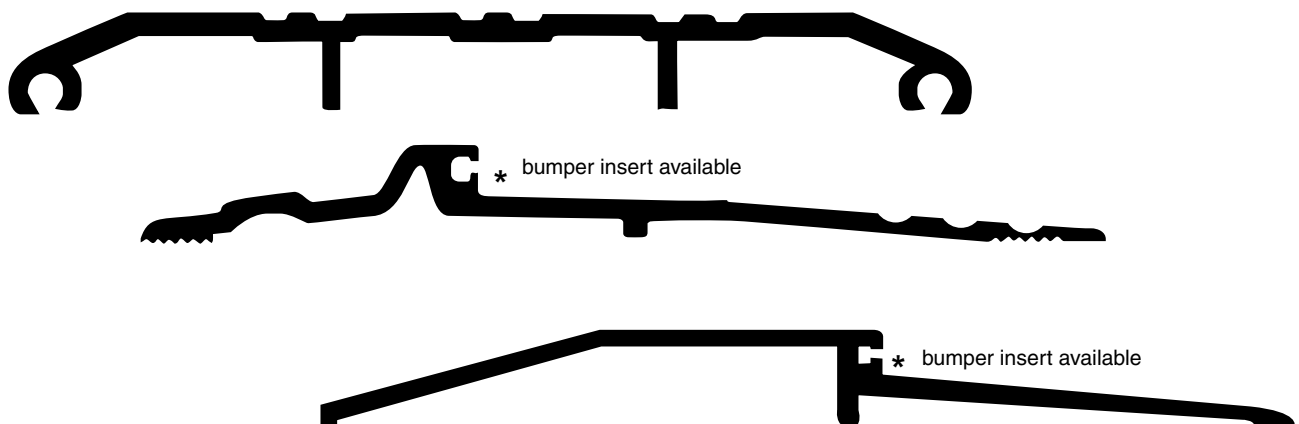
Sealing of door edges at meeting stiles, in lieu of or in addition to factory mounted astragals is accomplished by supplemental gasketing. This gasketing may be closely abutting fixed members or by overlapping strips in metal retainers.

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

*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.

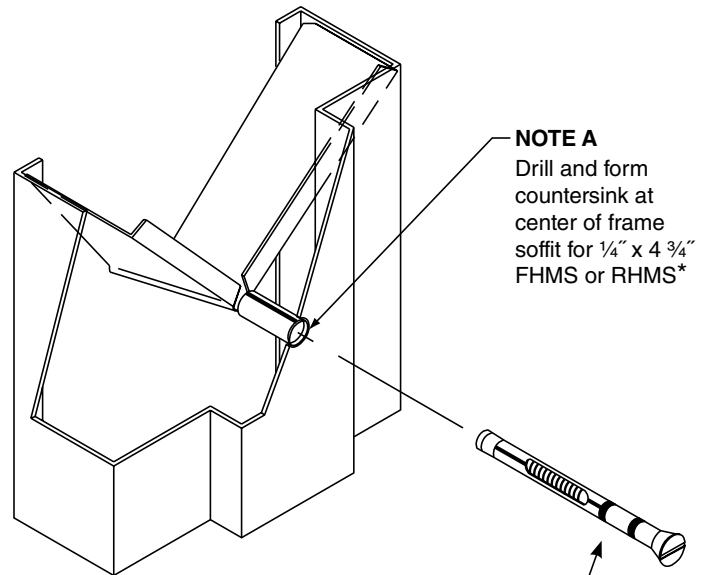
It has been "customary" to allow  $\frac{1}{4}$ " clearance around the frame perimeter when establishing rough opening sizes or when figuring non-standard overall frame sizes. Although this dimensional requirement does not appear in Industry publications, it is based on the following:

- 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.

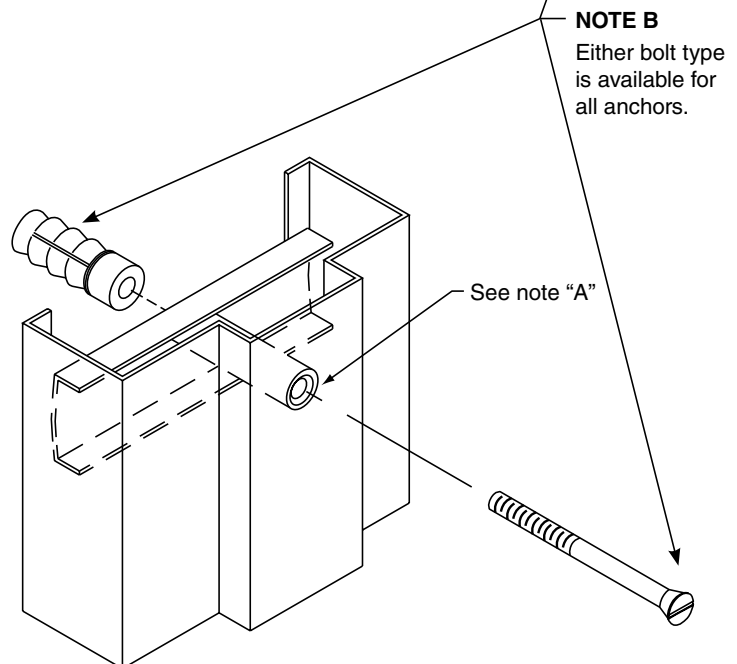
Frames will "fit and function" if made to these dimensional tolerances and installed within tolerances.

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

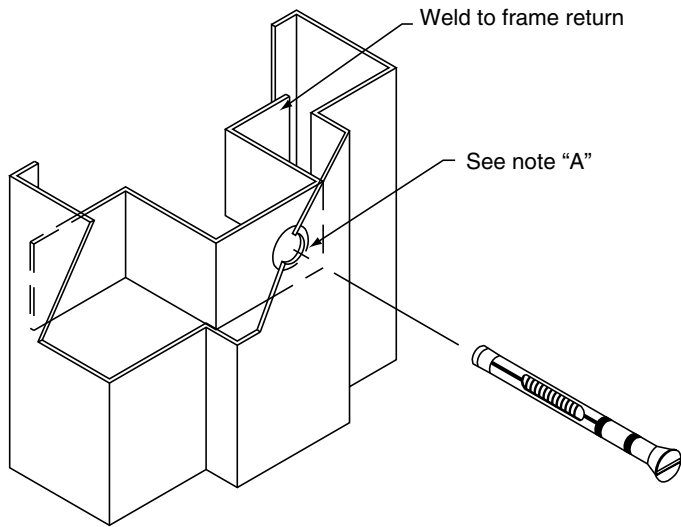
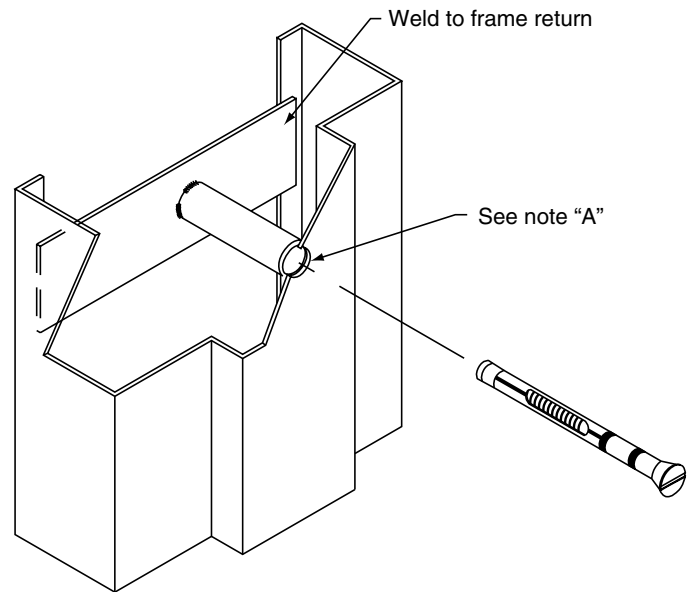
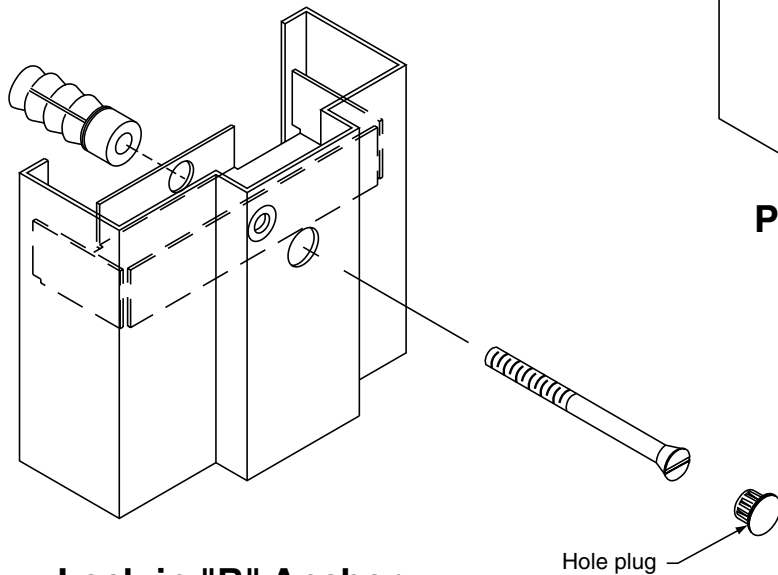
We therefore recommend that the rough openings for these cases be no less than  $\frac{3}{16}$ " larger on all 3 sides than the "intended" overall frame size. (Example: 3070 standard frame =  $3'-4\frac{3}{8}" \times 7'-2\frac{3}{16}"$ ). The installer carries the responsibility for shimming and aligning 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**

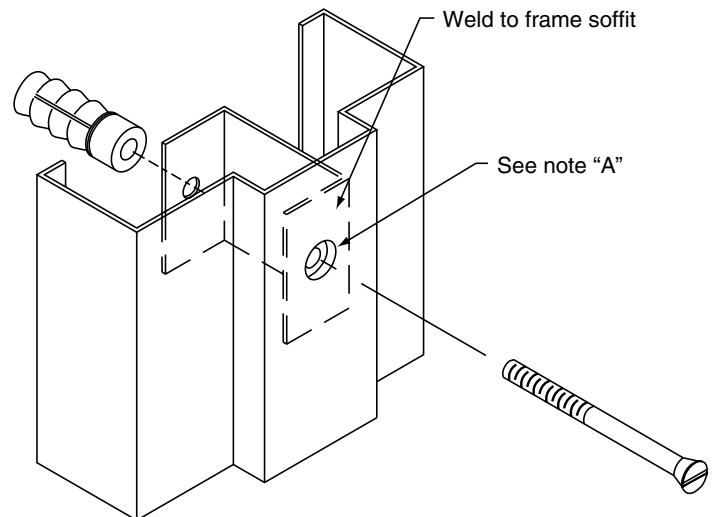
**Hat Anchor****Pipe Anchor****Lock-in "B" Anchor****NOTE C**

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

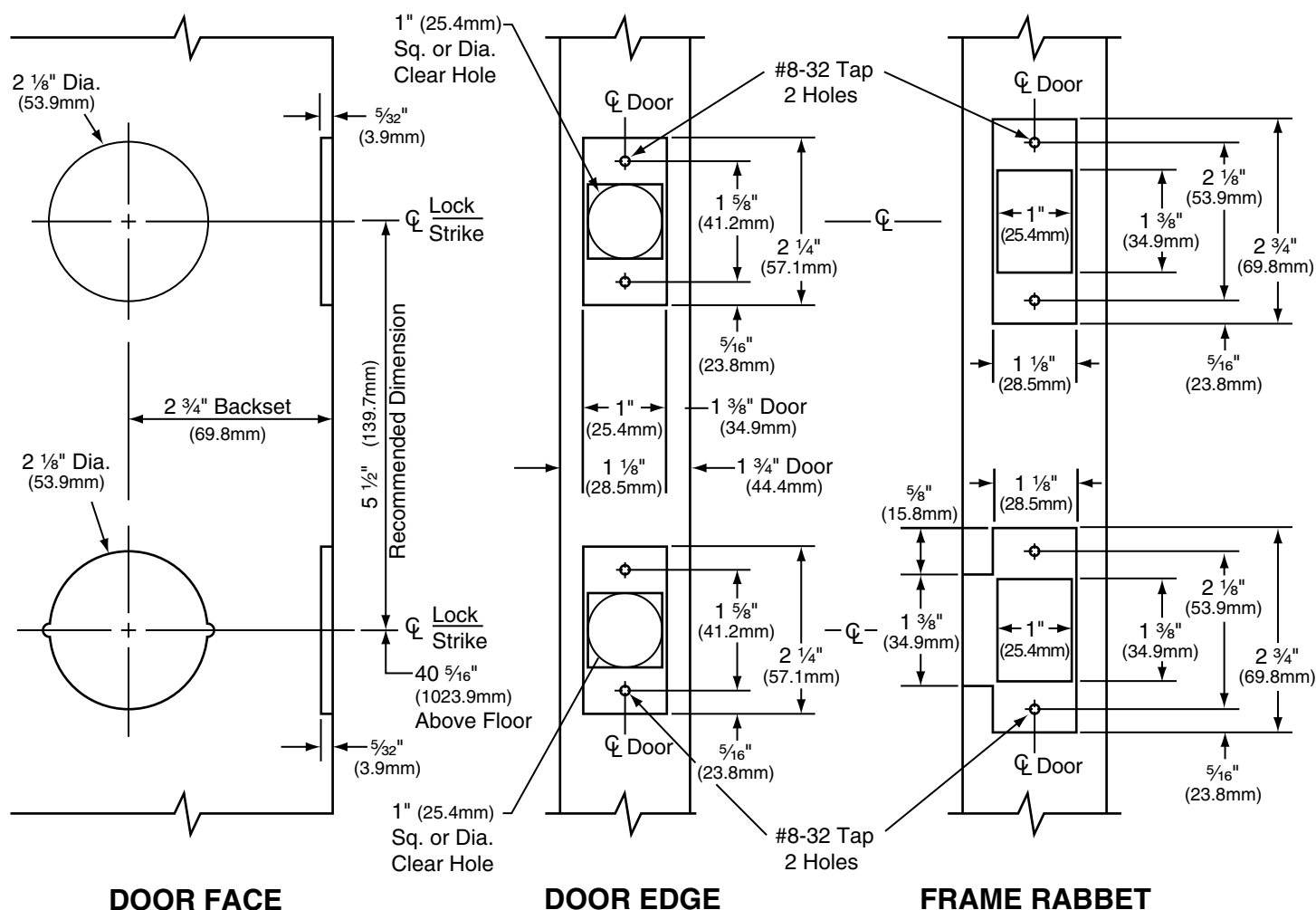
**NOTE D**

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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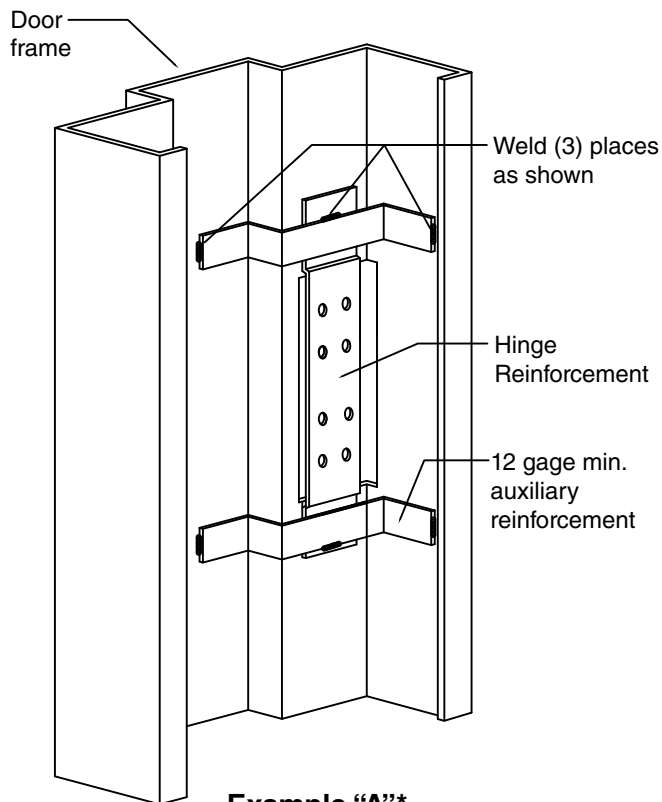
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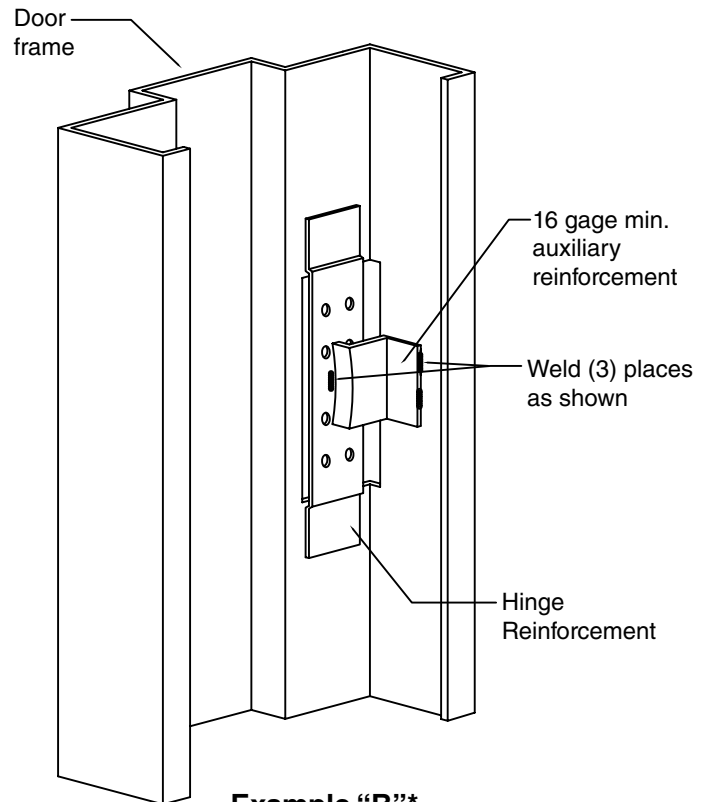
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## High Frequency Hinge Preparations for Frames



**Example "A"**\*



**Example "B"**\*

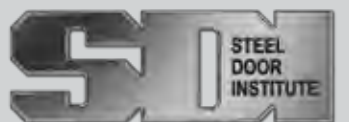
### Background:

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 reinforcement 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

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- SDI-122** Installation Troubleshooting Guide for Standard Steel Doors & Frames

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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)
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### Test Procedures

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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, *Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus*, ASTM C1199, *Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods* and ASTM E1423 *Standard 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 with definitive information regarding manufacturing tolerances of standard steel doors and frames. This document is not to be referenced for manufacturing tolerances of specialty products, i.e., bullet, acoustical, windstorm. This document is intended for in-plant inspections. It may be used as a reference document 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/SDI A250.8, *Specifications for Standard Steel Doors and Frames*. It is not intended to be a reference for specialty doors or unusual door and frame conditions.

## 2 Reference Documents:

ANSI/SDI A250.8-2017 *SDI 100 Specifications for Standard Steel Doors & Frames*

ANSI/SDI A250.6-2020 *Recommended Practice for Hardware Reinforcings on Standard Steel Doors and Frames*

ANSI/SDI A250.3-2019 *Test Procedure & Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors & Frames*

ANSI/SDI A250.10-2020 *Test Procedure & Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors & Frames*

ANSI/SDI A250.11-2022 *Recommended Erection Instructions for Steel Frames*

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

ASTM A568-2019 *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*

ASTM A653-2018 *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM A924-2022 *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*, 2022 Edition.

SDI 122-2021, *Installation and Troubleshooting Guide for Standard Steel Doors and Frames*

SDI 134-2020 *Glossary of Terms for Hollow Metal 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  $\pm 2$  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.

### 3.3 Metric

Values stated without parenthesis are the requirement. Values in the parenthesis are explanatory or approximate information.

## 4 Materials and Finishes

### 4.1 Steel Thickness

Manufacturers no longer order sheet and coil to a specific gauge, but rather to a minimum decimal thickness. This thickness is the lowest of the range for a specific gauge. 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 test facilities and labeling agencies such as UL Solutions, and ITS/Intertek Testing/War-nock Hersey. Examples of minimum allowable steel thickness:

Gauge (MSG)	Minimum
20	0.032"
18	0.042"
16	0.053"
14	0.067"
12	0.093"
10	0.123"
7	0.167"

Gauge (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/ft<sup>2</sup> total both sides.

A60 = 0.60 oz/ft<sup>2</sup> total both sides.

For reference, 1 oz/ft<sup>2</sup> = 1.7 mils thickness.

## 4.3 Factory Applied Coatings

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 Coatings 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 in Figure A:

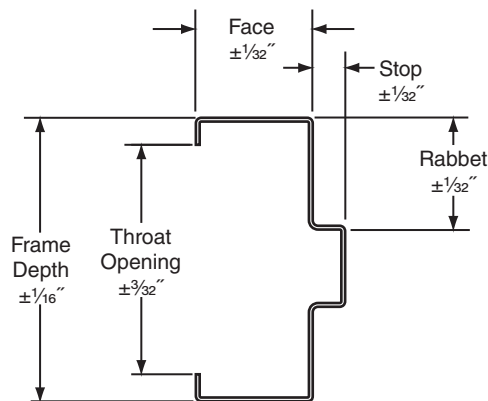


Figure A – Profile Tolerances

### 5.2 Frame Opening & Vertical Locations

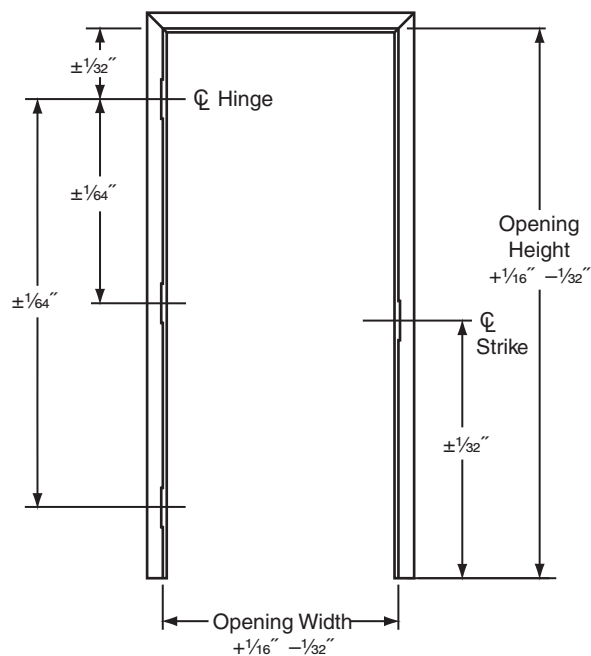


Figure B – Opening Tolerances

### 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.

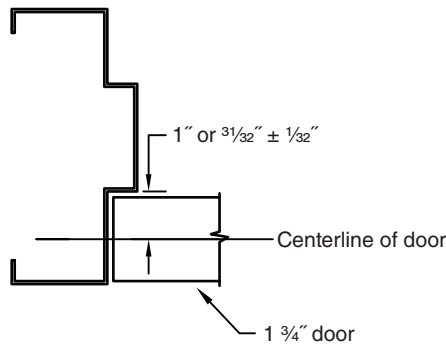


Figure C – Horizontal Alignment

### 5.5 Frames with Lights or Panels

Opening sizes (width or height) for side lights 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  $\frac{1}{8}$ ". (Reference Figure D.)

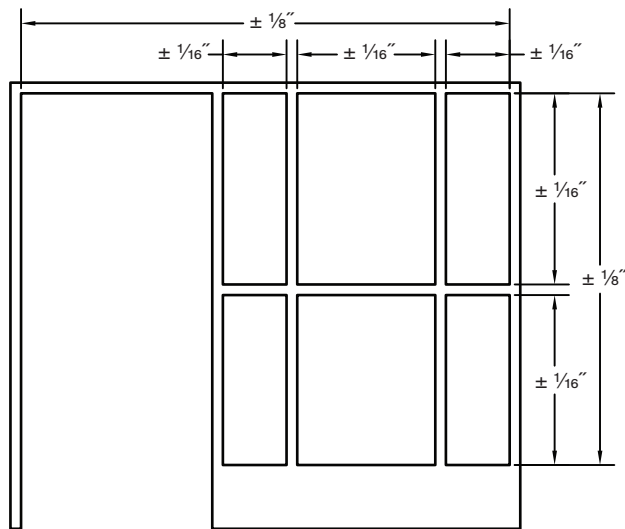


Figure D – Frames with Lights or Panels

## 6 Door Tolerances

### 6.1 Door Size, Thickness, and Vertical Locations

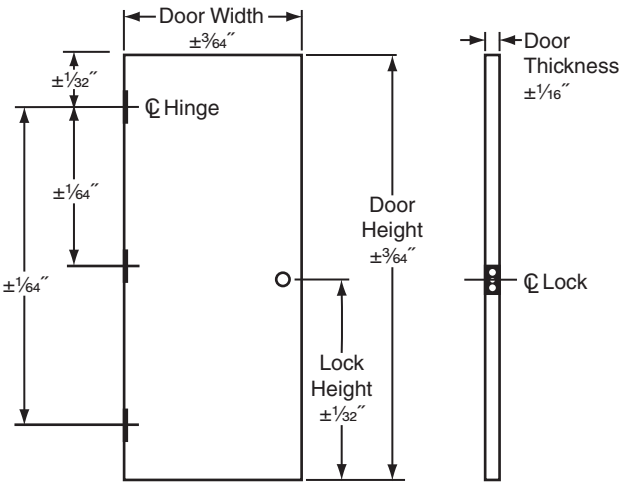


Figure E – Doors

### 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. (Reference Figure F.)

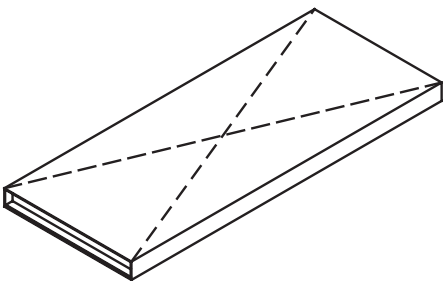


Figure F – Squareness

### 6.3 Door Perimeter Flatness

Using a straightedge suitable for the size of the door, the 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. (Reference 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.

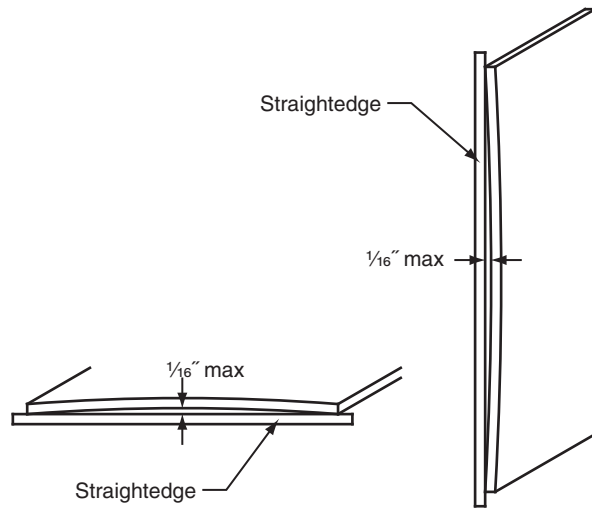


Figure G – Flatness

### 6.4 Door Face Bow or Crown (Flatness)

When a straightedge suitable for door size 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. (Reference Figure H.)

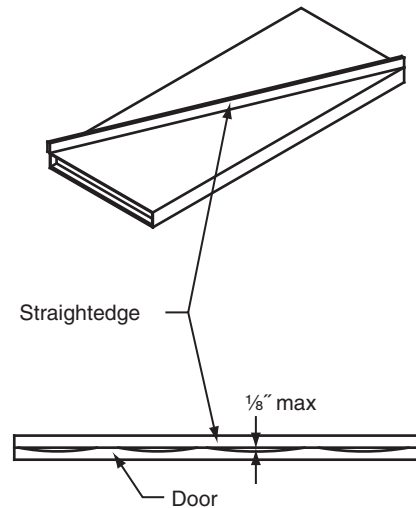


Figure H – Flatness

### 6.5 Door Twist

The door is laid on 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 or surface and the door face at all four corners of the door. Any deviation space between the face and the support blocks shall not allow a 0.0625" rod or block to pass. An additional two blocks shall be inserted between fixture or surface and the door face at or near mid points of door height.

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

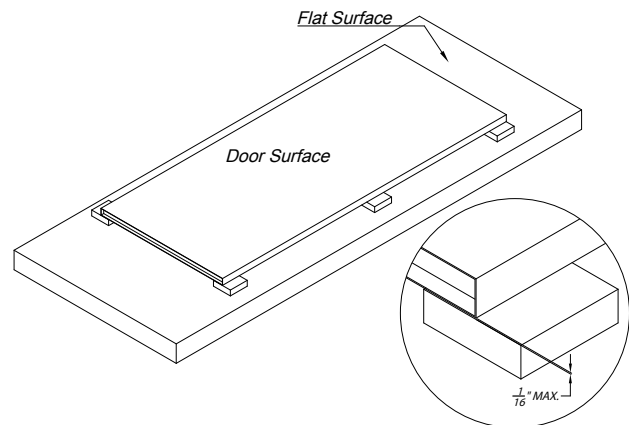


Figure I – Door Twist

## 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 5.2 and 6.1.

### 7.2 Horizontal Alignment

Tolerances for horizontal alignment of door and rabbet are as noted in Paragraph 5.4.

### 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

To allow for field adjustments, typically 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  $1/16"$ .

#### 7.3.2 Depth for Recessed or Concealed Hardware

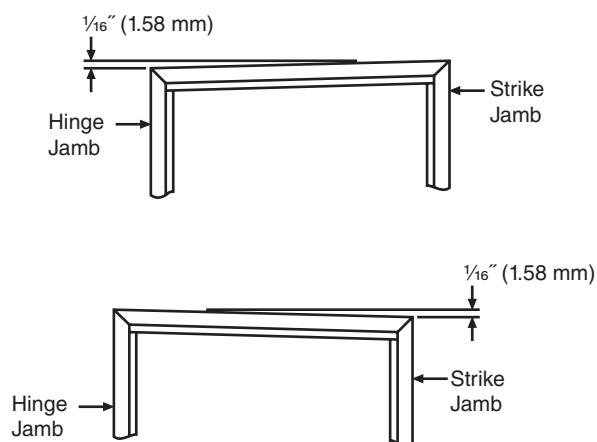
The depth for hardware items recessed into top or bottom of doors or edges of doors (such as pocket pivots, floor closers, top pivots, concealed closers or holders, etc) shall be as defined on manufacturer's templates subject to an additional tolerance of  $+1/16" - 0"$ . Notches in door faces shall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

## 8 Frame Installation

### 8.1 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.

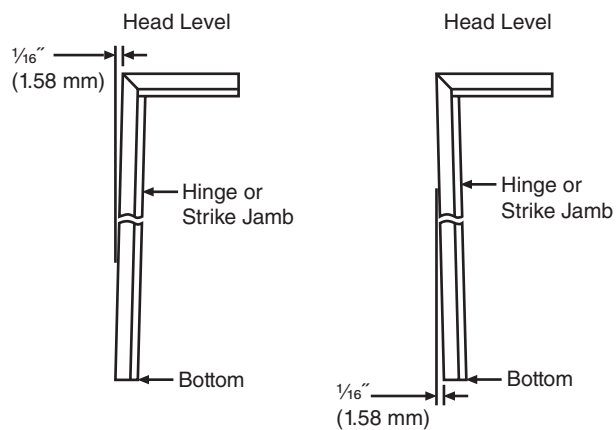
Figures "J-K-L-M" show examples of the accuracy to be maintained while setting and installing frames. Instructions for installation may be found in ANSI/SDI A250.11.



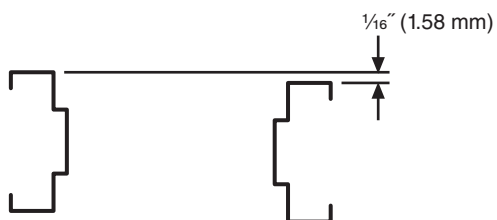
Maximum 1/16" allowable tolerance on total opening.

**Figure J – Squareness**

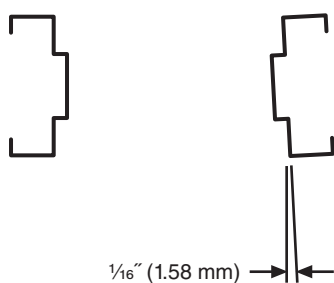




**Figure K – Plumbness**



**Figure L – Alignment**



**Figure M – Twist**

## 8.2 Troubleshooting

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

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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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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and Window Frame  
Requirements**



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

## 1 Introduction








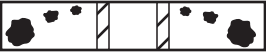
Fire testing of doors, door frames, transom/sidelight frames, window frames, glazing, and hardware and the resulting labeling programs granted by third-party testing agencies are complex subjects better understood when basic rules and guidelines are applied. The following information is based upon the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

Note: Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

## 2 Doors

The fire-protection classification of the wall into which the door is installed dictates the required fire-protection rating of the door. The location of the wall in the building and prevailing building codes establish the fire-protection rating requirements for the wall. Fire door assemblies are often required to also act as smoke and draft control barriers by the building code in addition to the specified fire-protection rating. For openings in a smoke partition, no fire-protection rating is required for the door assembly but the door cannot exceed the code's maximum air

**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.
	½ Hour	⅓ Hour (20 minute)	These openings are in corridors where smoke and draft control is required.
	No Fire-protection rating	Smoke and draft control	These openings are in partitions required for smoke control in a building. No fire resistance rating is needed for the door assembly. The air leakage rate for the assembly cannot exceed 3.0 CFM/ft² at 0.10 inch (0.9 m³/min./m² at 25 Pa).



leakage rate. The associated door fire-protection ratings are shown in Table 1.

## **2.1 Hourly ratings**

Steel fire doors are “rated” by the duration of time (in minutes or hours) that a door has successfully withstood exposure to fire test conditions. Hourly ratings include 1-½-hour (90 minute), 1-hour (60 minute), ¾-hour (45 minute), and ⅓-hour (20 minute), with the maximum rating required of any swinging type fire door being 3-hour (180 minute). All doors have been subjected to a hose stream test, unless otherwise noted on the label.

## **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.

## **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.

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 Smoke and Draft Control Door**

Doors marked as smoke and draft control door assemblies will be used in smoke partitions with no fire resistance rating. These doors are used to control the passage of smoke from room to room where the partition must only provide smoke and draft control. The door and frame assembly with all hardware and gasketing are required to have a maximum leakage rate not to exceed 3.0 CFM/ft<sup>2</sup> at 0.10 in. (0.9 m<sup>3</sup>/min./m<sup>2</sup> at 25 Pa) of water. These assemblies will be indicated by a leakage-rated door assembly label. These assemblies must be tested in accordance with UL 1784 and installed in accordance with NFPA 105. For double egress doors used as cross corridor smoke barriers, please refer to Section 15.

## **2.9 Summary**

Doors are typically 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 exceptions are the 1-hour and the ⅓-hour rated doors which are typically used with one-hour rated walls. However, a door with a higher fire-protection 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” (6.35 mm) thick was once the most common type of glazing in fire-rated assemblies but is

generally prohibited for use in areas subject to human impact. For this reason, ceramic and other non-wired glazing materials, along with filmed wire glass, are now the most common types of glazing used in fire-rated assemblies. For glazing materials, the maximum exposed area per individual light, the minimum groove depth, glazing compound and the rating shall be as indicated in the individual manufacturer's published listings. Consult the door and glazing manufacturers for the limitations of size, area and number of vision lights in a door.

The vision light kit or window frame used for glazing materials 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, door frames, and transom/sidelight frames in accordance with UL 10C or NFPA 252 and borrowed light frames in accordance with UL 9 or 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 or 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, explained in the next section.

Fire protection and fire resistance glazing installed in fire doors and fire-rated 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").

The reader may also wish to review NFPA 80, Chapter 4, *Glazing Material in Fire Doors* for additional information on this topic.

The manufacturers' listings for fire door, transom/sidelight frame, window frame, and glazing may be obtained through the listing agencies as follows:

## UL

Use the following link to access the UL "Online Certifications Directory". Enter the "UL Category Code" indicated below for a listing of approved manufacturers or search by company name or product type.

<https://productiq.ul.com> (*link valid as of 7/13/2021*)

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](https://bpdirectory.intertek.com/Pages/DLP_Search.aspx) (*link valid as of 12/14/2021*)

## 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. These doors are fire-resistance rated, as opposed to fire-protection rated. 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 (139°C), 450°F (250°C), and 650°F (361°C), and the ratings 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. In some applications the International Building Code (IBC) requires a 450° F (250°C) temperature rise rating for doors, interior exit stairs and ramps, and exit passageways. The 250°F (139°C) temperature rise designation is the most stringent rating of the three, since it

requires the most limited rise in temperature. A 250°F (139°C) temperature rise door meets the requirements of specifications calling for a 450°F (250°C) or 650°F (361°C) temperature rise rating.

## 5 Louvers

Listed louvers are permitted in 1-½-hour and ¾-hour fire doors where the louver is 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 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 for 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.

Unless otherwise stated in the manufacturer's certification, grout or any other filler material is not required for transom and sidelight frames installed in either drywall or masonry walls for any hourly rating.

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

## 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. Individual glazing material exposed areas are not to exceed 1296 square inches (32.92 m<sup>2</sup>) and the dimension for width or height shall not exceed 54 inches (137.16 cm) 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 installation in drywall walls. Unless otherwise stated in the manufacturer's certification, grout or any other filler material is not required for fire window frames installed in either drywall or masonry walls at any hourly rating.

## 9 Fire doors with builders hardware

Fire doors with builders 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 online listings published by UL LLC and Intertek. These listings identify hardware and other products that may be used in fire-rated assemblies. The information can also be accessed at the following links:

## UL

<http://productiq.ul.com> (link valid as of 10/16/2020)

Search by type of hardware, company name, or UL Category Code such as GXHX or GYJT.

## Intertek Testing Services (Warnock Hersey)

[https://bpdirectory.intertek.com/Pages/DLP\\_Search.aspx](https://bpdirectory.intertek.com/Pages/DLP_Search.aspx) (link valid as of 12/14/2021)

NFPA 80 provides requirements for installing fire doors, frames, and hardware in the building openings, as well as requirements for annual inspection, testing and maintenance.

### 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 ball-bearing hinges 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-protection 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. 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 (3.4 mm) leaf thickness) 4-½" (114.3 mm) steel hinges as a minimum on 1-¾" (44.45 mm) doors up to 4'-0" (1.22 m) in width and 8'-0" (2.44 m) in height. Doors over 8'-0" (2.44 m) in height shall have heavy weight (.180 inch (4.6 mm) leaf thickness) 4-½" (114.3 mm) hinges as a minimum. Some manufacturers have the capability of providing lighter weight hinges on doors over 8'-0" (2.44 m) 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 listed and 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 simultaneously 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 listing. 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. 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 a cycling test in accordance with 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. The cycling test ensures that the hardware is durable and does not malfunction due to every day use.

Care must be taken when selecting exit devices for use on fire-rated doors, as some devices have been tested for panic applications only, and have not been fire tested. In addition, exit devices have size and hourly rating restrictions, and must be properly labeled and identified as fire exit hardware.

NFPA 80 provides additional guidance on use of other listed hardware in conjunction with fire exit hardware devices.

### 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 ANSI/BHMA Grade 1 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 (if allowed by the local Authority Having Jurisdiction) 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 Fire resistive frames

The assemblies detailed above in sections 8 and 9, where located in *fire barriers*, are limited to 156 square feet (14.49 square meter) in area or an aggregate width of 25 percent of the length of the wall. Where either of these parameters are exceeded, the opening protective must be tested in accordance with ASTM E119 or UL 263 and have a minimum fire-resistance rating not less than the fire-resistance rating of the wall. These are referred to as fire resistive frame assemblies as they limit the radiant heat transfer through the assembly in addition to the passage of flame.

## 11 Hardware – pairs of doors

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

### 11.1 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.

## 11.2 Latching hardware

### 11.2.1 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.

### 11.2.2 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.

### 11.3 Double egress pairs

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

### 11.4 Astragals

The application of astragals on pairs of doors depend upon the individual door manufacturer's published listings. For pairs of doors that do require an astragal, the astragal shall project a minimum of 3/4-inch (19 mm) 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.

## 12 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 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, any attempt to remove the label will indicate 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, or lock edge of door or face of door, 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.

## 13 Fire test methods

There are two primary fire test methods recognized by the IBC to establish the fire-protection ratings of doors. The first is ANSI/UL 10C and is referred to as a 'positive pressure' test. The second is, NFPA 252 and is required by the IBC to be conducted under positive pressure test conditions.

Fire doors 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.

## 14 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.

### 14.1 Gaskets

Gaskets are typically 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.

### 14.2 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 to be present on the label.

## 15 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.

## 16 Field Labeling

If a product or component does not have a certification acceptable to the Authority Having Jurisdiction (AHJ) or other vested party, field labelling can be performed by a testing and listing agency that is used by the manufacturer of the product or component under review.

## 17 Field modifications

If the product or component requires a field modification, the testing / listing agency that the product or component was listed with shall be contacted by the manufacturer and provided with a description of the proposed modification. If the agency determines that the modification does not affect the integrity and fire protection capabilities of the opening and provides written authorization, then field modifications may be performed. Any modification of a non-fire-rated door assembly to achieve a fire-protection rating

must be conducted under label service (See Field Labeling) evaluation process.

## 18 Fire door inspections

The 2018 edition of the International Building Code and subsequent editions require fire door assemblies to be inspected after they are installed, in addition to the acceptance and annual requirements found in NFPA 80. Building owners must have a qualified individual inspect all components of the fire door assembly and document the results as outlined in NFPA 80. Any deficiencies noted during the inspection must be addressed with maintenance or component replacement, and a follow-up acceptance test performed.

## 19 References

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

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

ASTM E119-2020 *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 March 20, 2020

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 May 4, 2020

Underwriters Laboratories Standard for Safety ANSI/UL 10C *Standard for Positive Pressure Fire Tests of Door Assemblies*, 3rd Edition, May 27, 2021

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 September 9, 2020

Underwriters Laboratories Standard for Safety ANSI/UL 305, *Standard for Panic Hardware*, 6<sup>th</sup> 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 21, 2020

*International Building Code*, 2018

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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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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[www.republicdoor.com](http://www.republicdoor.com)

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## STEEL DOOR INSTITUTE

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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

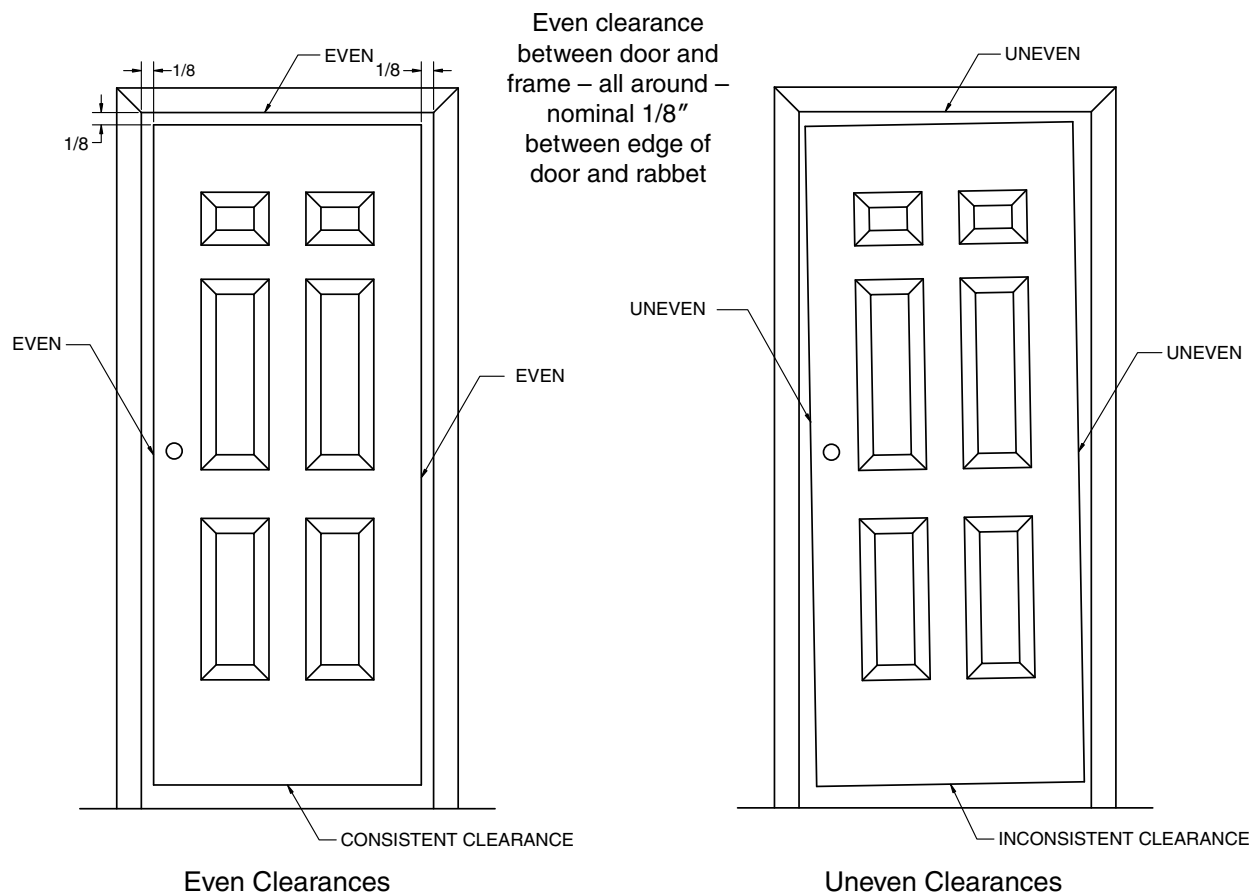
## Installation Troubleshooting Guide for Standard Steel Doors and Frames

### 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.

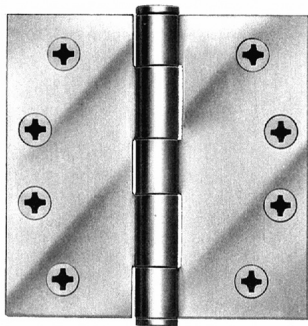
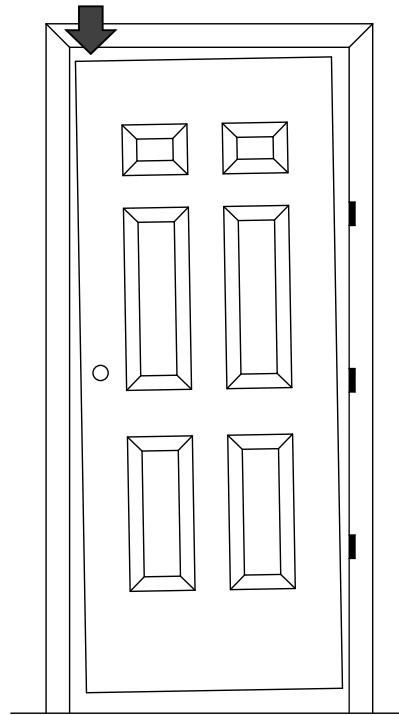
The Steel Door Institute has many publications which were developed to establish industry standards and assist in specifying as well as installing standard steel doors and frames. One publication, ANSI/SDI A250.11, *Recommended Erection Instructions for Steel Frames*, will be of assistance regarding 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.

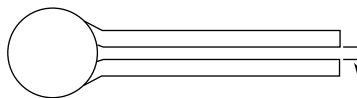
### **Are hinges worn?**

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 the proper hinge swage.

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

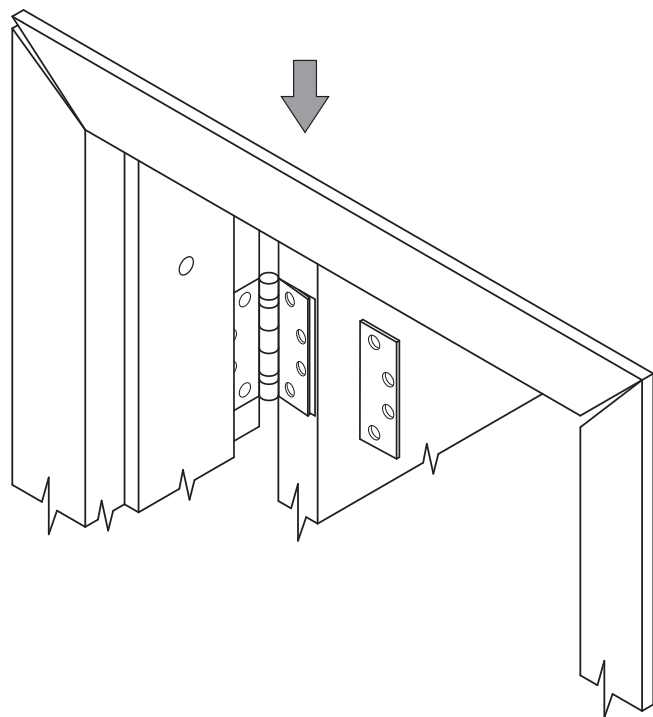
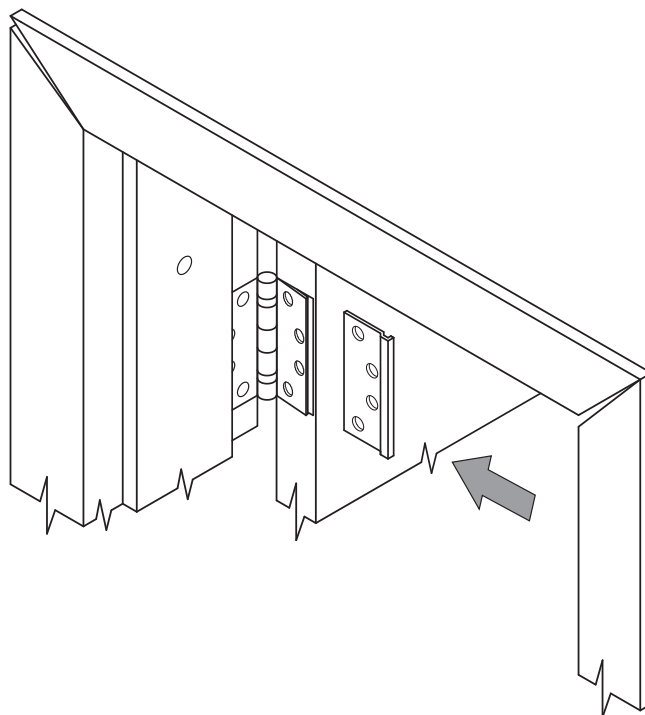


Standard swaging of standard-weight and heavy-weight full mortise hinges, when closed to the parallel position, provides a  $\frac{1}{16}$ ” clearance between leaves.

## 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.



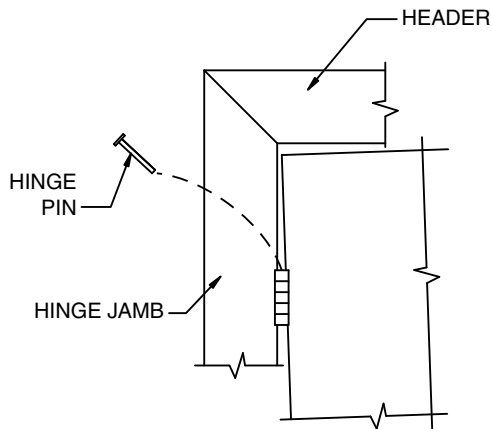
### **Add shims to bottom and/or middle hinge**

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**

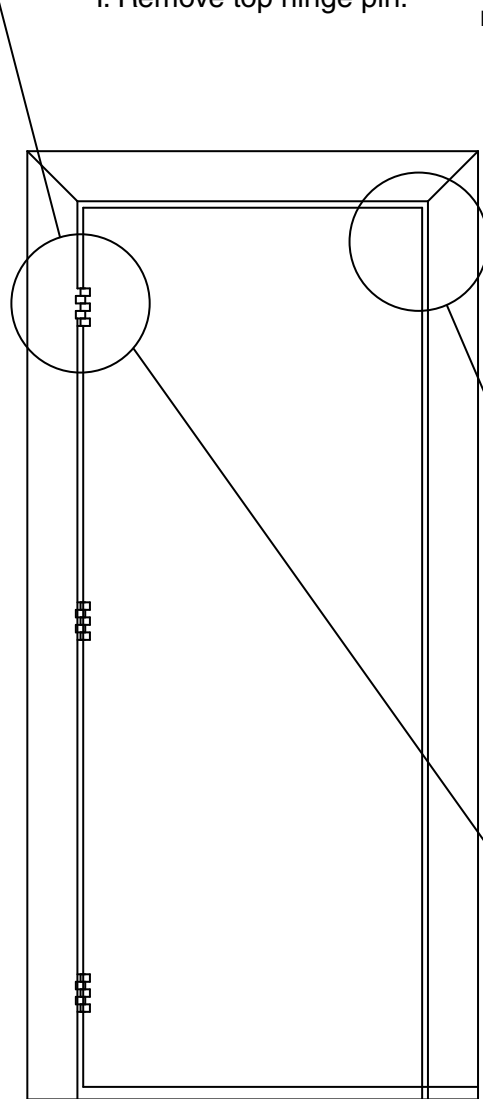
Although styles and types vary, many manufacturers offer built-in features that allow hinge pockets on doors and frames to be modified from standard-weight to heavy-weight. Examples of the different methods are: grinding or flattening down raised embossments in shim plates or reinforcements; removing 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**

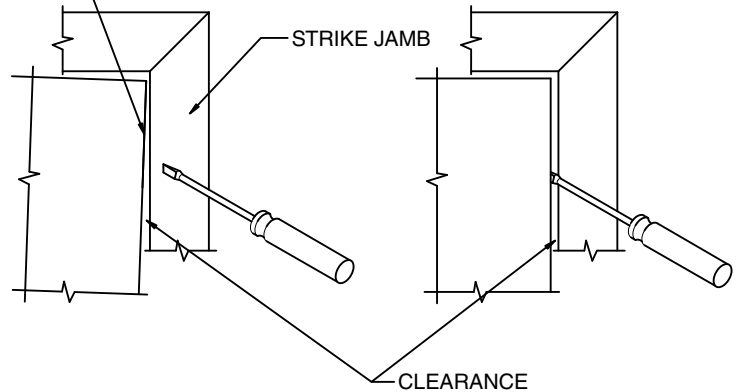
The following example shows how a hinge leaf can be reswaged to correct minor improper door/frame clearances. This particular method allows the reswaging to be accomplished while the door remains in the opening and the hinge leaves remain on the door and frame. The example shows a top hinge reswaged 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.

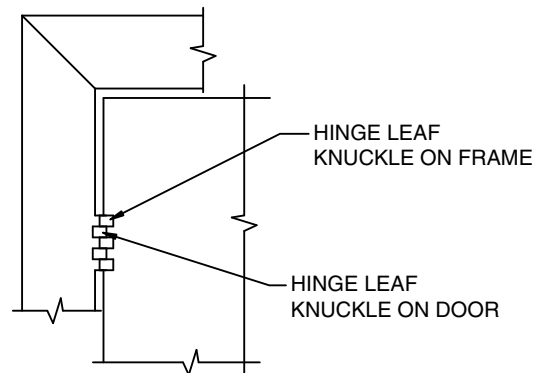


DOOR LOCK  
EDGE

STRIKE JAMB



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

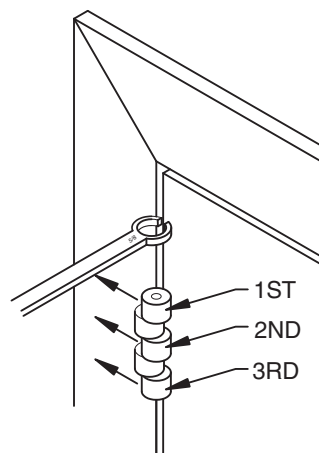


3. Hinge knuckle will now be misaligned.

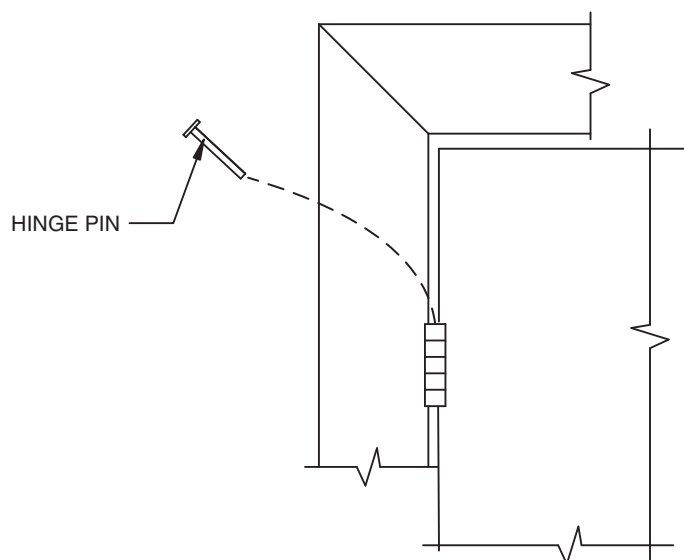
## IMPROPER DOOR / FRAME CLEARANCE *(continued)*

### 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 1<sup>st</sup> knuckle and align it with the new location. Once the first knuckle has been aligned, the wrench will now slip down to the 2<sup>nd</sup> 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.

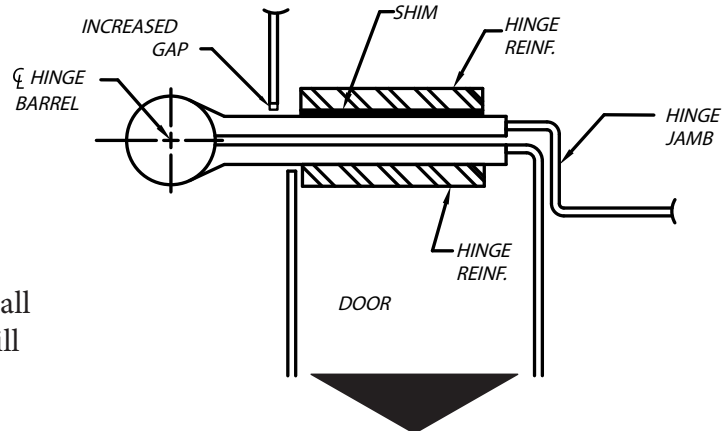
### Is the door binding?

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.

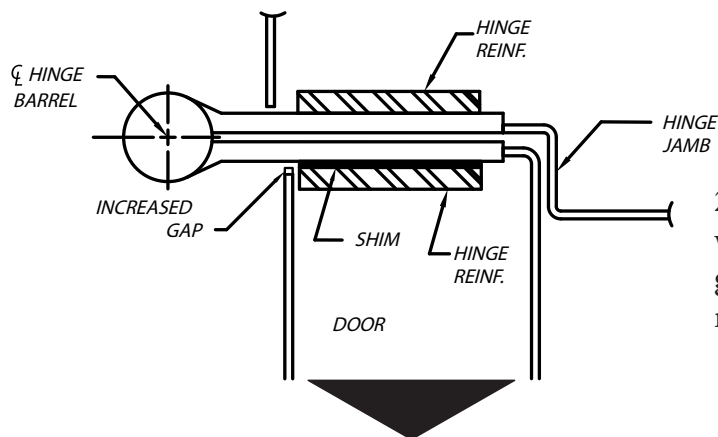
## DOOR BIND AGAINST RABBET

Normally, door 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.

2.1 This method will move the door toward the Strike jamb. It will leave a small gap between Hinge and Frame face. It will not prevent or help hinge bind.

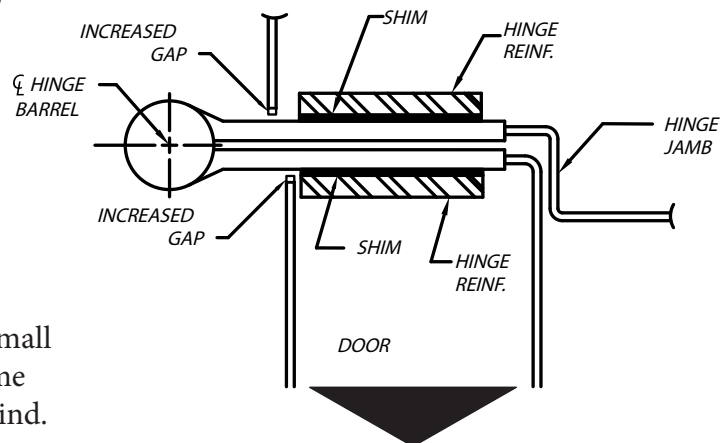


*Door - Frame - Hinge  
Full Shim - Frame*



*Door - Frame - Hinge  
Full Shim - Door*

2.2 This method will move the door toward the Strike jamb. It will leave a small gap between Hinge and Door face. It will not prevent or help hinge bind.



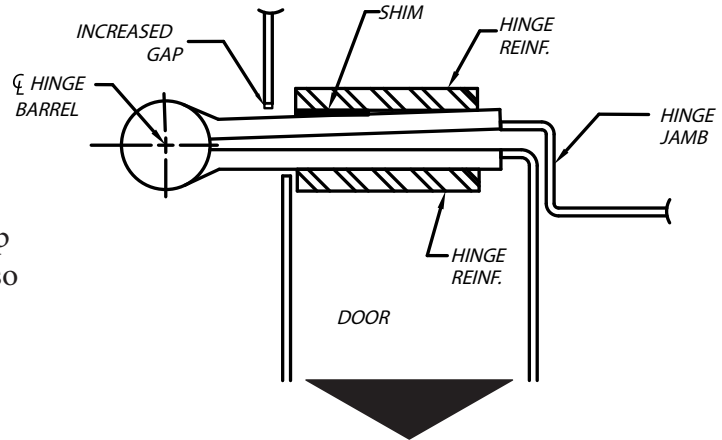
*Door - Frame - Hinge  
Full Shims - Door & Frame*

2.3 This method will move the door toward the Strike jamb. It will leave a small gap between Hinge and Door and Frame face. It will not prevent or help hinge bind.

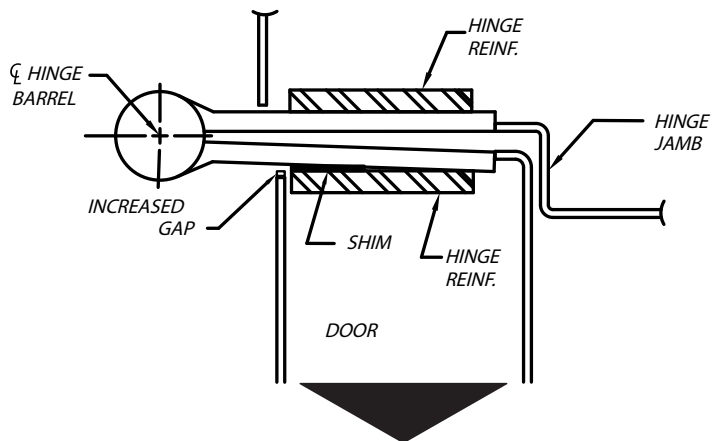
## HINGE BIND AGAINST STOPS

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.

3.1 This method will move door toward Strike jamb. It will leave a small gap between Hinge and frame face. It will also help if hinge bind is occurring.

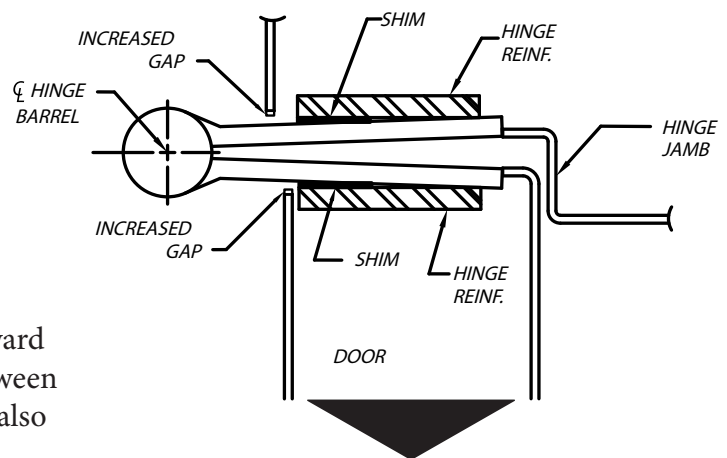


*Door - Frame - Hinge  
Half Shim - Frame*



*Door - Frame - Hinge  
Half Shim - Door*

3.2 This method will move door toward Strike jamb. It will leave a small gap between Hinge and Door face. It will also help if hinge bind is occurring.

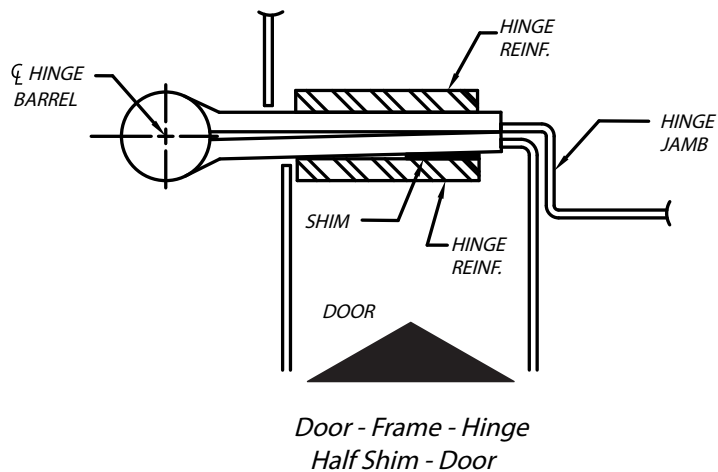
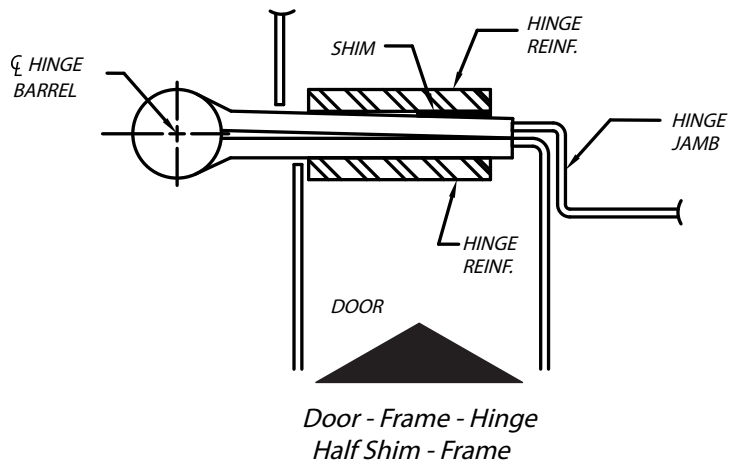


*Door - Frame - Hinge  
Half Shims - Door & Frame*

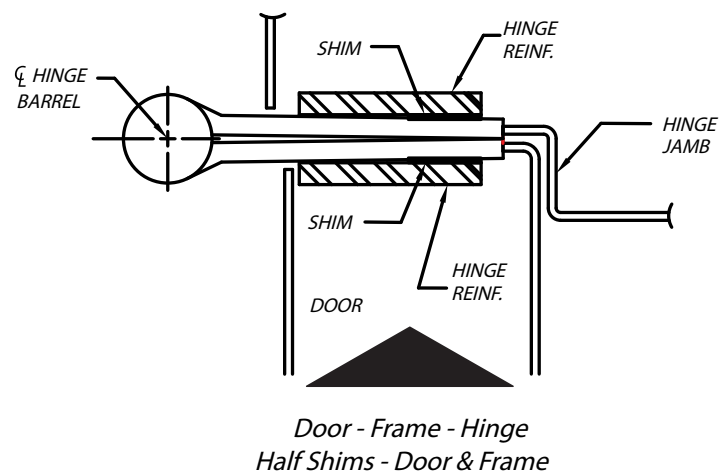
3.3 This method will move door toward Strike jamb. It will leave a small gap between Hinge and Door and Frame face. It will also help if hinge bind is occurring.

**HINGE BIND AGAINST STOPS** *(continued)*

4.1 This method will pull door toward Hinge jamb. It may create hinge bind.



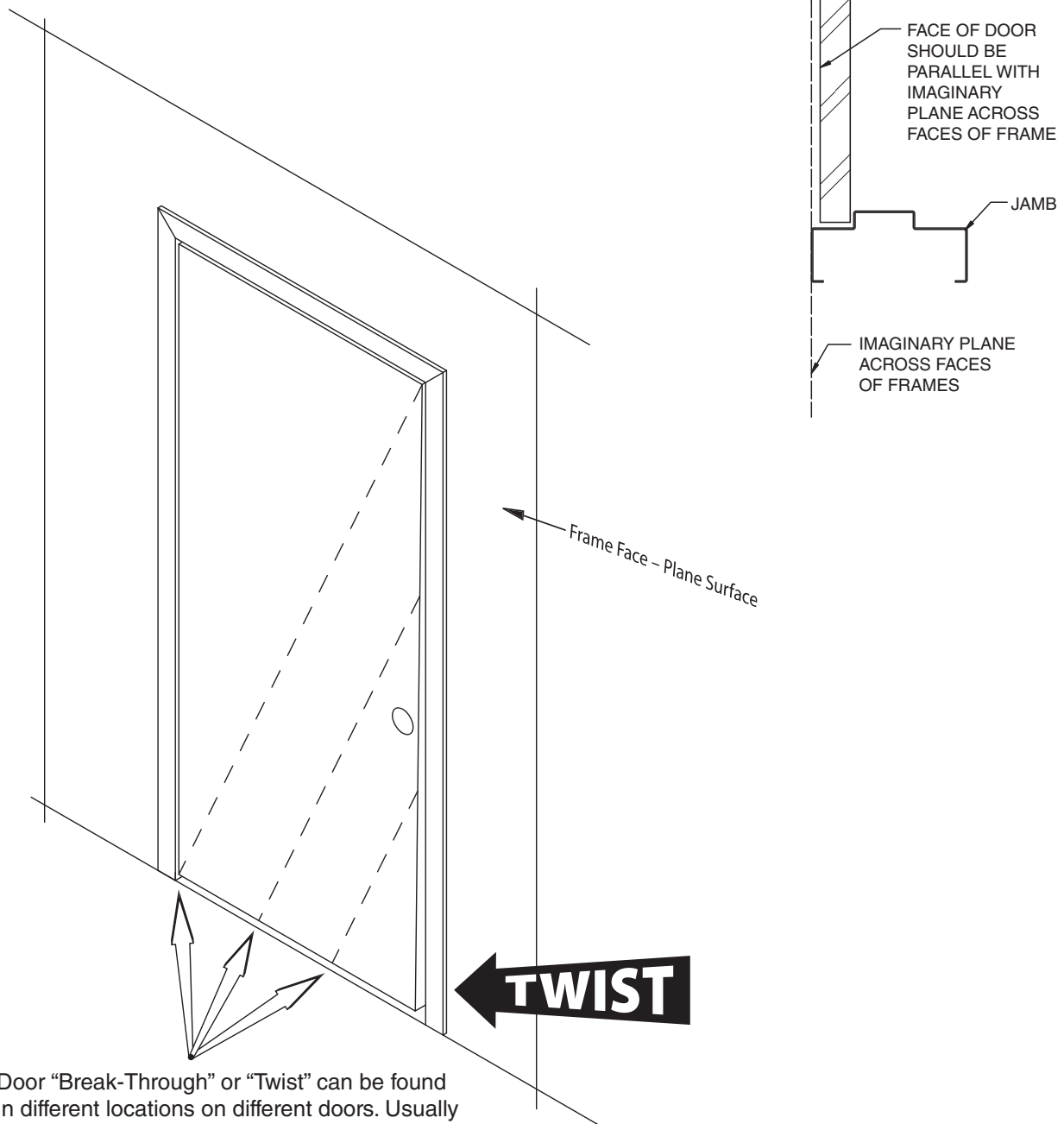
4.2 This method will pull door toward Hinge jamb. It may create hinge bind.



4.3 This method will pull door toward Hinge jamb. It may create hinge bind.

## TWISTED DOOR

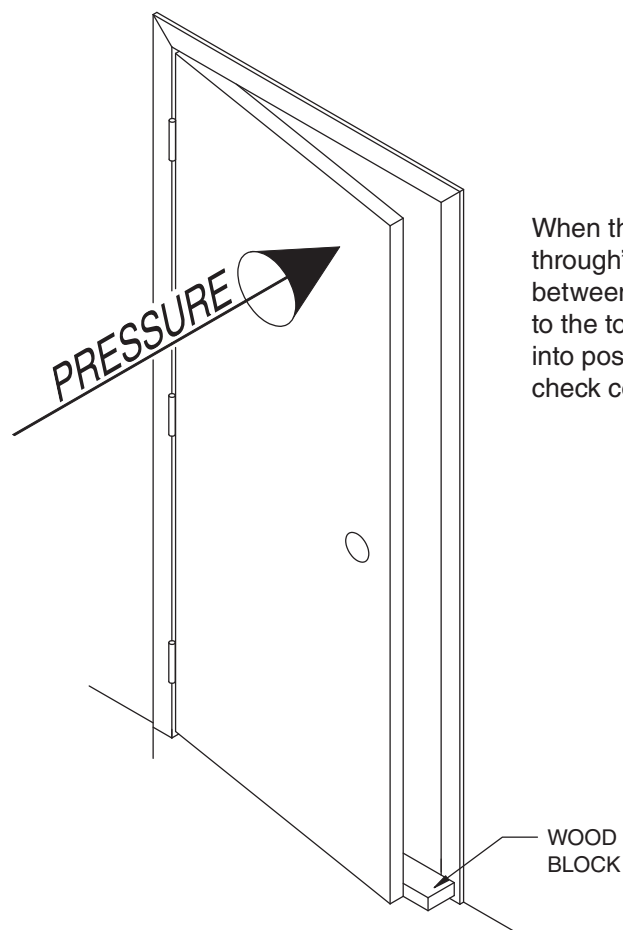
Normal installation results in the plane of the door face being parallel with the plane of the frame face. If the frame is square and plumb, all face surfaces of the frame will be in the same plane. A twisted door will “break through” the frame’s face plane surface. **BE SURE** the frame is square and 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.

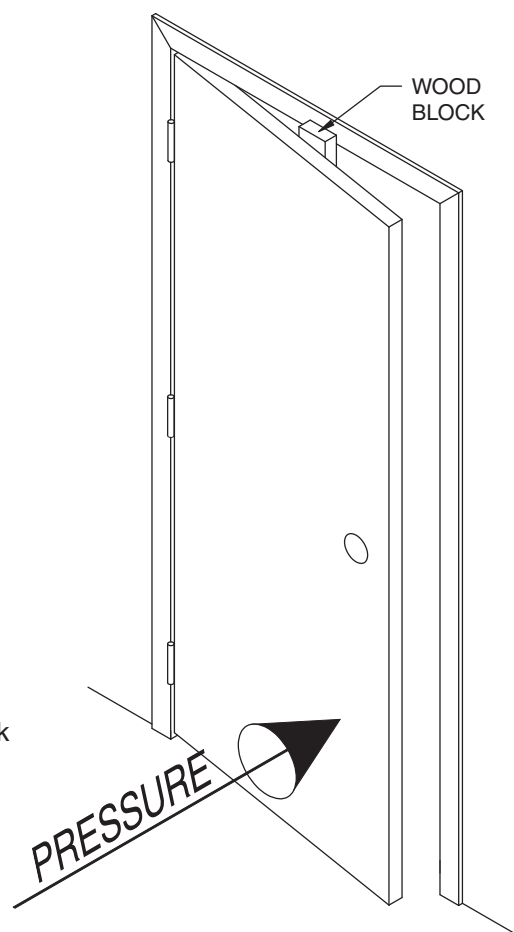
## TWISTED DOOR ADJUSTMENTS

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.

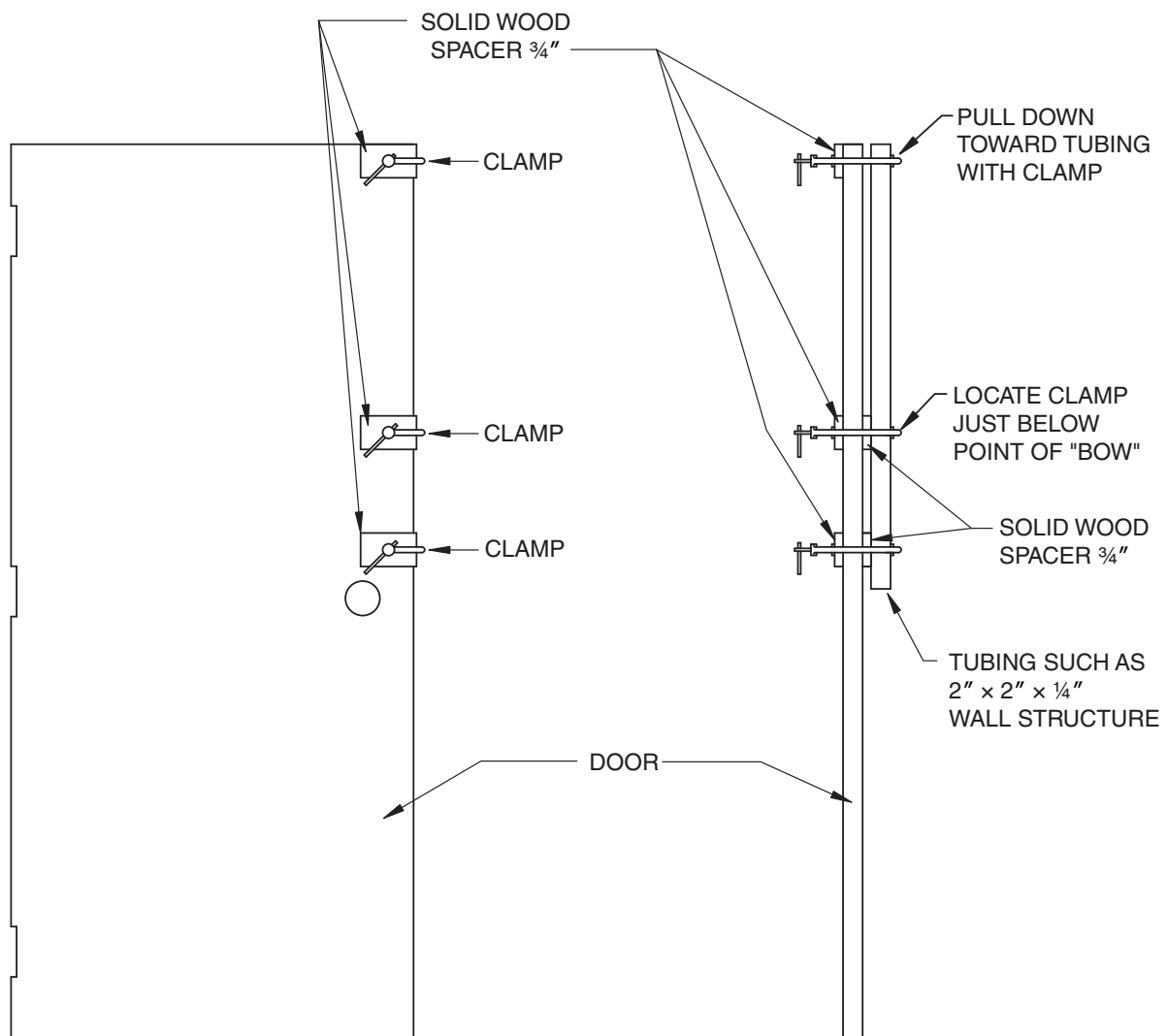


### Twisted at Bottom

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.



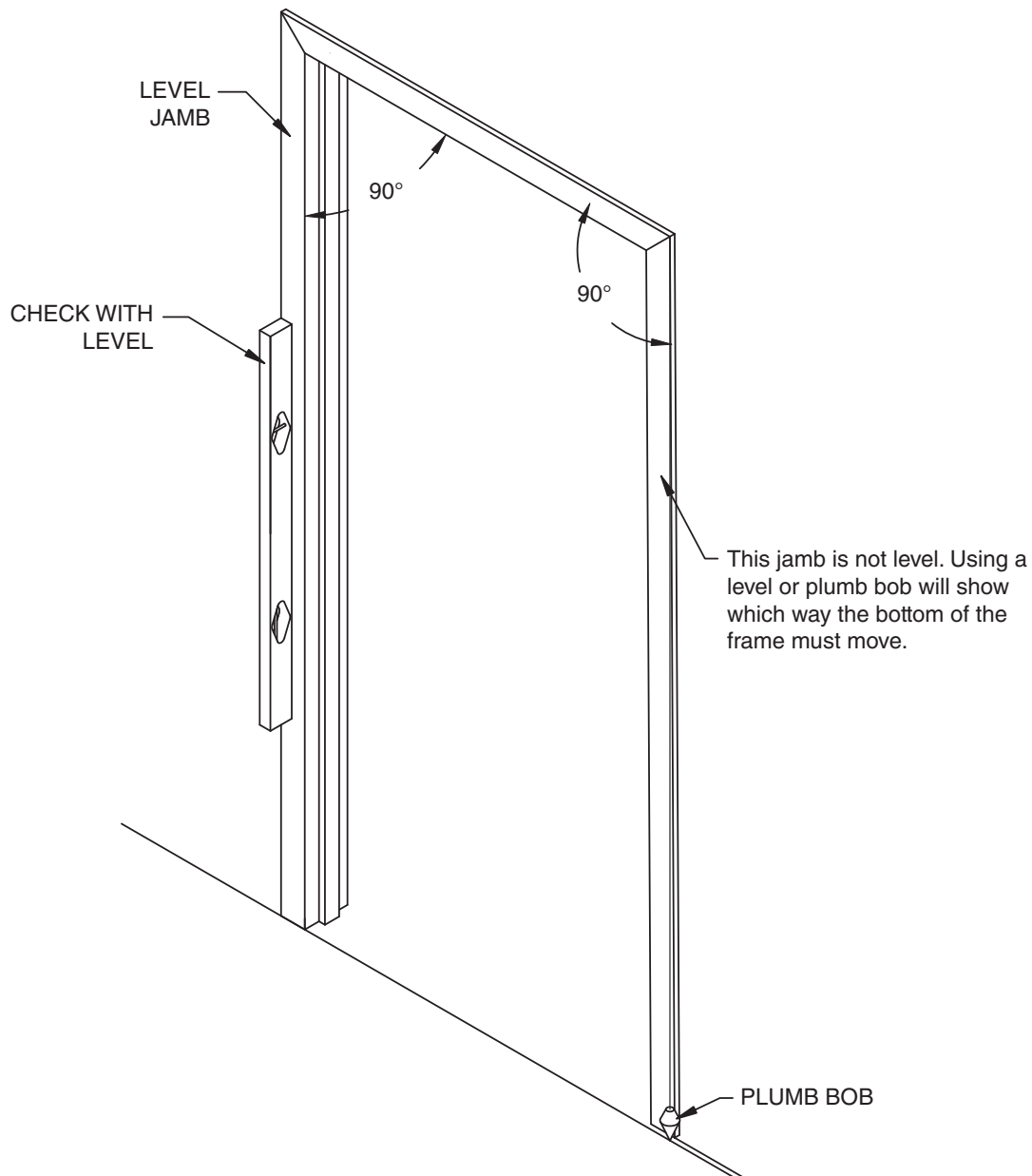


## TWISTED FRAME

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.

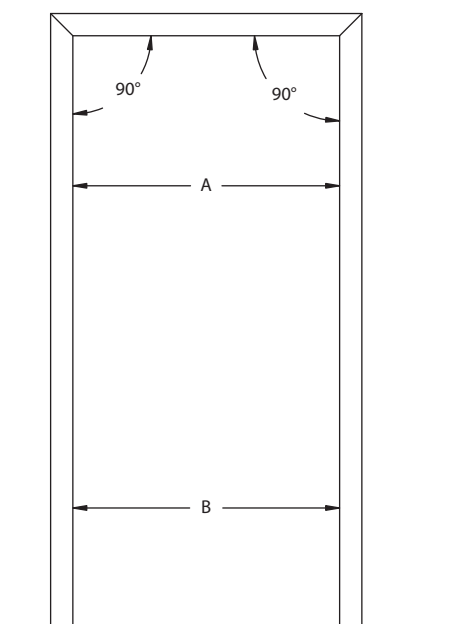


## FRAME SET OUT OF SQUARE

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.

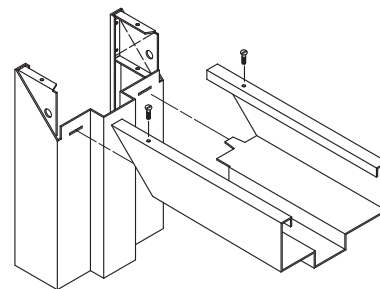
If the "out of square" condition is slight, some adjustment can be made by shimming and/or adjusting anchors, particularly if the frame being worked on is a slip-on drywall type.

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.

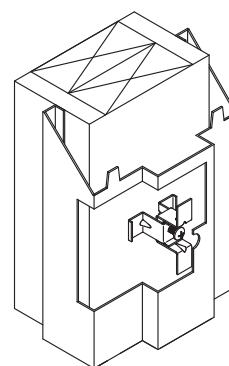


### **PROPERLY SET FRAME**

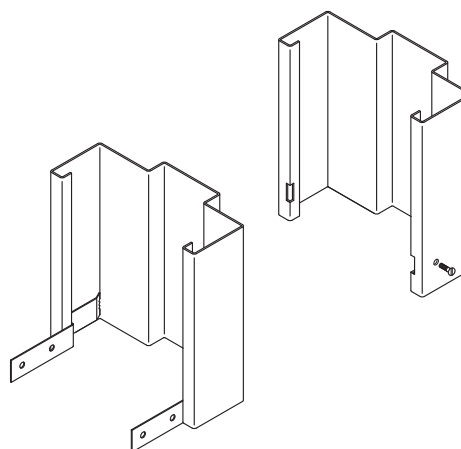
All corners are 90°. The dimension taken at Point "A" is equal to the dimension checked at Point "B." Both hinge and strike jambs are plumb and level.



**Corner Clip  
Header to jamb connection**



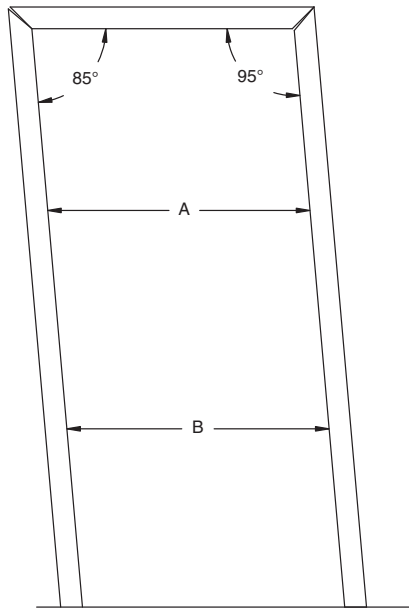
**Compression Anchor  
(Cut-away view)**



**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.

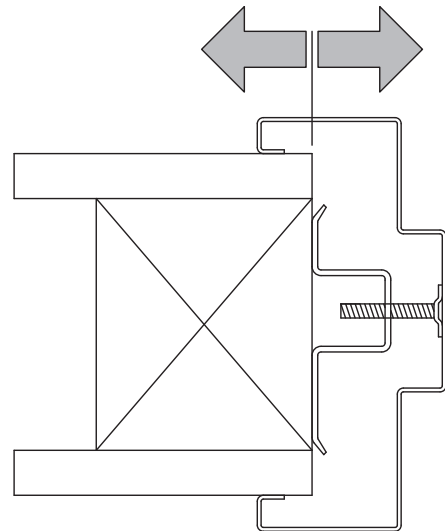
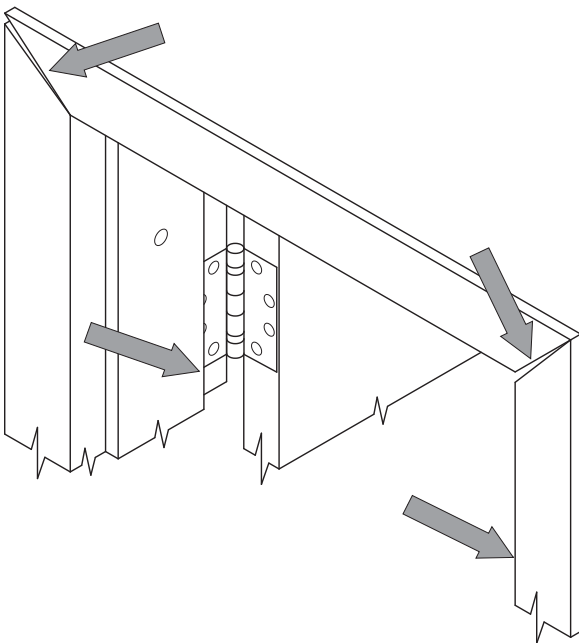
**IMPROPERLY SET FRAME (A)**

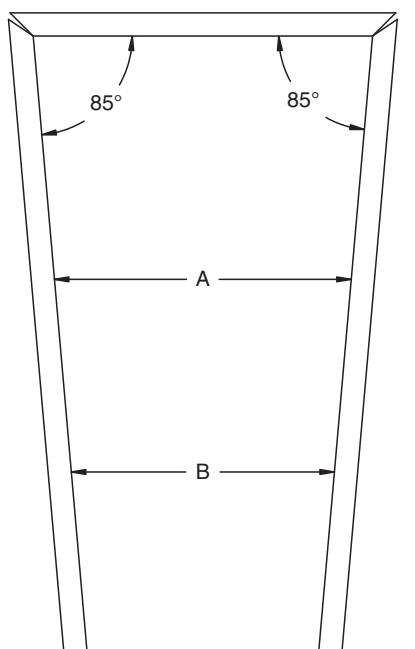
One corner is greater than 90° and one corner is less than 90°. The miters do not properly align with one another and “gaps” are created in the miters which are opposites of one another. The dimension taken at point “A” would remain the same when checked at point “B” if the 90° corners are out of square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

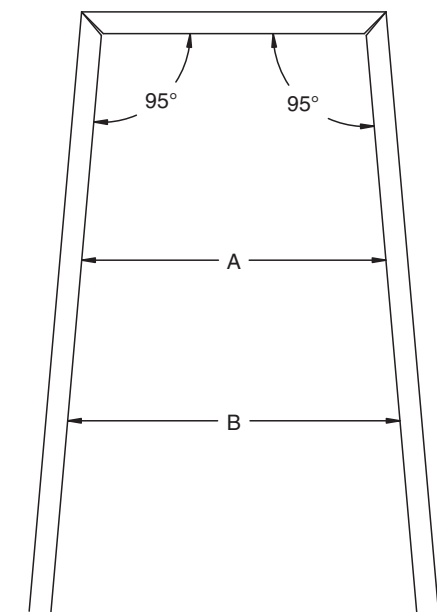
To correct this condition, the sill anchors must be loosened to allow the bottom of each jamb to be moved in and/or out. In the case of the snap-in type sill anchor, the baseboard trim might have to be removed to gain access to the anchors. This type of anchor is generally used because it can be hidden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

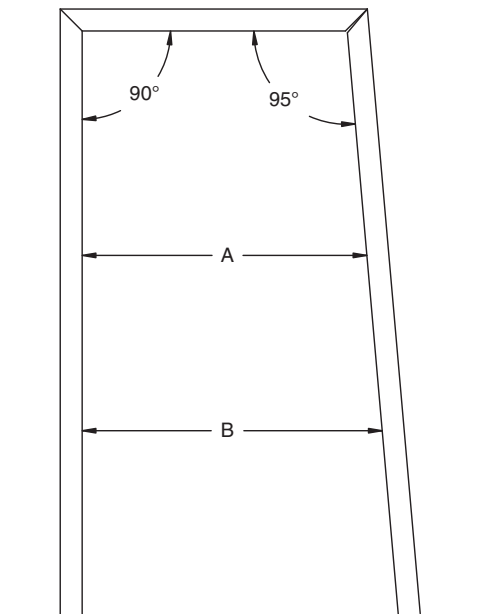
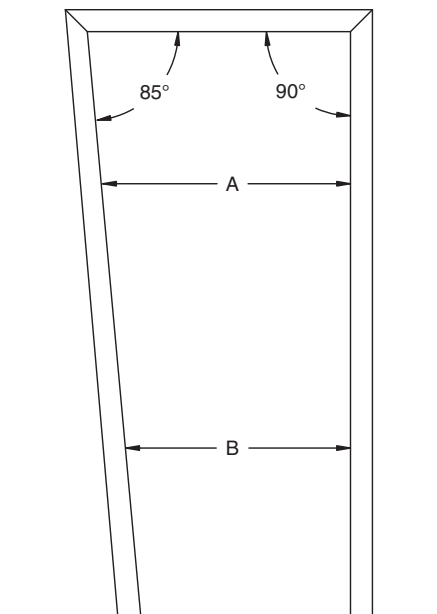
The corners are both greater than or less than 90°. The miters do not properly align with one another. When the corner is less than 90° the miter will have a gap which increases as it goes towards the return. When the corner is greater than 90° the miter will have a gap, which increases as it goes towards 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.

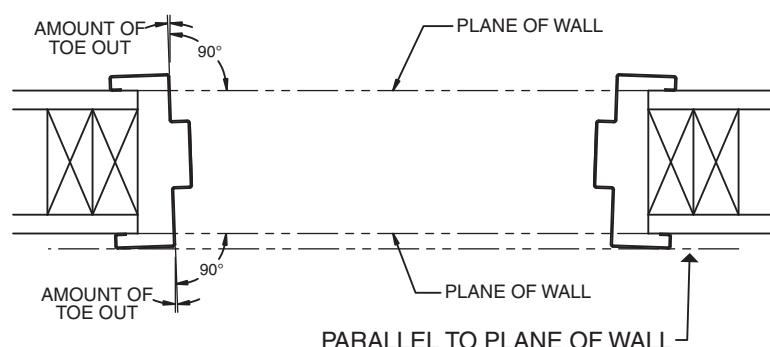
A similar procedure should be used when the jamb is toed out at the sill. The sill (base) of the jamb should be pushed in towards the opening. The jamb should be plumbed, squared with the header and leveled as it is pushed into its proper position. The sill anchor should be reset, the compression anchor 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.

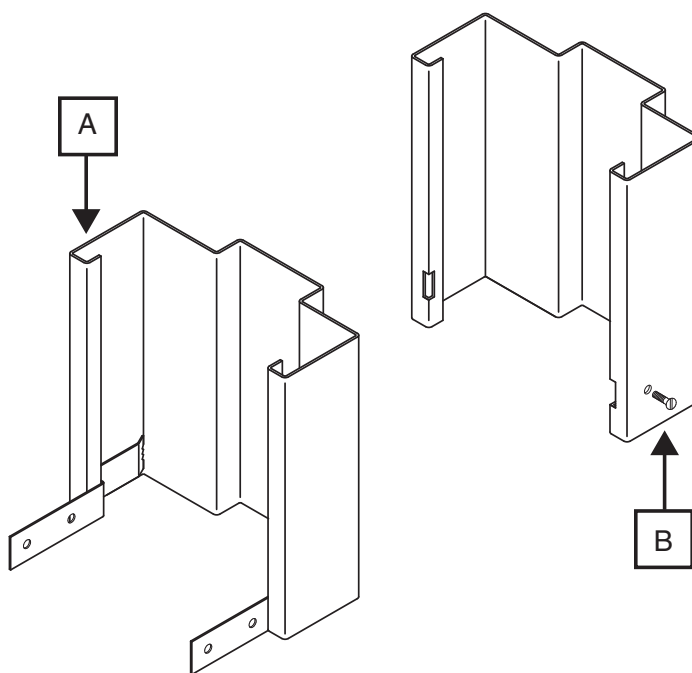
The straight edge should set flat across both faces at the same time. If the jambs are twisted, a “gap” will be created as shown in the figure to the left.

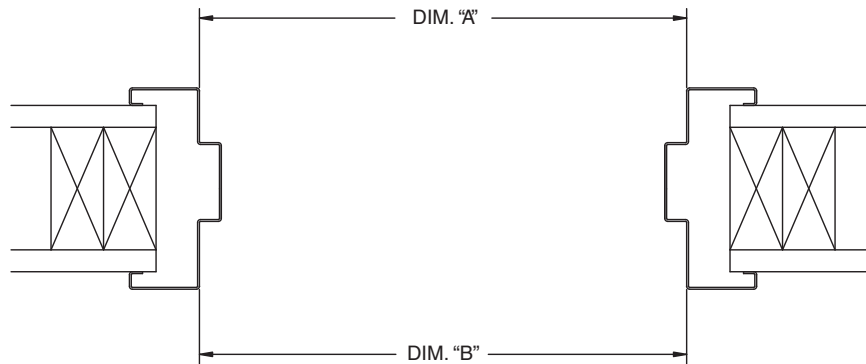
### Typical toed-in or out condition

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.

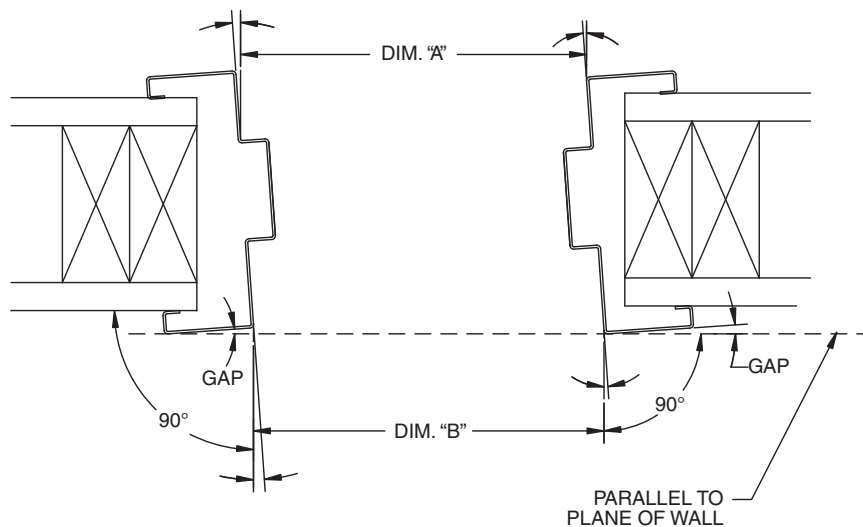


**FRAME WITH RABBETS TOED IN OR OUT** *(continued)*

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.

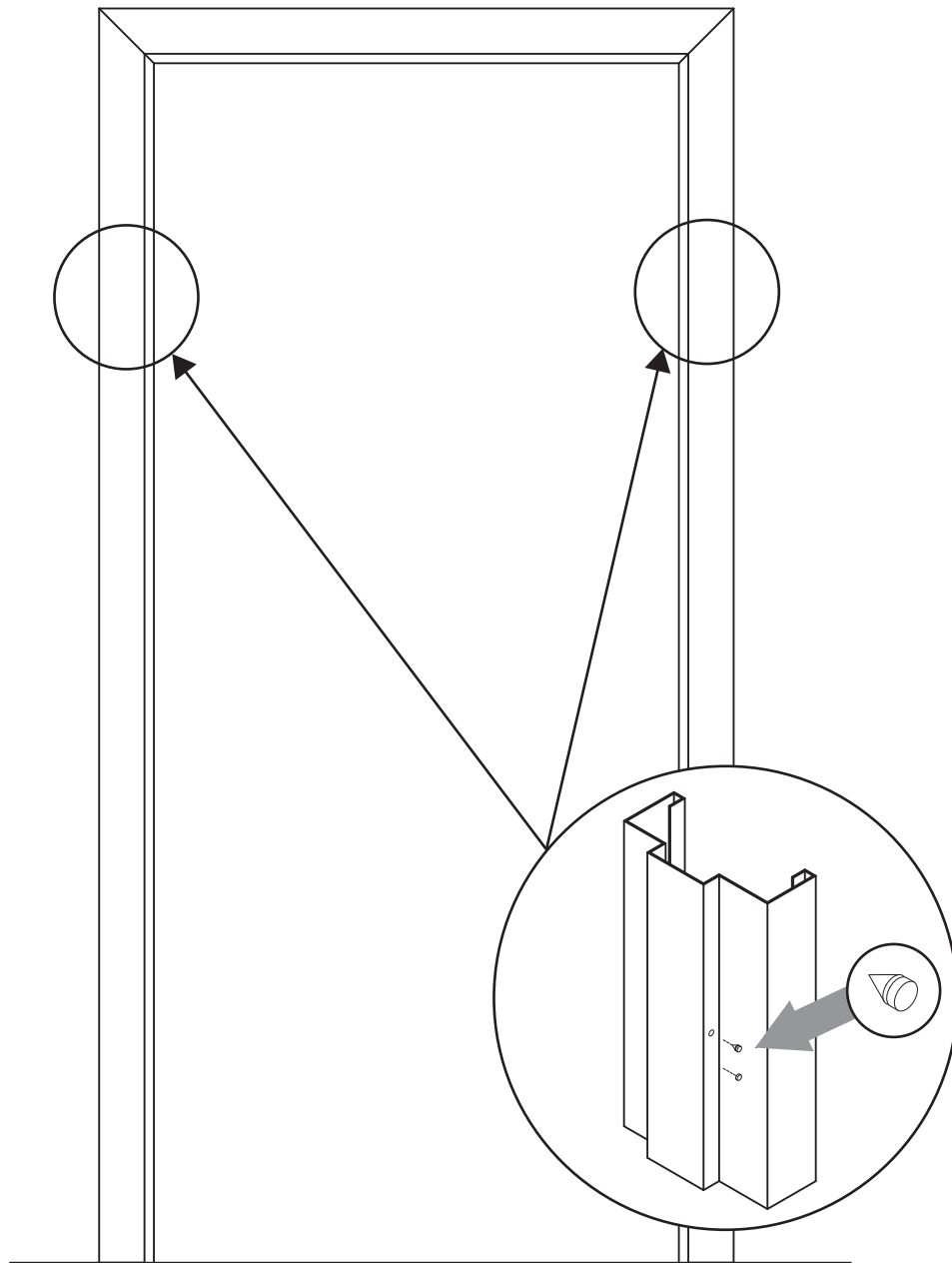
The below figure shows a condition which can give the impression that the frame is properly installed. Both dimensions “A” and “B” will be equal but the frame will not be square in the opening. Both jambs can be twisted to create a parallelogram. This can be checked by placing a straight edge across 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.



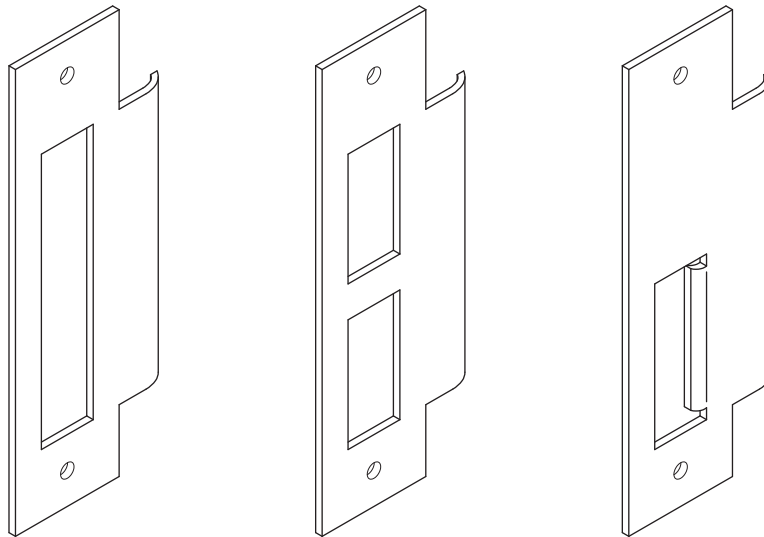


## LOCK FITS LOOSE ON STRIKE

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:

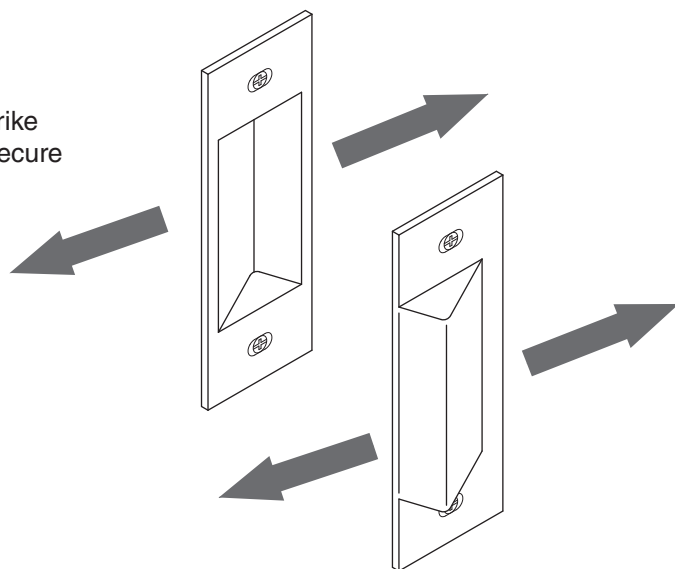
### PROPER STRIKE

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**

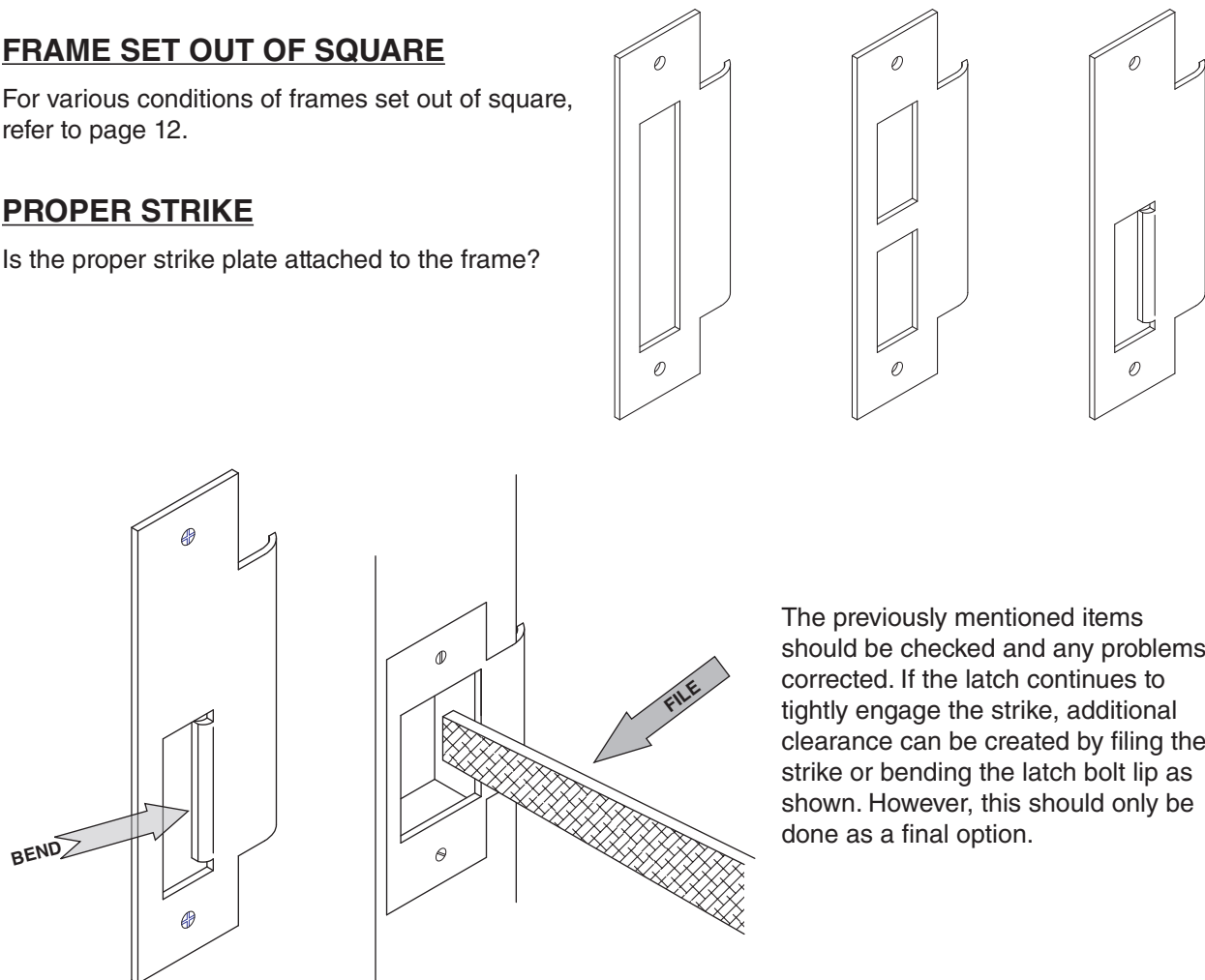
For various conditions of twisted frames, refer to page 11.

### **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?

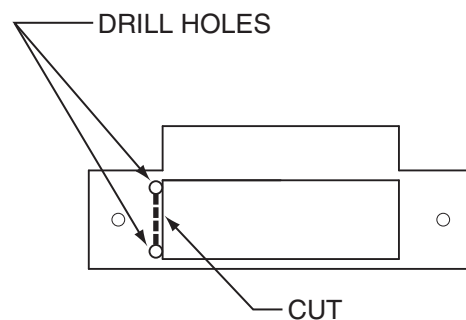
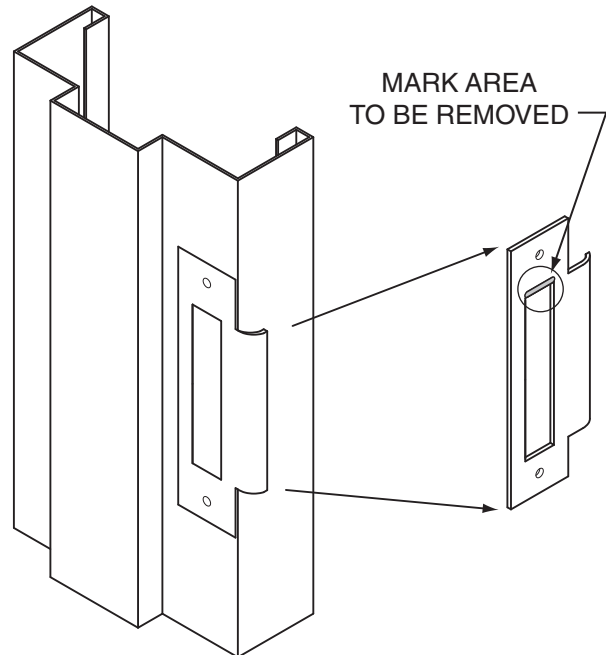


The previously mentioned items should be checked and any problems corrected. If the latch continues to tightly engage the strike, additional clearance can be created by filing the strike or bending the latch bolt lip as shown. However, this should only be done as a final option.

## 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.

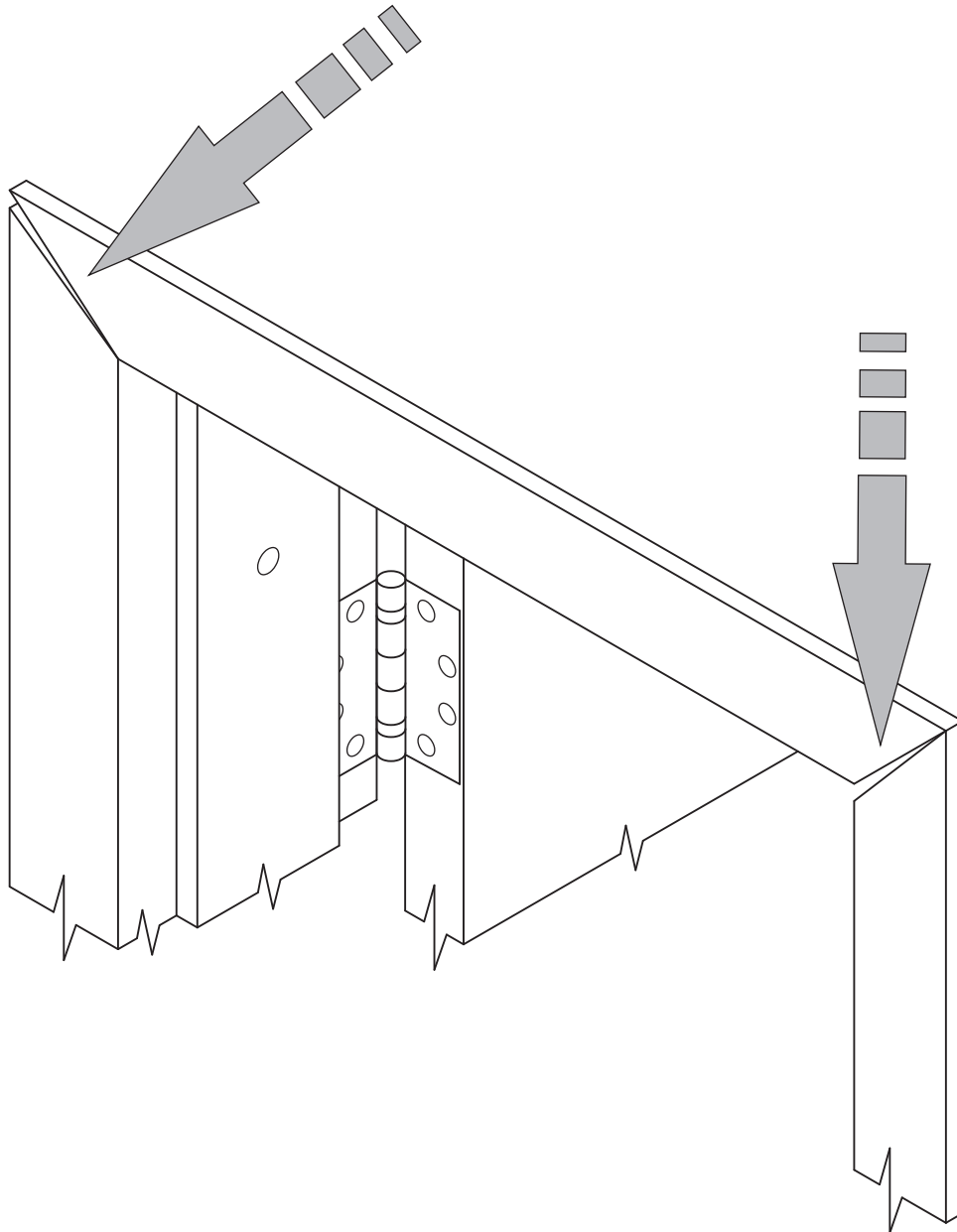
- Mark the area on the strike plate which must be removed.
- Remove strike plate from frame.
- Center punch corners of area to be removed and drill a  $\frac{1}{8}$ " diameter hole in each corner.
- Use a saber saw and cut from the existing opening up to the  $\frac{1}{8}$ " diameter holes. The remaining 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.

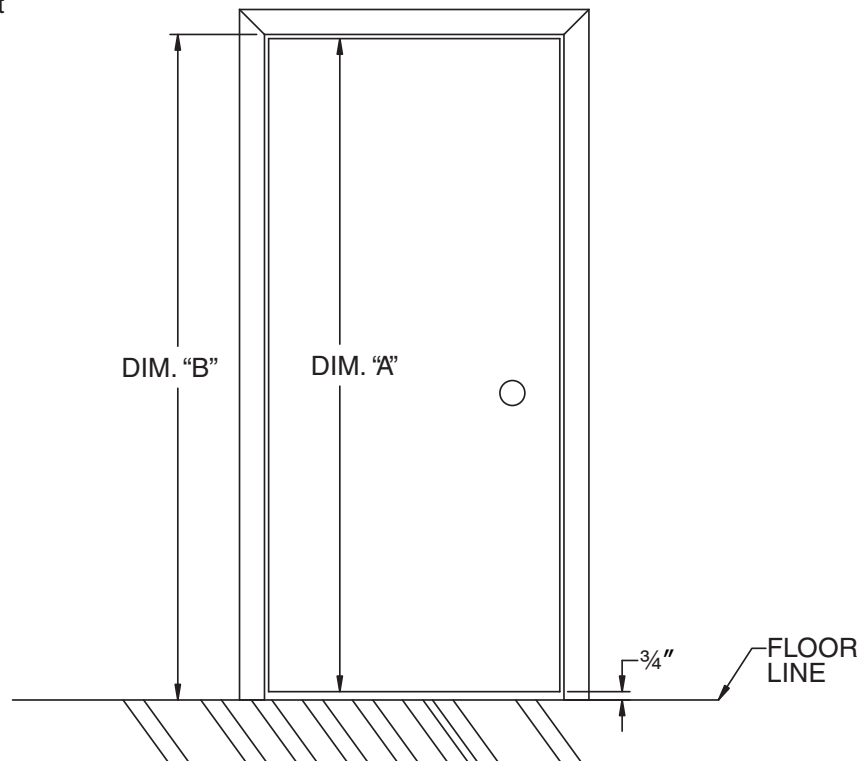
The frame jambs should be set at floor level which then results in  $\frac{3}{4}$  of an inch between the bottom of the door and floor.

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.



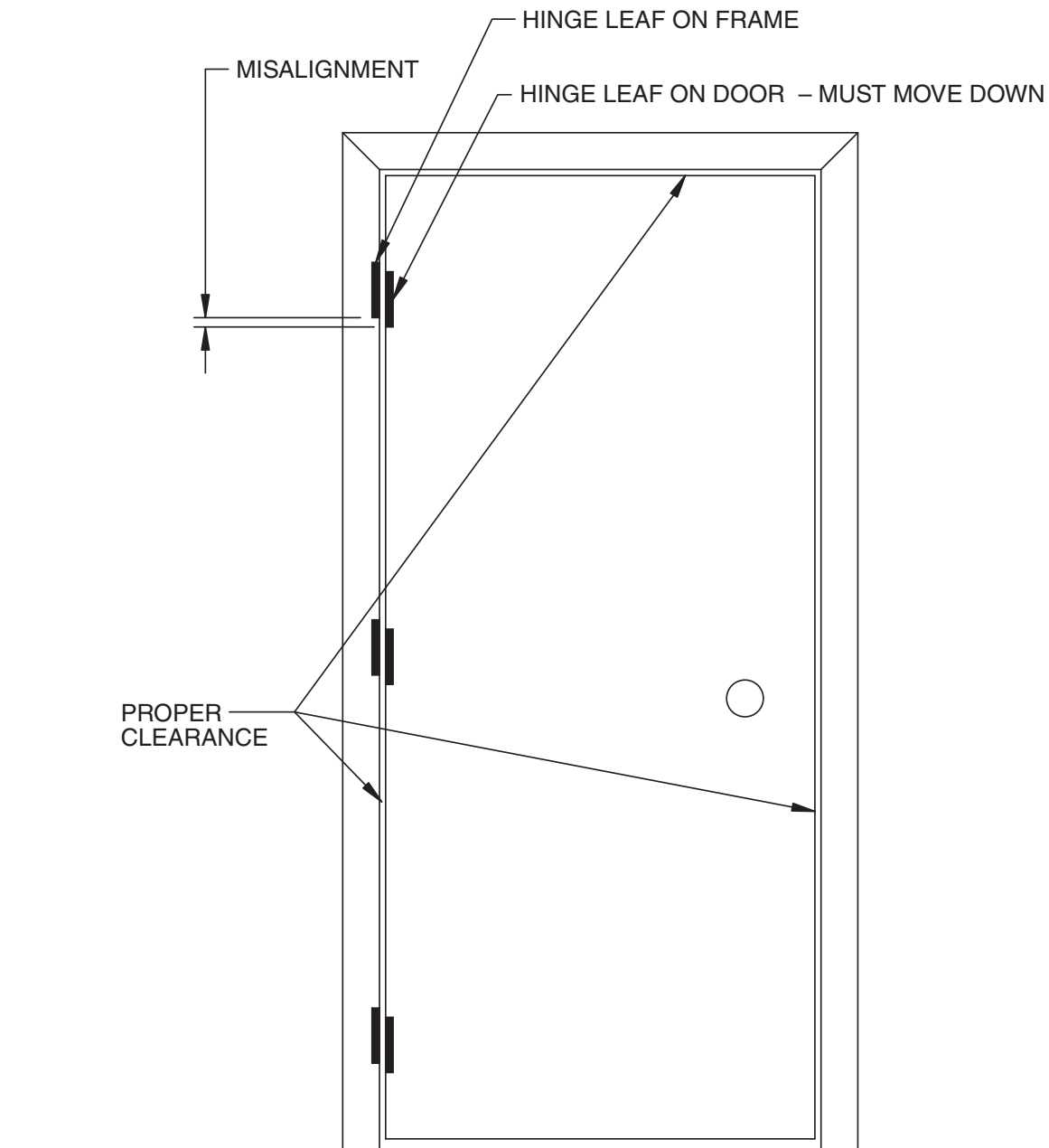
The bottom of the frame jambs should be set “on” the floor not “in” the floor. In some special cases the jambs can be set “in” the floor but this requires special design consideration and adjustments in door height and jamb heights. If this was not compensated for in the designed heights, the clearance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

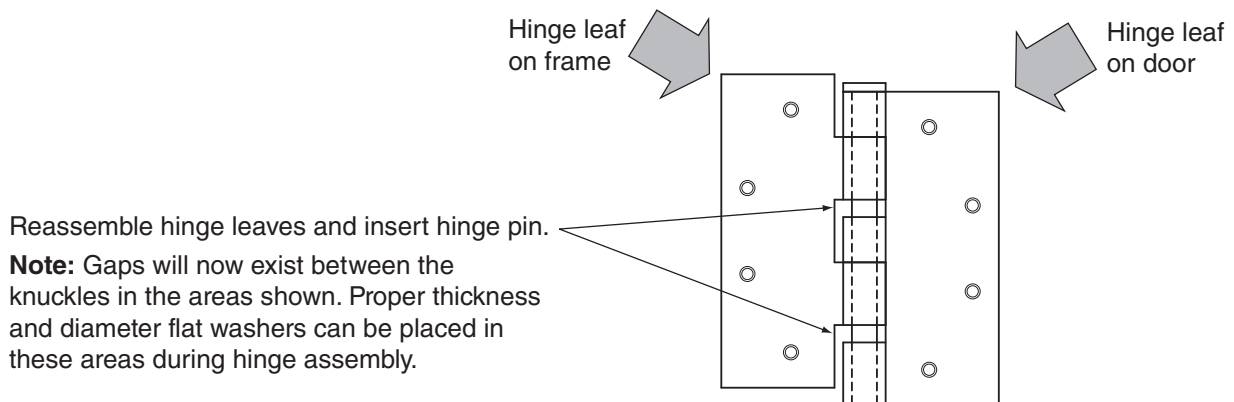
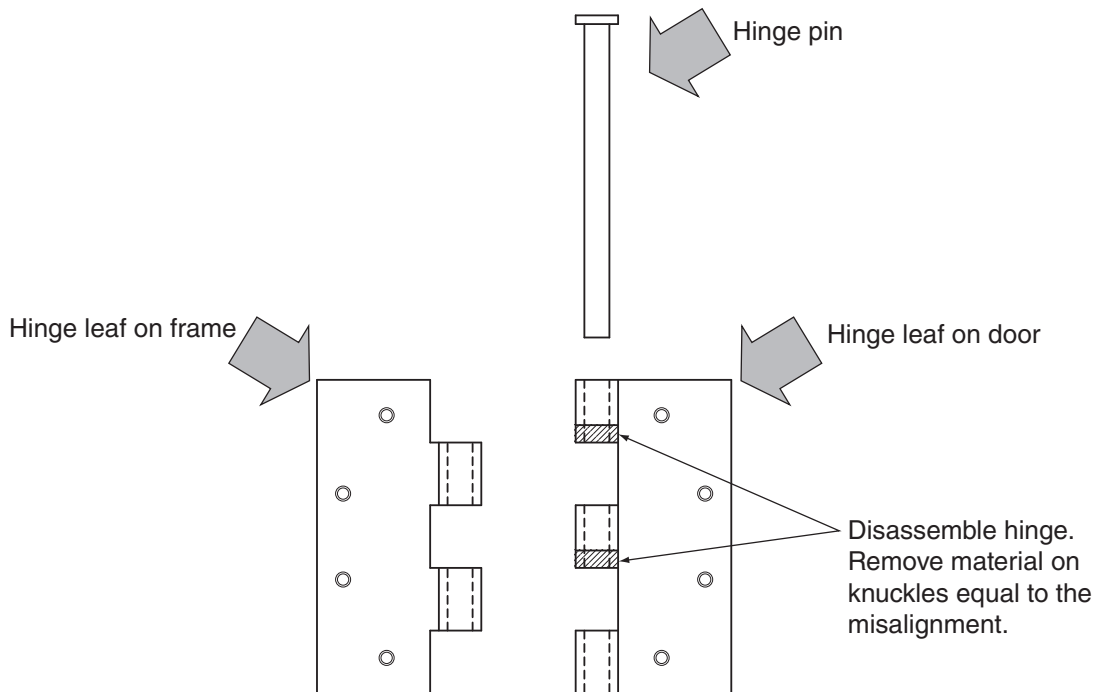
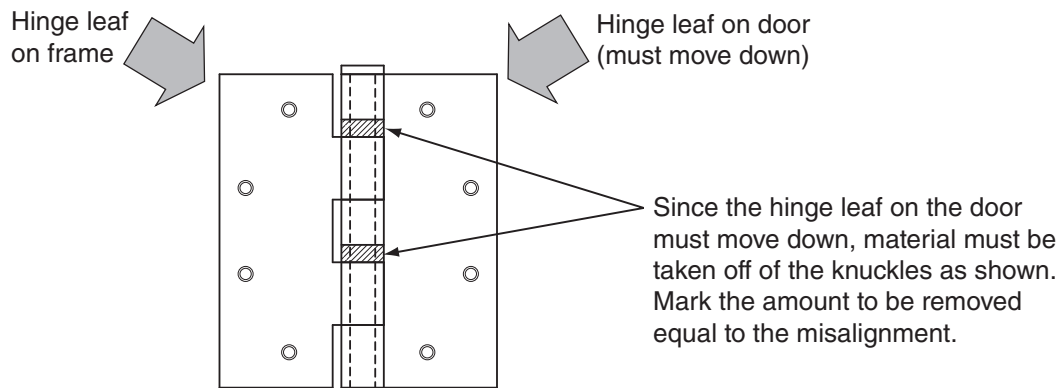
By taking these basic dimensions, you can confirm what element of the opening is in error. If trimming the bottom of the door is considered, you must make sure that the door’s design will allow such a modification to be made. It is best to contact the distributor or the manufacturer to determine if and 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)*

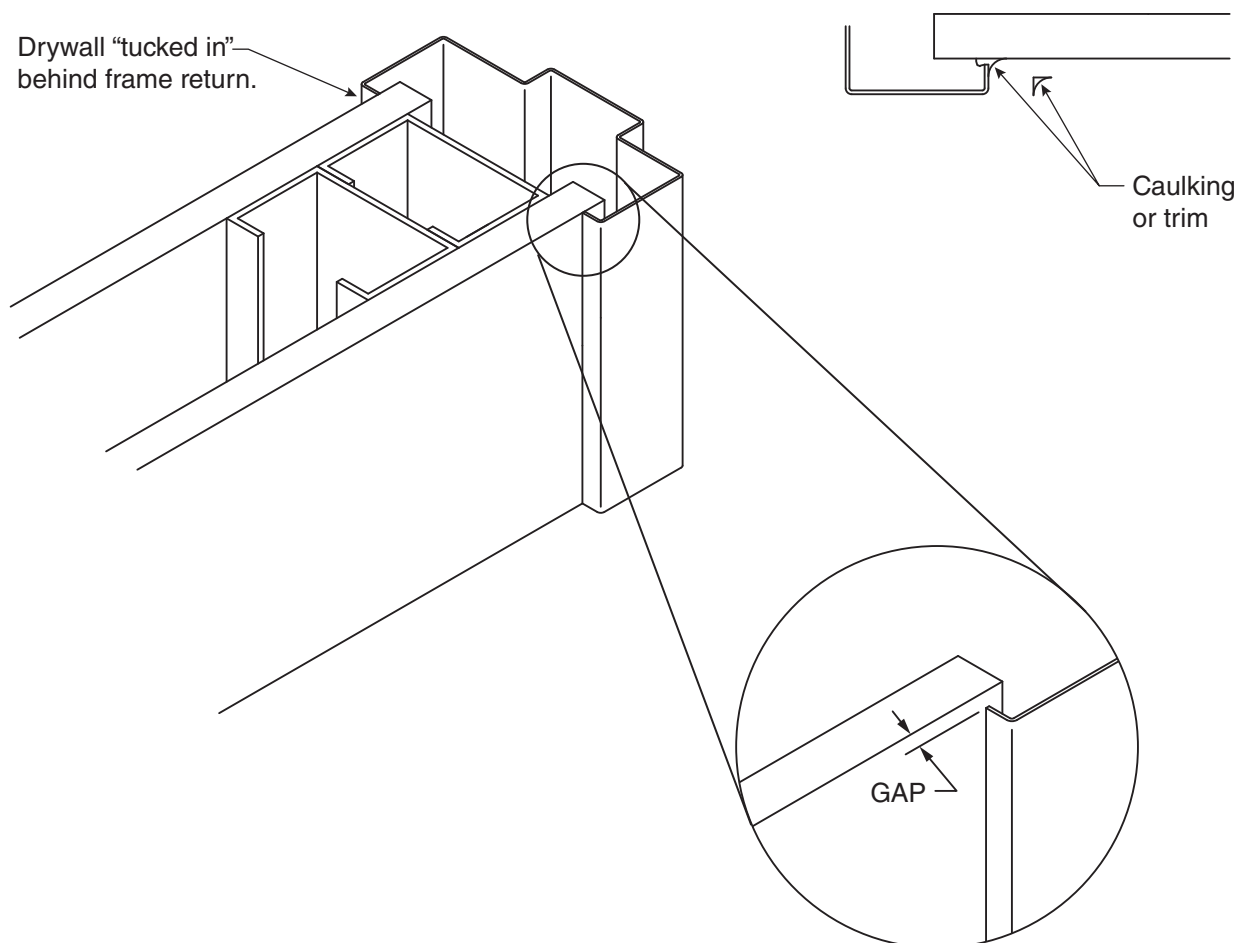
## FRAME LOOSE ON DRYWALL

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.



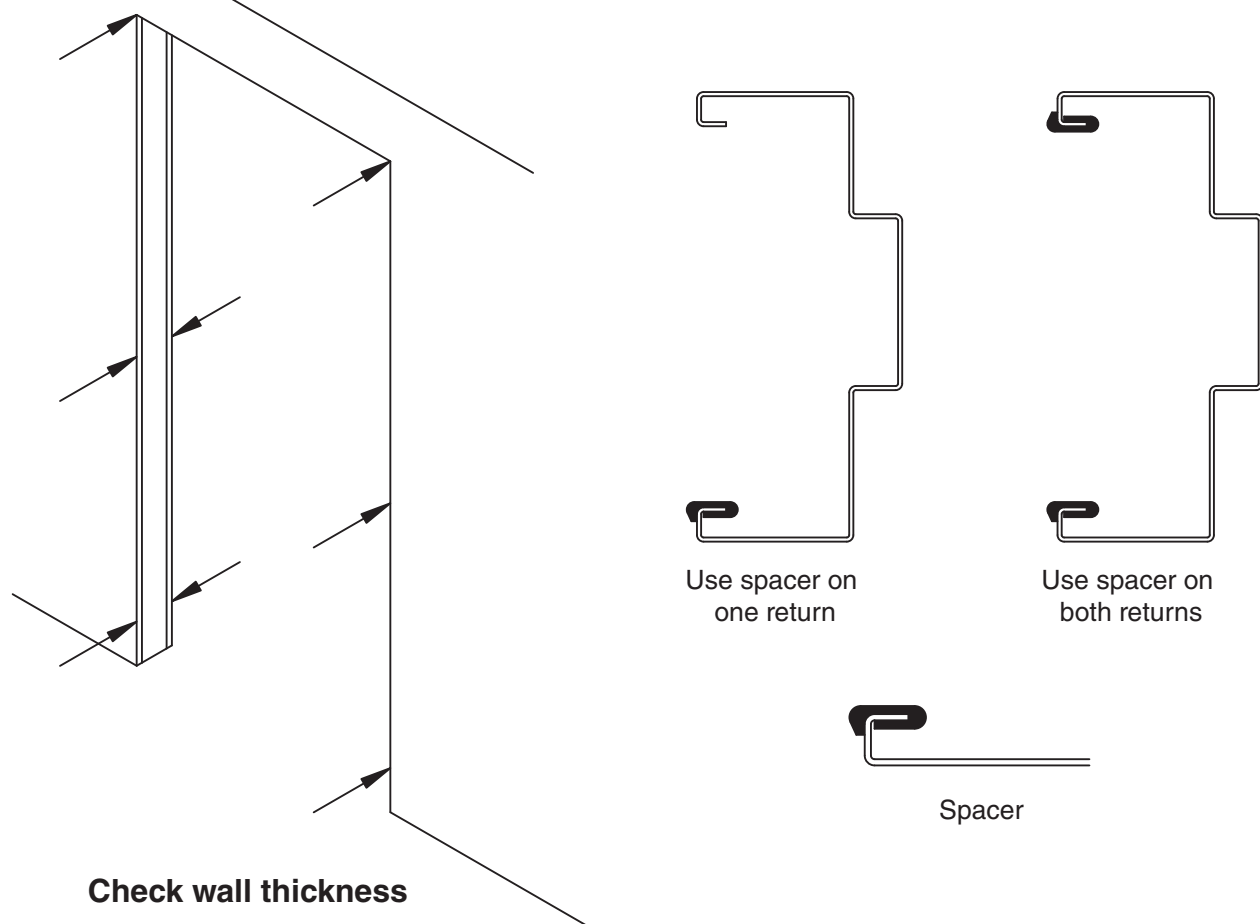


**FRAME LOOSE ON DRYWALL** *(continued)***DRYWALL FRAMES WITH COMPRESSION ANCHORS**

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."

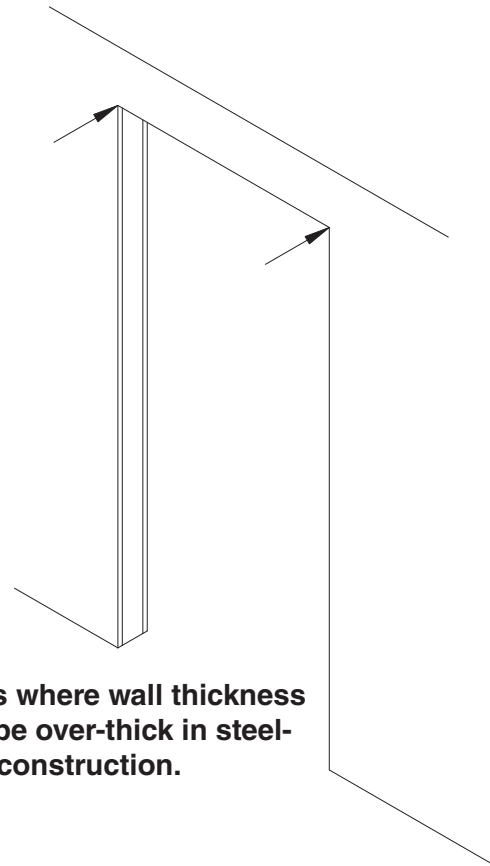
- 1) The first condition is a uniform gap along the entire length (height) of the frame jambs. The frame should be removed from the opening and the wall thickness checked at numerous places around the opening. These measurements should be compared to the job specifications. If the wall thickness is undersize, 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.**

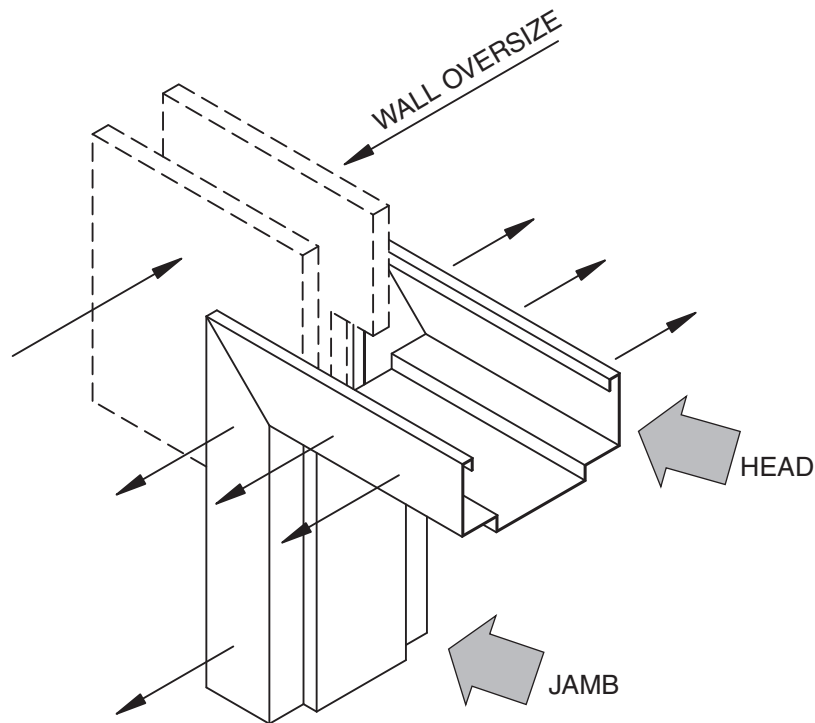


**FRAME LOOSE ON DRYWALL** *(continued)*

- 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.



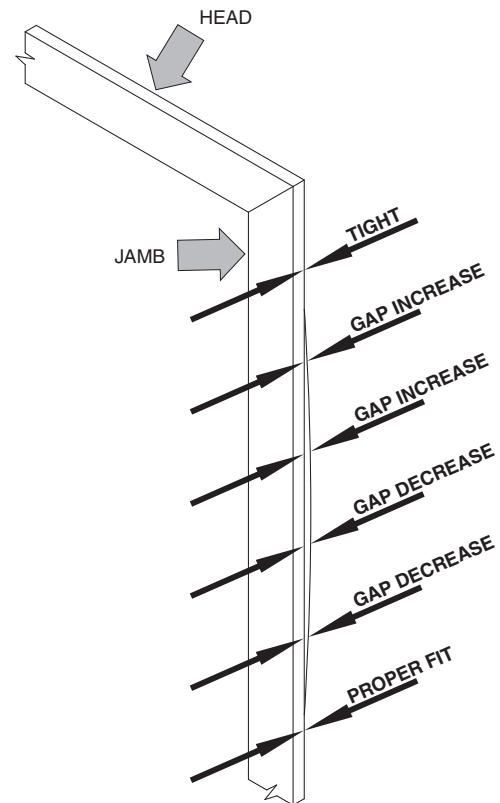
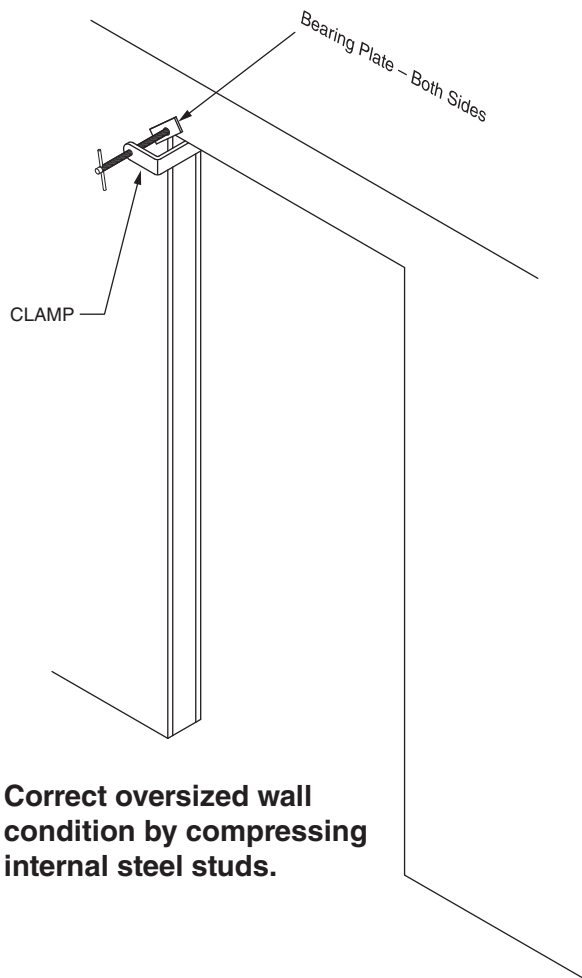
**Areas where wall thickness may be over-thick in steel-stud construction.**



**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.

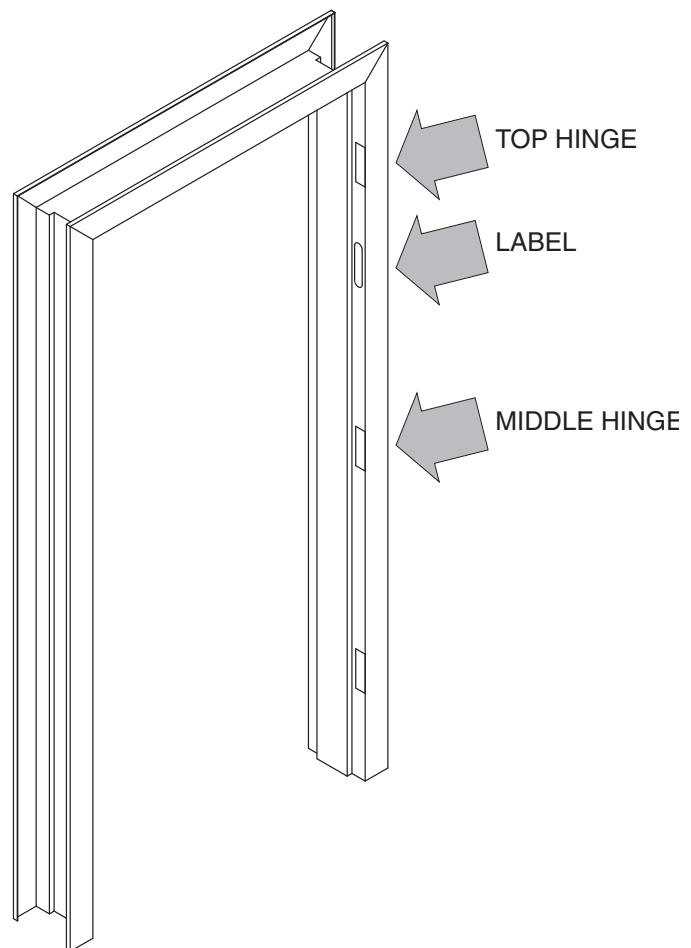
Manufacturers cannot control the workmanship associated with the installation of these types of frames, therefore, this work must be specified in the installation/glazing/caulking section of specifications.

## 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:

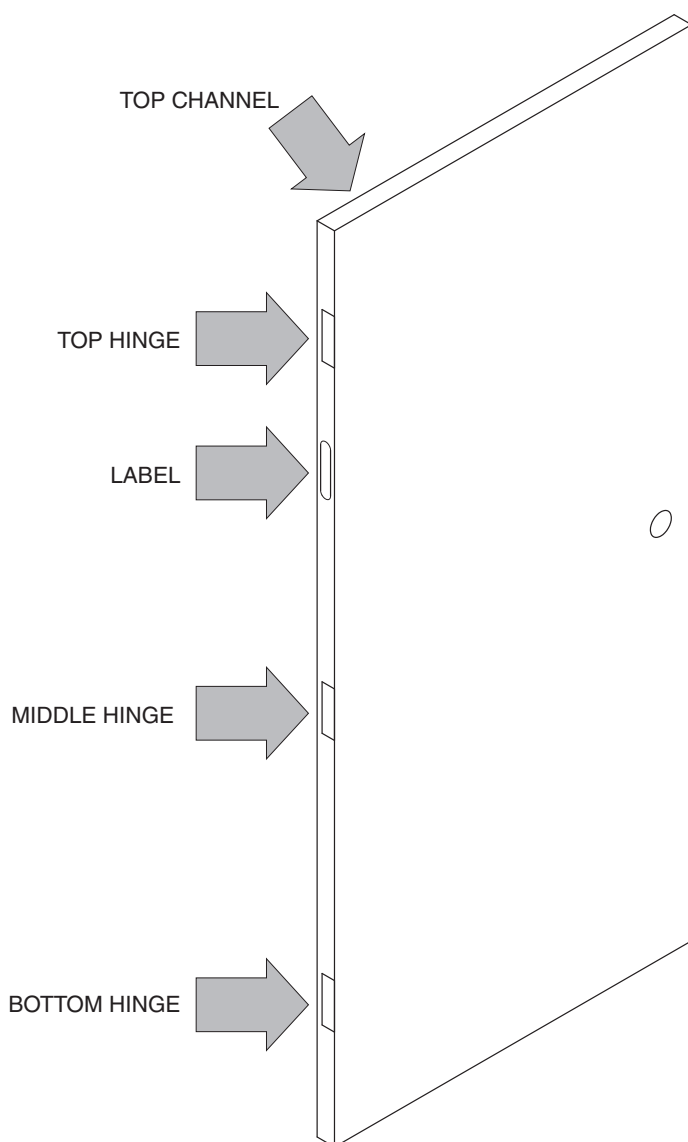
- Borrowed light frames may have labels applied to soffit of frame due to glass and glazing bead location.
- Frames incorporating continuous hinges may have labels applied to soffit or frame head.
- See manufacturer's procedures.

## 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.

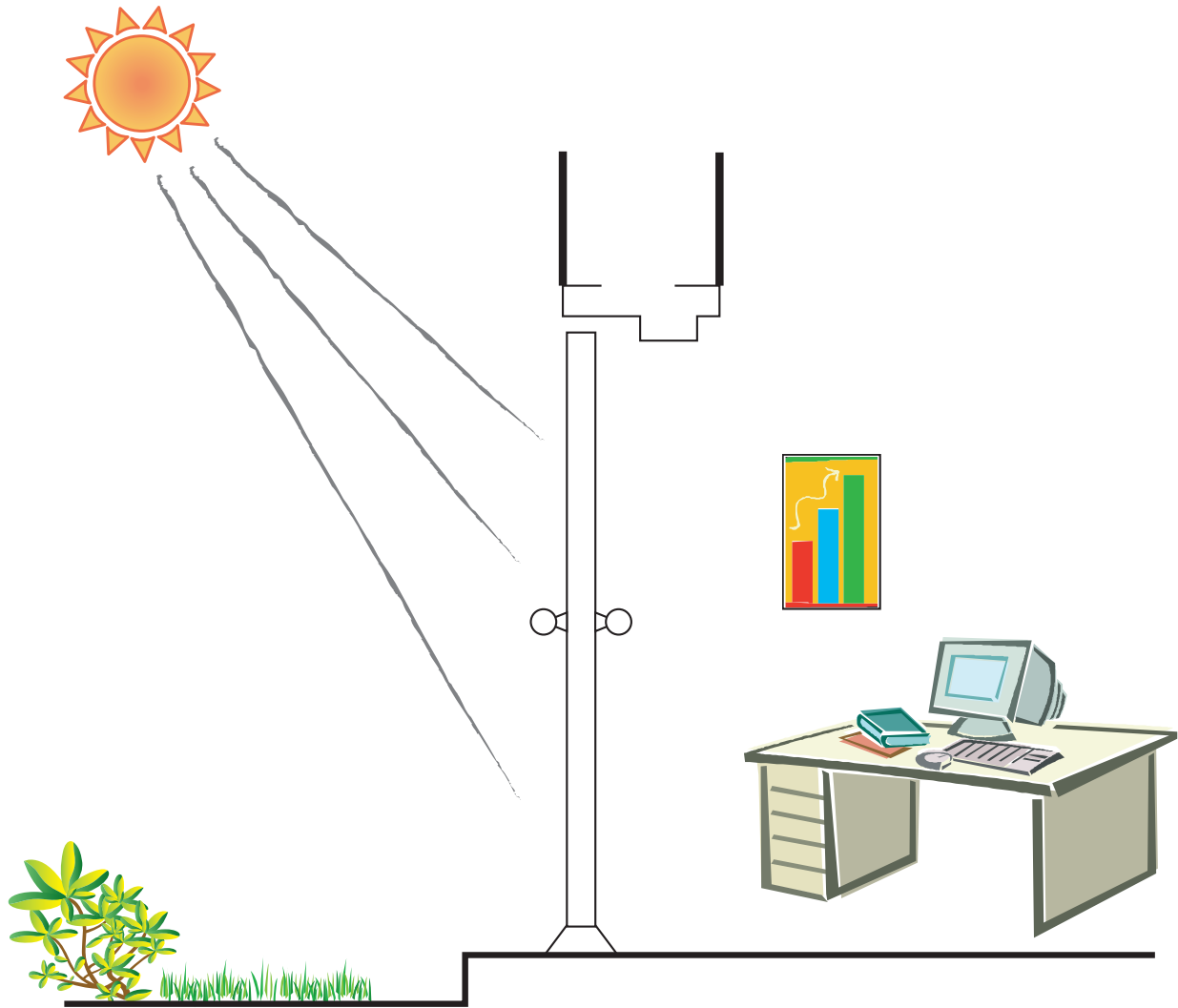
### **To correct water stain damage, use the following guidelines:**

- 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.



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**Maintenance**  
*of*  
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**Assemblies**



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# Maintenance of Steel Door and Frame Assemblies

## 1 Introduction

This document is intended to serve as a general outline of maintenance activities needed for standard steel doors and frames. 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 recommendations. 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. Certification labels present shall not be painted over during any repainting.

### **Fire Door/Smoke Door Assemblies**

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 block-

ing 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, silencers, mutes, etc. Inspect for signs of deterioration such as splitting, cracking or deforming of flexible components. Install replacement components as needed.

To inspect operational integrity, position gasketing 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
- NFPA 105 Standard for Smoke Door Assemblies and Other Protective Openings
- SDI-122 Installation and Troubleshooting Guide for Standard Steel Doors and Frames



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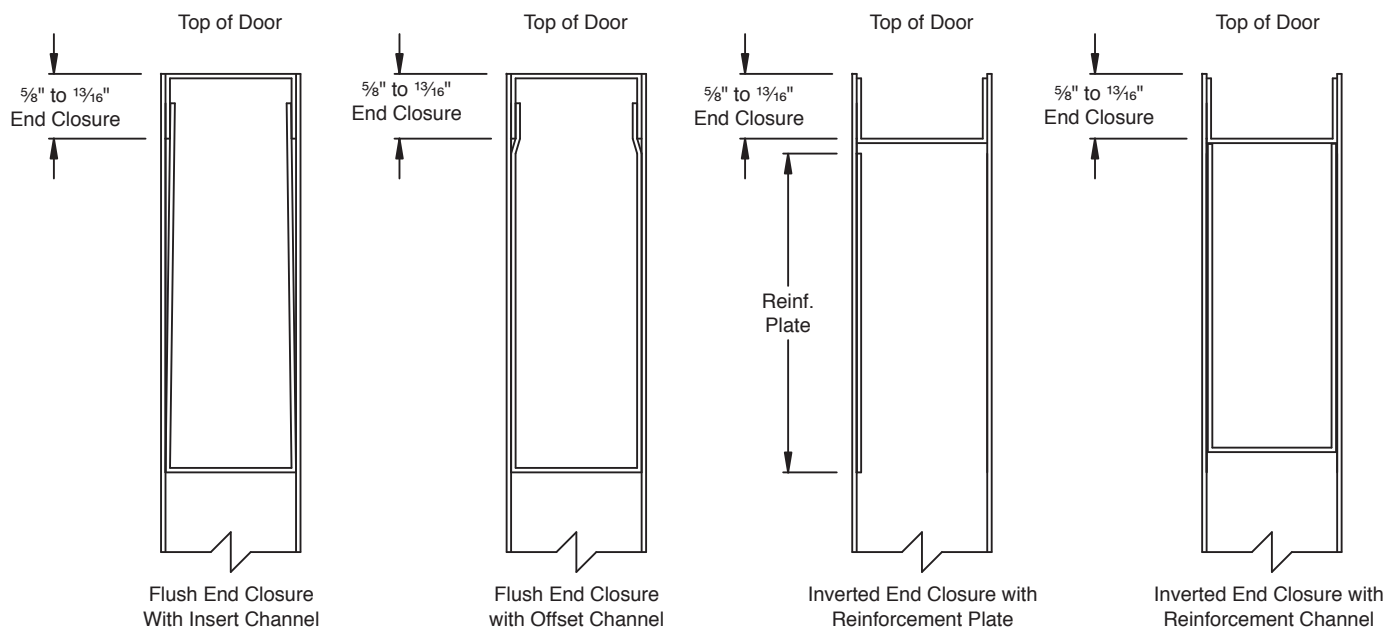
# End Closure Location

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

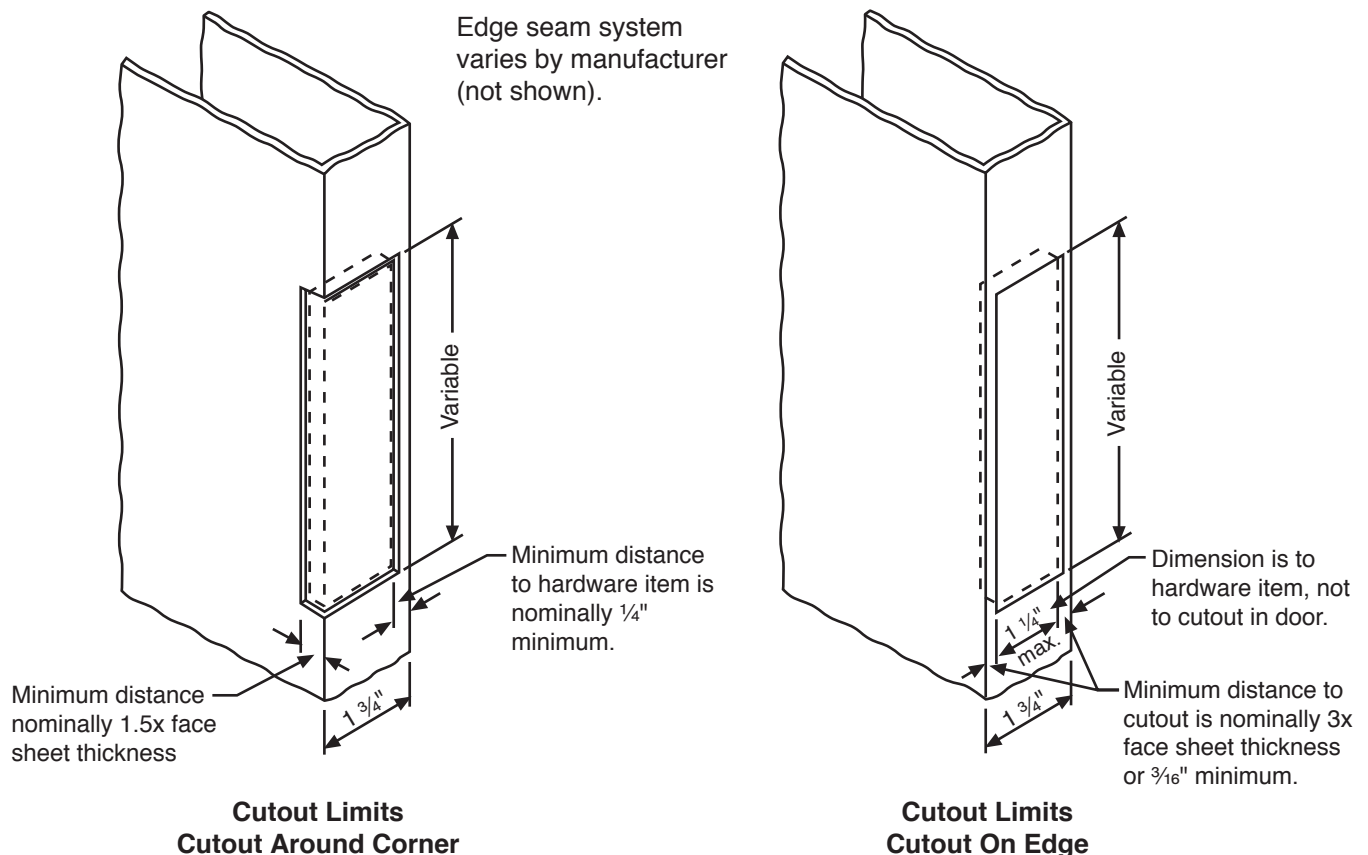
The ability to form a crisp aesthetic cutout in the edge of a steel door, especially in the vicinity of a bend line is directly influenced by the steel thickness and the proximity of the cutout to the bend line. A cutout too close to the bend line will result in a flare-out of the cutout area due to 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  $\pm 2$  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.



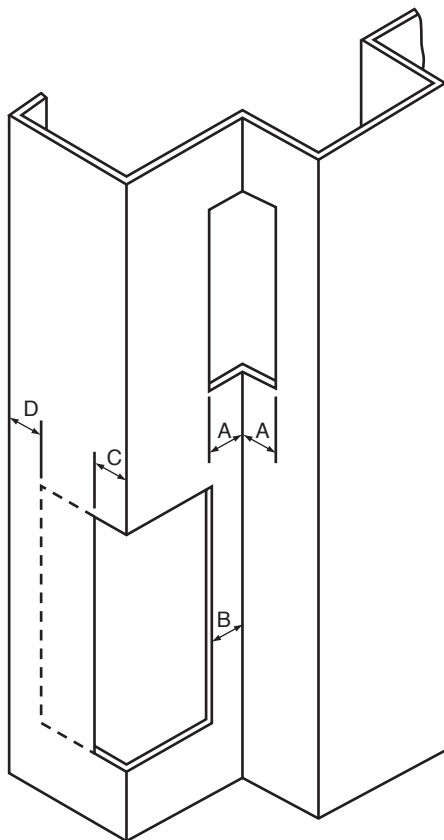
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## Frame Cutout Limits

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  $\pm 2$  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.

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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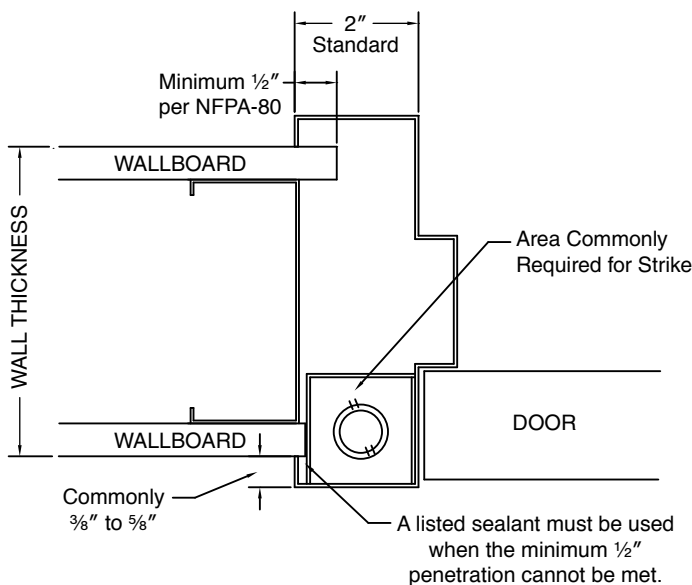
# Electric Strikes & Electric Hinges in Stud Walls

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.

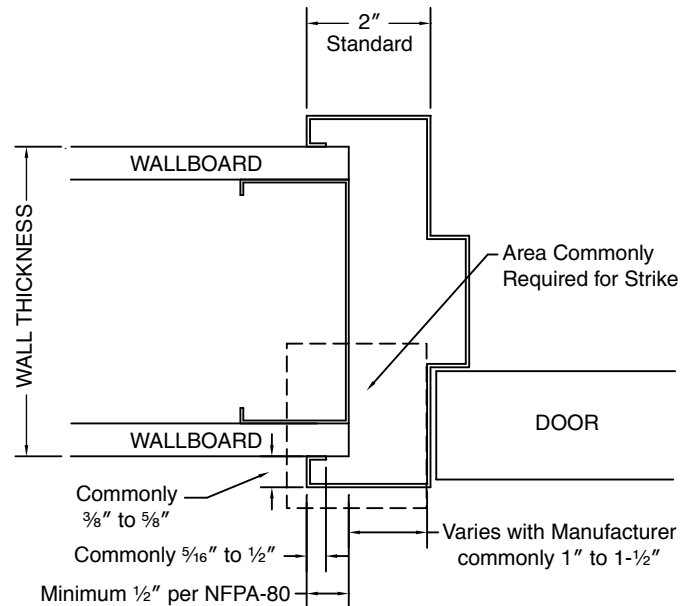
Dependent on the dimensions of the strike, the cutouts may extend beyond the frame face or the returns, thus leaving critical strike parts or wiring exposed.

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  $\pm 2$  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.

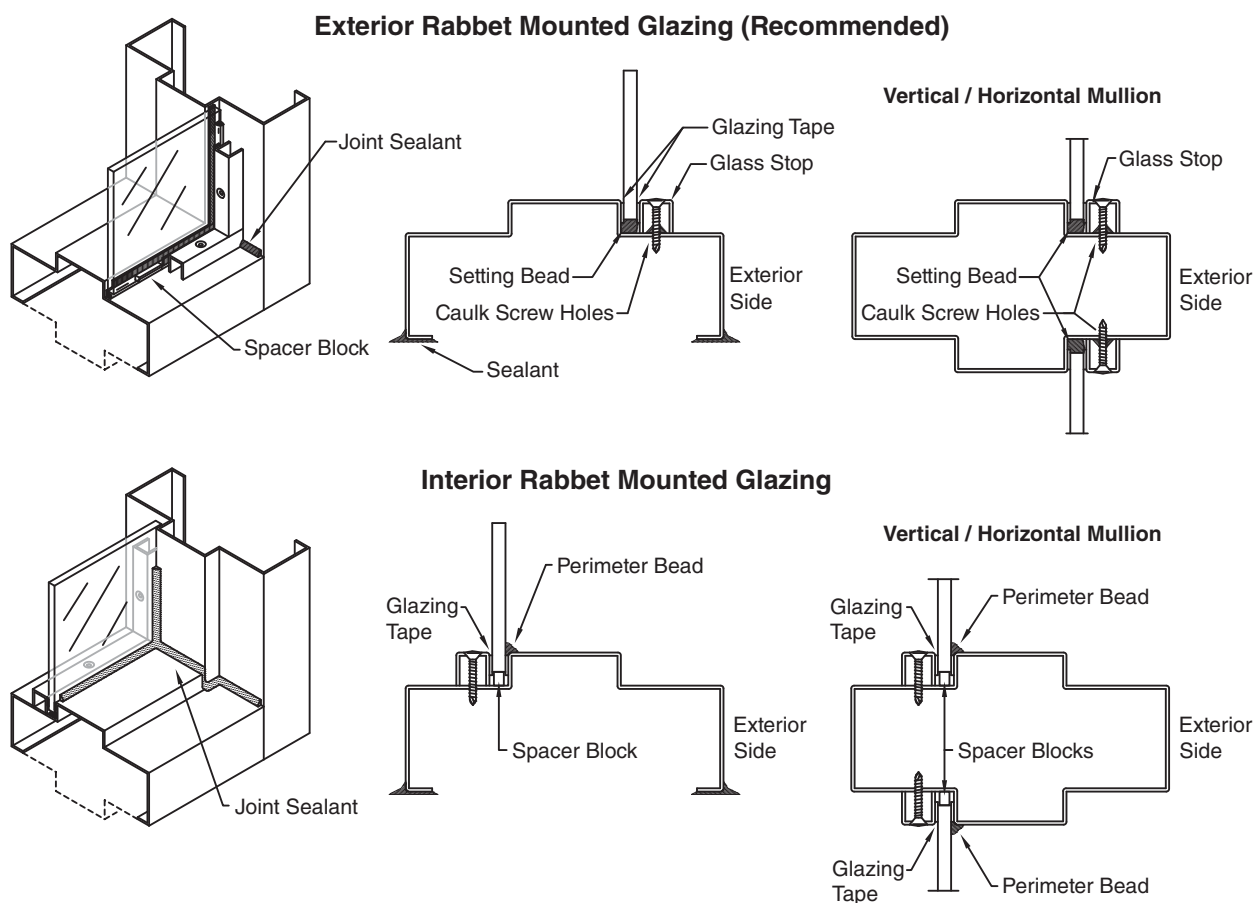


## Water Penetration

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.

## 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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 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

### 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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## STEEL DOOR INSTITUTE

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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.

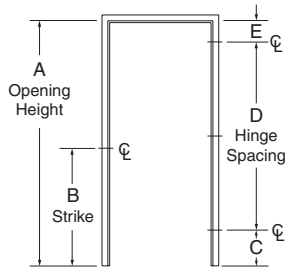
The Steel Door Institute and its member companies shall not be held liable for products manufactured using the information published here.

### Notes

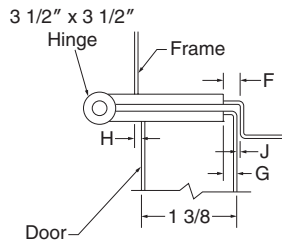
**Tolerances** – All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be  $\pm 1/16$  in. (1.6 mm). Weight or force shall be  $\pm 2\%$ . Angles shall be  $\pm 2$  degrees. Where only minus tolerances are given,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

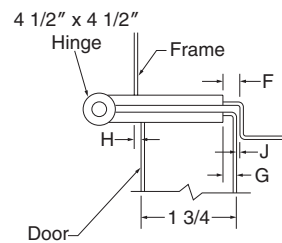
## Ceco Door



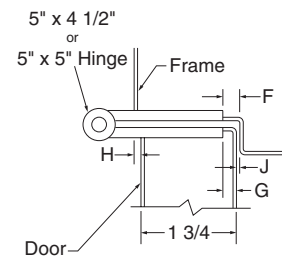
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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

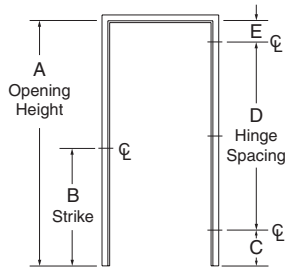


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	41-13/16"	9"	2 @ 31"	9"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 32"					
7'-0"			2 @ 33"					
7'-2"			2 @ 34"					
7'-4"			2 @ 35"					
7'-6"			2 @ 36"					
7'-8"			3 @ 24-21/32"					
7'-10"			3 @ 25-21/64"					
8'-0"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



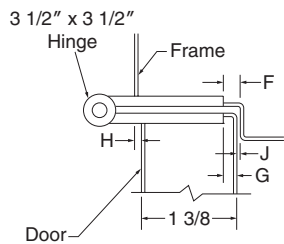
5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	41-13/16"	9"	2 @ 31"	9"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 32"					
7'-0"			2 @ 33"					
7'-2"			2 @ 34"					
7'-4"			2 @ 35"					
7'-6"			2 @ 36"					
7'-8"			3 @ 24-21/32"					
7'-10"			3 @ 25-21/64"					
8'-0"			3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

## Curries

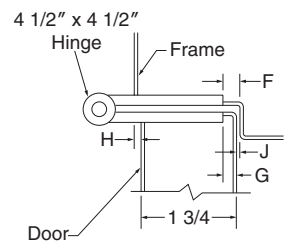


Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.

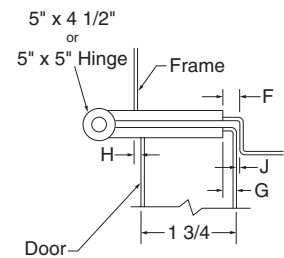
Note: On 3 1/2" hinge preparation for 1 3/8" doors, the standard for non-fire rated frames is two (2) hinges.



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

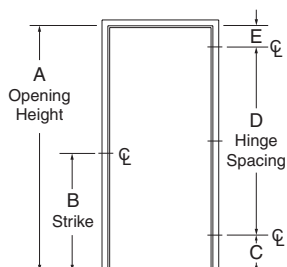


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		12-1/4"	2 @ 35-1/4"				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

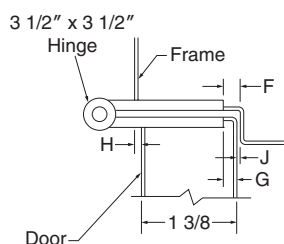


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		12-1/4"	2 @ 35-1/4"					
7'-8"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

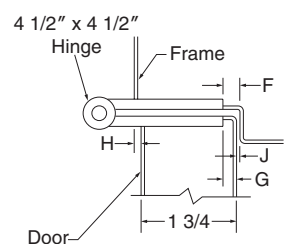
## De La Fontaine Industries



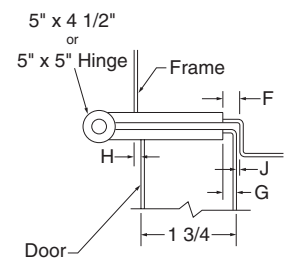
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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



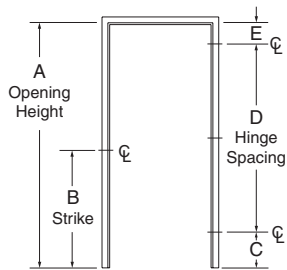
4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	3/8"	1/4"	1/16"	1/8"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"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



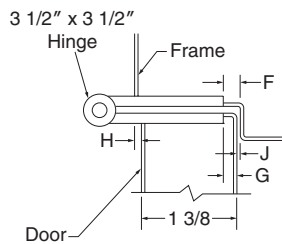
5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	3/8"	1/4"	1/16"	1/8"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"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



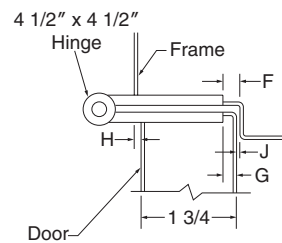
## Deansteel Manufacturing Co.



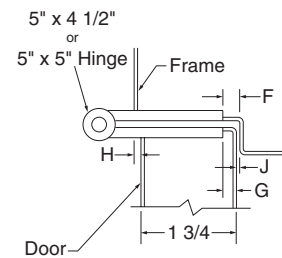
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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

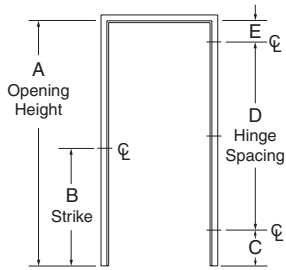


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30-1/4"					
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"			2 @ 34-1/4"					
7'-6"	40-5/16"	12-1/4"	2 @ 35-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
7'-8"			24-1/8", 24-1/4", 24-1/8"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

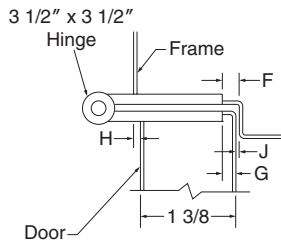


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		12-1/2"	2 @ 30"					
6'-10"		12-1/2"	2 @ 31"					
7'-0"		12-1/2"	2 @ 32"					
7'-2"		12-1/2"	2 @ 33"					
7'-4"		12-1/2"	2 @ 34"					
7'-6"	40-5/16"	12-1/2"	2 @ 35"	7-1/2"	5/16"	1/4"	1/8"	1/16"
7'-8"		12-1/2"	3 @ 24"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

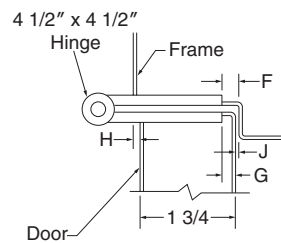
## Door Components Inc.



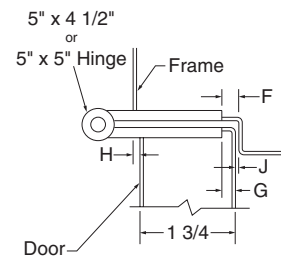
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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

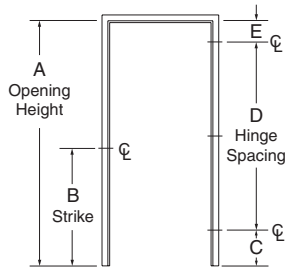


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			23-15/16",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

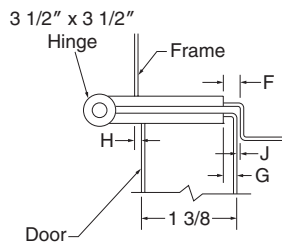


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			23-15/16", 24",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

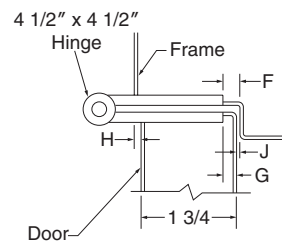
## Hollow Metal Xpress (HMX)



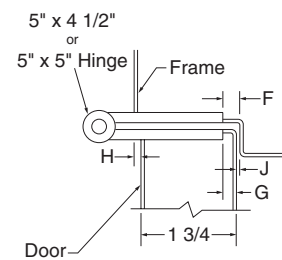
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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

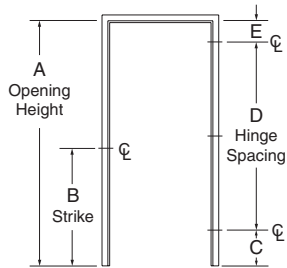


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		12-1/4"	2 @ 30-1/4"					
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"	40-5/16"	12-1/4"	2 @ 35-1/4"	7-1/4"	5/16"	1/4"	1/8"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

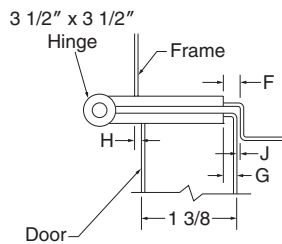


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		12-1/4"	2 @ 30-1/4"					
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"	40-5/16"	12-1/4"	2 @ 35-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"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

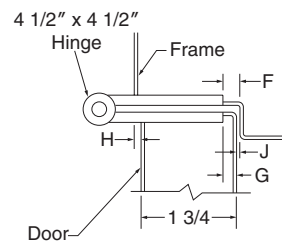
## Mesker Door



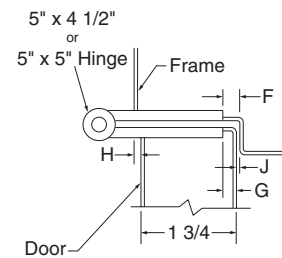
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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

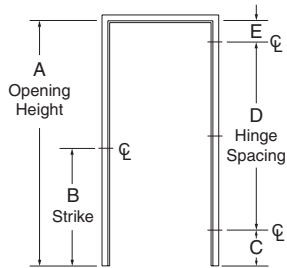


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		12-1/4"	2 @ 35-1/4"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

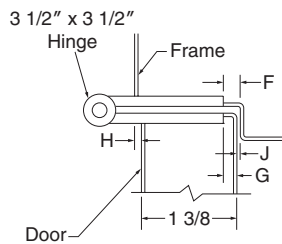


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		12-1/4"	2 @ 35-1/4"			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

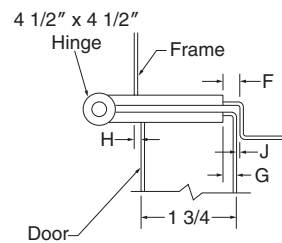
# MPI



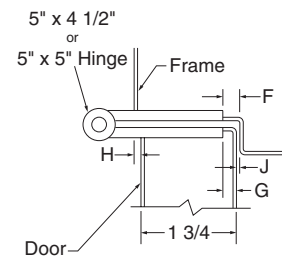
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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

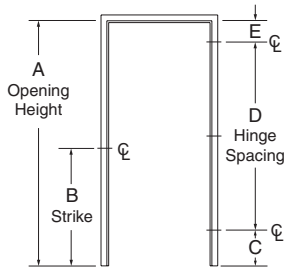


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"			2 @ 34-1/4"					
7'-6"			2 @ 35-1/4"					
7'-8"			2 @ 24-3/16", 1 @ 24-1/8"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

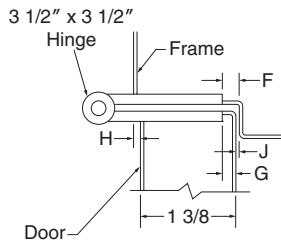


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/2"	2 @ 30	7-1/2"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 31					
7'-0"			2 @ 32					
7'-2"			2 @ 33					
7'-4"			2 @ 34					
7'-6"			2 @ 35					
7'-8"			3 @ 24					
7'-10"			2 @ 24-11/16", 1 @ 24-5/8"					
8'-0"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

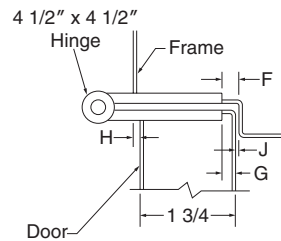


Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



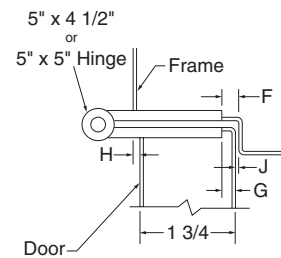
### 3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors

A	B	C	D	E	F	G	H	J
6'-8"	38"	11-3/4"	2 @ 30-3/4"	6-3/4"	5/16"	7/32"	1/8"	1/16"
7'-0"			2 @ 32-3/4"					
7'-2"			2 @ 33-3/4"					



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

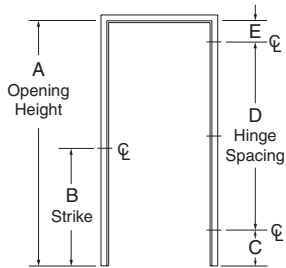
A	B	C	D	E	F	G	H	J
6'-8"	38"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	7/32"	3/32"	3/32"
6'-10"		12-1/4"	2 @ 31-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		12-1/4"	2 @ 33-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		12-1/4"	3 @ 23-1/2"					
7'-8"		12-3/16"	3 @ 24-3/16"					
7'-10"		12-5/16"	3 @ 24-13/16"					
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"					



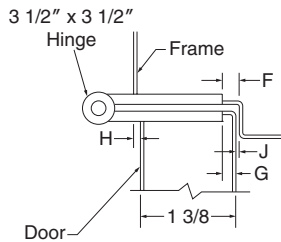
### 5" Hinge & Strike Comparison for 1-3/4" Thick Doors

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"					

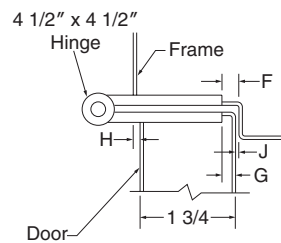
## Pioneer Industries, Inc. – S-Series



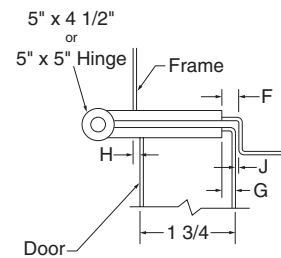
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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

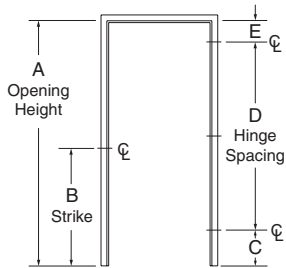


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 29-15/16"					
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"	40-5/16"	10-3/8"	2 @ 34-15/16"	9-3/4"	5/16"	7/32"	3/32"	3/32"
7'-8"			3 @ 23-61/64"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

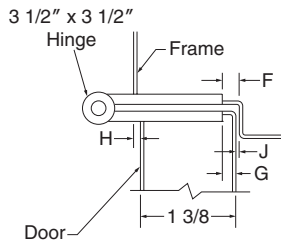


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 29-15/16"					
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"	40-5/16"	10-3/8"	2 @ 34-15/16"	9-3/4"	5/16"	7/32"	3/32"	3/32"
7'-8"			3 @ 23-61/64"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

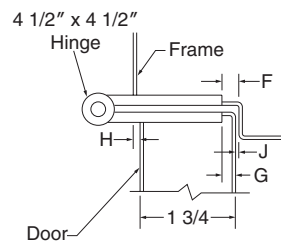
## Premier Steel Doors & Frames, Inc.



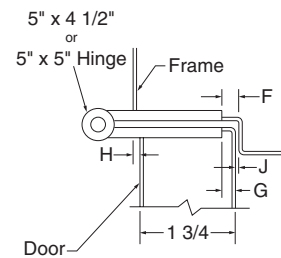
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors								
A	B	C	D	E	F	G	H	J
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"	1/8"	1/16"
7'-2"			2 @ 32-15/16"					



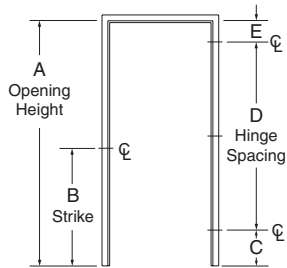
4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30-1/4"					
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"	40-5/16"	12-1/4"	3 @ 22-53/64"	7-1/4"	3/8"	1/4"	1/16"	1/8"
7'-6"			3 @ 23-1/2"					
7'-8"			3 @ 24-11/64"					
7'-10"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



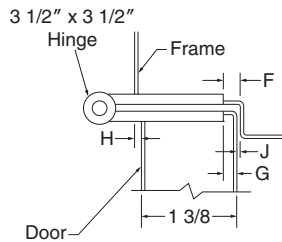
5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30-1/4"					
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"	40-5/16"	12-1/4"	3 @ 22-53/64"	7-1/4"	3/8"	1/4"	1/16"	1/8"
7'-6"			3 @ 23-1/2"					
7'-8"			3 @ 24-11/64"					
7'-10"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



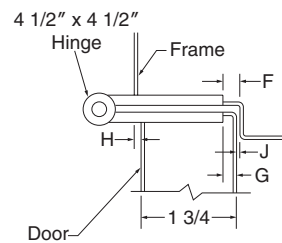
## Republic Doors & Frames



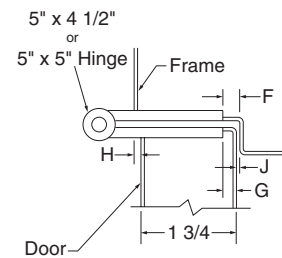
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions. Republic hinge locations effective as of 7/15/2015.



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

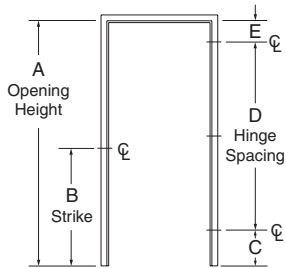


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 31-1/4"					
7'-0"			2 @ 32-1/4"					
7'-2"			2 @ 33-1/4"					
7'-4"			2 @ 34-1/4"					
7'-6"			2 @ 35-1/4"					
7'-8"			3 @ 24-11/64"					
7'-10"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

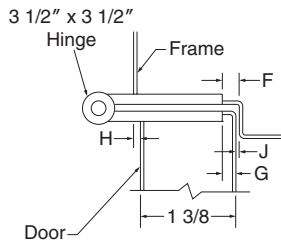


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/2"	2 @ 30"	7-1/2"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 31"					
7'-0"			2 @ 32"					
7'-2"			2 @ 33"					
7'-4"			2 @ 34"					
7'-6"			2 @ 35"					
7'-8"			3 @ 24"					
7'-10"			3 @ 24-43/64"					
8'-0"		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

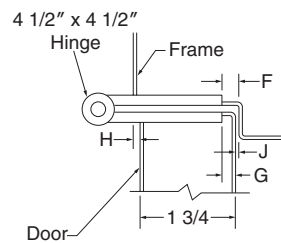
# Steelcraft



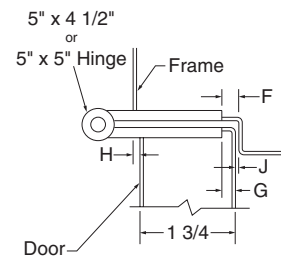
Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



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

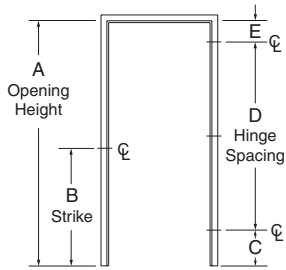


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"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

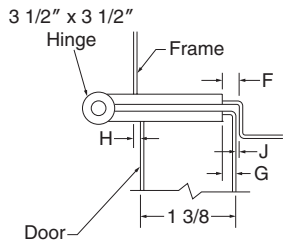


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-3/8"	2 @ 29-15/16"	9-3/4"	5/16"	1/4"	1/8"	1/16"
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"			2 @ 33-15/16"					
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-61/64"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

## Stiles

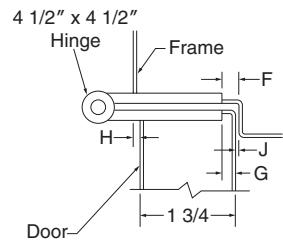


Note: Dimensions listed are valid at time of publication. However, manufacturers do periodically revise their hinge and strike spacing, therefore, the SDI strongly recommends that individual manufacturers be contacted to verify dimensions.



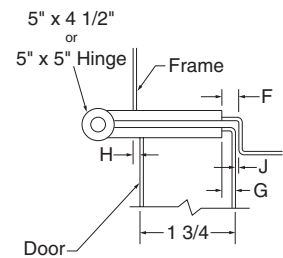
### 3-1/2" Hinge & Strike Comparison for 1-3/8" Thick Doors

A	B	C	D	E	F	G	H	J
—	—	—	—	—	—	—	—	—



### 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"	3 @ 23-1/2"	7-1/4"	3/8"	1/4"	1/16"	1/8"
7'-8"			3 @ 24-5/32"					
7'-10"			3 @ 24-27/32"					
8'-0"			3 @ 25-1/2"					
9'-0"			4 @ 22-1/8"					
10'-0"			4 @ 25-1/8"					

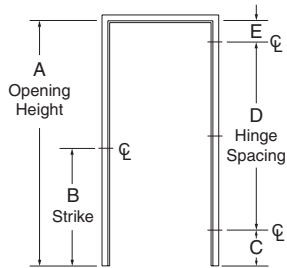


### 5" Hinge & Strike Comparison for 1-3/4" Thick Doors

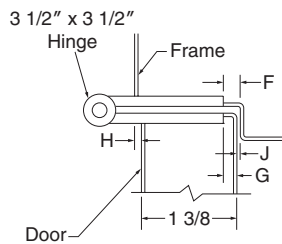
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 30"					
6'-10"			2 @ 31"					
7'-0"			2 @ 32"					
7'-2"			2 @ 33"					
7'-4"			2 @ 34"					
7'-6"	40-5/16"	12-1/2"	3 @ 20-1/2"	7-1/2"	3/8"	1/4"	1/16"	1/8"
7'-8"			3 @ 24-5/32"					
7'-10"			3 @ 24-27/32"					
8'-0"			3 @ 25-11/32"					
9'-0"			4 @ 22"					
10'-0"			4 @ 25"					

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

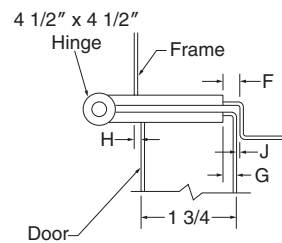
## Benchmark



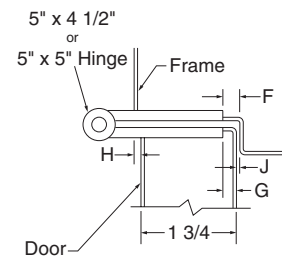
Note: Benchmark is no longer a member of the Steel Door Institute. Its hinge and strike spacing are included for legacy purposes; the validity of the data cannot be confirmed.



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

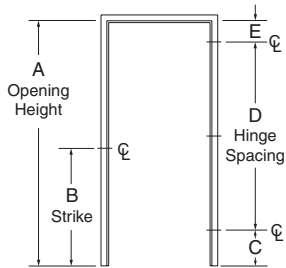


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	12-1/4"	2 @ 30-1/4"	7-1/4"	11/32"	1/4"	1/8"	3/32"
6'-10"		14-1/4"	2 @ 30-1/4"					
7'-0"		12-1/4"	2 @ 32-1/4"					
7'-2"		14-1/4"	2 @ 32-1/4"					
7'-4"		12-1/4"	2 @ 34-1/4"					
7'-6"		14-1/4"	2 @ 34-1/4"					
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"					

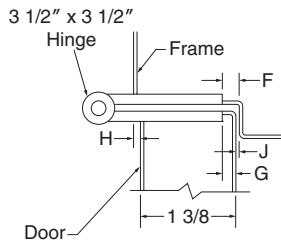


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
—	—	—	—	—	—	—	—	—

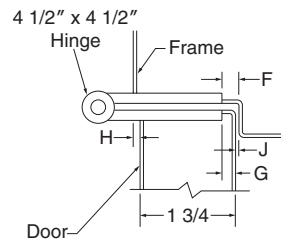
## Black Mountain Door (Formerly Amweld Building Products)



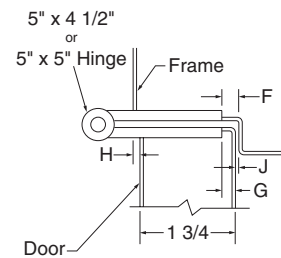
Note: Black Mountain Door is no longer a member of the Steel Door Institute. Its hinge and strike spacing are included for legacy purposes; the validity of the data cannot be confirmed.



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

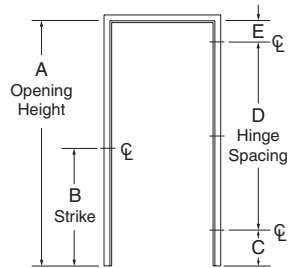


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		10-3/8"	2 @ 29-15/16"					
6'-10"		8-3/8"	2 @ 31-15/16"					
7'-0"		10-3/8"	2 @ 31-15/16"					
7'-2"		12-3/8"	2 @ 31-15/16"					
7'-4"		10-3/8"	2 @ 33-15/16"					
7'-6"	40-5/16"	12-3/8"	2 @ 33-15/16"	9-3/4"	5/16"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

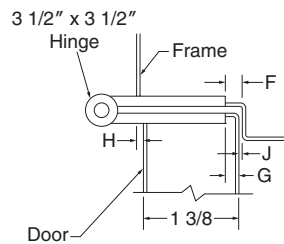


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"		10-3/8"	2 @ 29-15/16"					
6'-10"		8-3/8"	2 @ 31-15/16"					
7'-0"		10-3/8"	2 @ 31-15/16"					
7'-2"		12-3/8"	2 @ 31-15/16"					
7'-4"		10-3/8"	2 @ 33-15/16"					
7'-6"	40-5/16"	12-3/8"	2 @ 33-15/16"	9-3/4"	5/16"	3/16"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

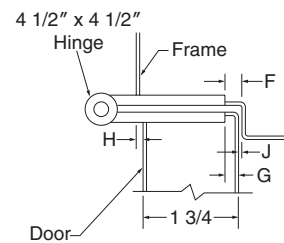
# Copco



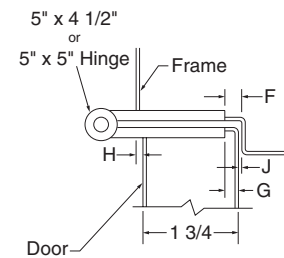
Note: Copco is no longer a member of the Steel Door Institute. Its hinge and strike spacing are included for legacy purposes; the validity of the data cannot be confirmed.



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

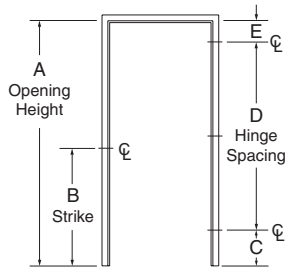


4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 29-15/16"					
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"	40-5/16"	10-3/8"	2 @ 33-15/16"	9-3/4"	5/16"	7/32"	1/32"	3/32"
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-19/64"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

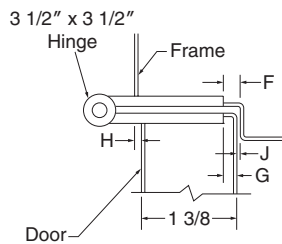


5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"			2 @ 29-15/16"					
6'-10"			2 @ 30-15/16"					
7'-0"			2 @ 31-15/16"					
7'-2"			2 @ 32-15/16"					
7'-4"	40-5/16"	10-3/8"	2 @ 33-15/16"	9-3/4"	5/16"	7/32"	1/32"	3/32"
7'-6"			2 @ 34-15/16"					
7'-8"			3 @ 23-19/64"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

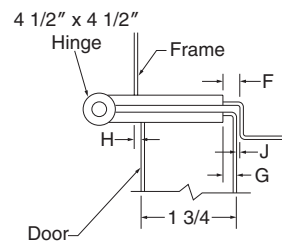
## Kewanee



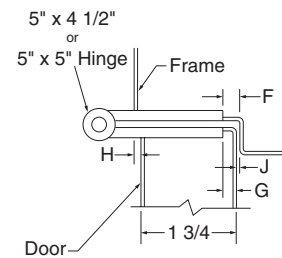
Note: Kewanee is no longer a member of the Steel Door Institute. Its hinge and strike spacing are included for legacy purposes; the validity of the data cannot be confirmed.



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



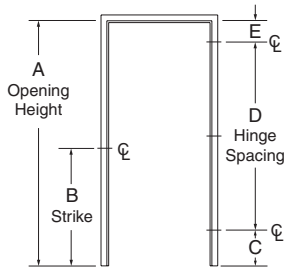
4-1/2" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-1/4"	2 @ 30-1/16"	9-5/8"	3/8"	1/4"	1/16"	1/8"
6'-10"			2 @ 31-1/16"					
7'-0"			2 @ 32-1/16"					
7'-2"			2 @ 33-1/16"					
7'-4"			2 @ 34-1/16"					
7'-6"			2 @ 35-1/16"					
7'-8"			24-1/16", 24", 24-1/16"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



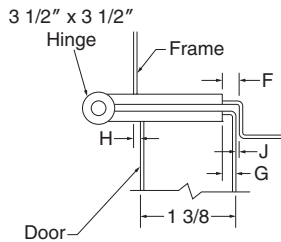
5" Hinge & Strike Comparison for 1-3/4" Thick Doors								
A	B	C	D	E	F	G	H	J
6'-8"	40-5/16"	10-1/4"	2 @ 30-1/16"	9-5/8"	3/8"	1/4"	1/16"	1/8"
6'-10"			2 @ 31-1/16"					
7'-0"			2 @ 32-1/16"					
7'-2"			2 @ 33-1/16"					
7'-4"			2 @ 34-1/16"					
7'-6"			2 @ 35-1/16"					
7'-8"			24-1/16", 24", 24-1/16"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



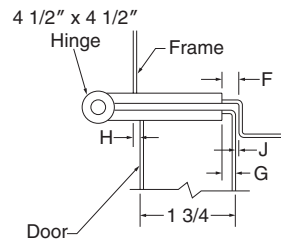
## Security Metal Products



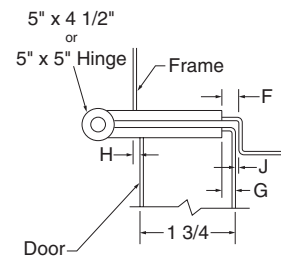
Note: Security Metal Products is no longer a member of the Steel Door Institute. Its hinge and strike spacing are included for legacy purposes; the validity of the data cannot be confirmed.



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



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"					

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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)
- ANSI/SDI A250.14** Hardware Preparation in Steel Doors and Steel 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 and Frames
- SDI-129** Hinge and Strike Spacing
- SDI-133** Guideline for Specifying Steel Doors & Frames for Blast Resistance
- SDI-136** Guideline for Specifying Windstorm Products

### 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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# **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  $\pm 2$  degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

## 5 Location

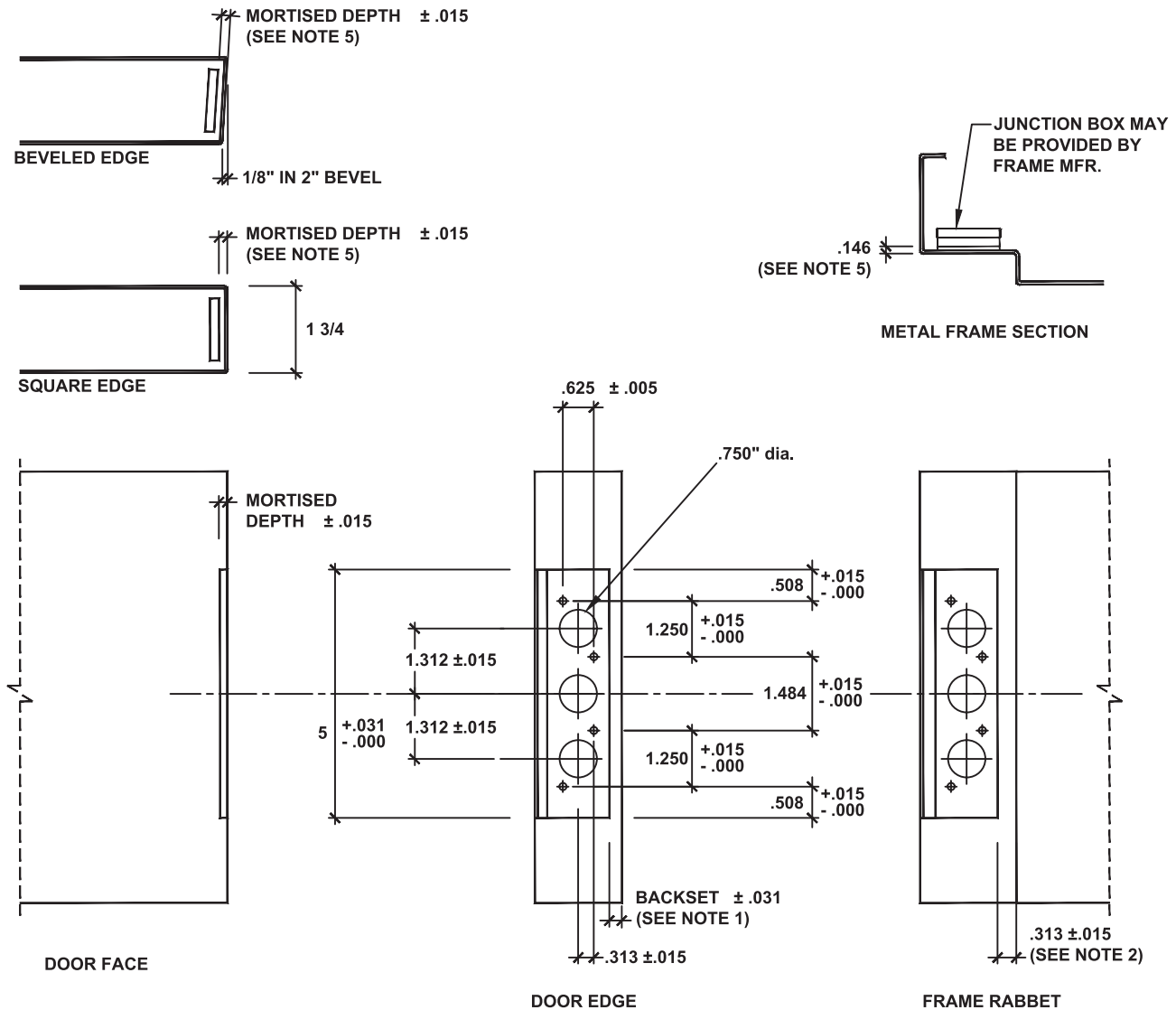
The preparation for electric hinges is intended to be non-load bearing. Therefore it shall be located in the center hinge preparation on frames with 1-½ pair of hinges, and on the second hinge from the bottom on frames with 2 pair of hinges.

## 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.

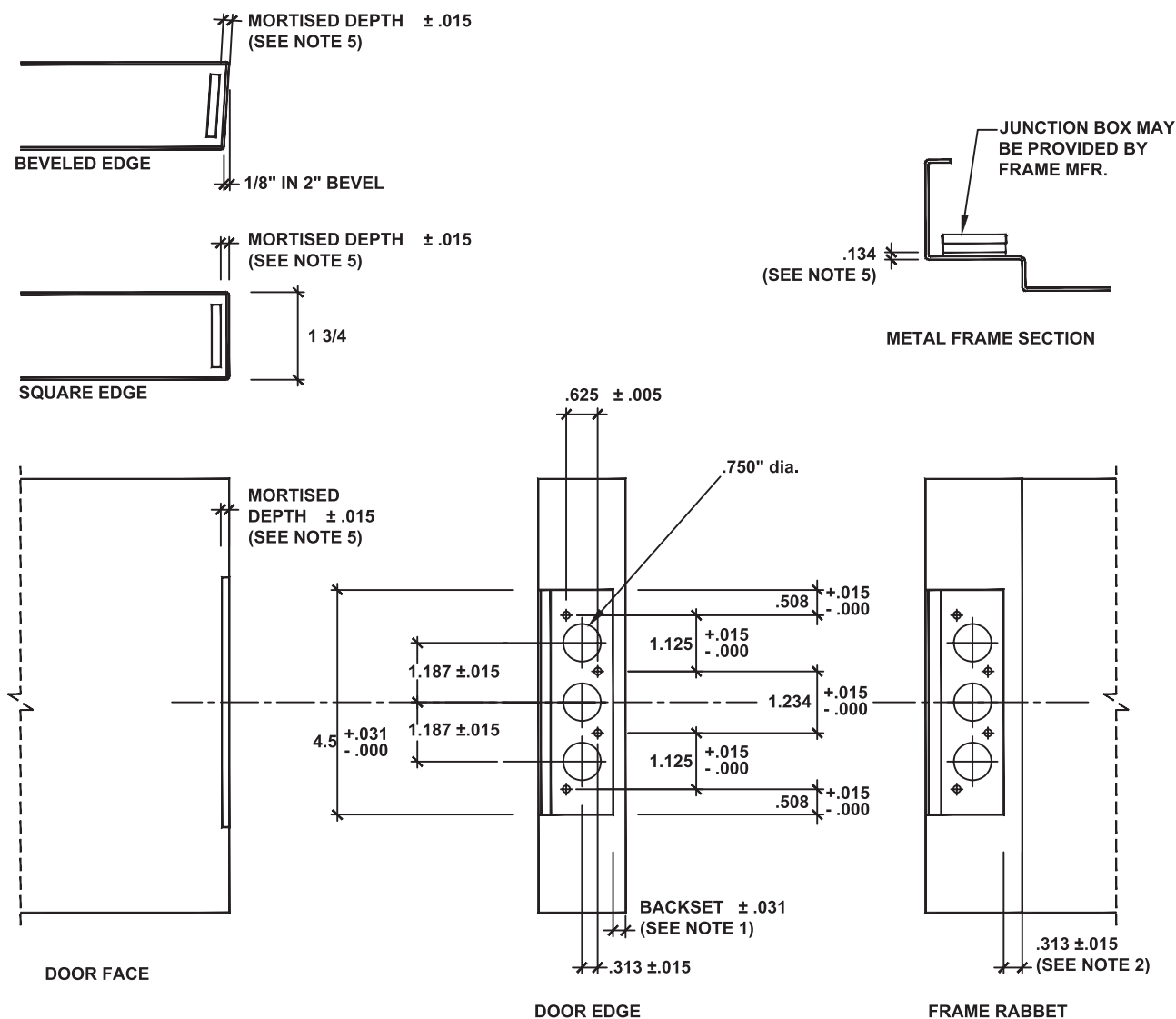
**Note 5:** The most common mortise depths are in accordance with ANSI/BHMA A156.1 as follows:

Standard Weight butt 0.146"

Heavy weight butt 0.190"

**Figure 1 – Preparation of 1 3/4" Steel Doors & Frames for 5" Full Mortise Electric Hinge**





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

**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.

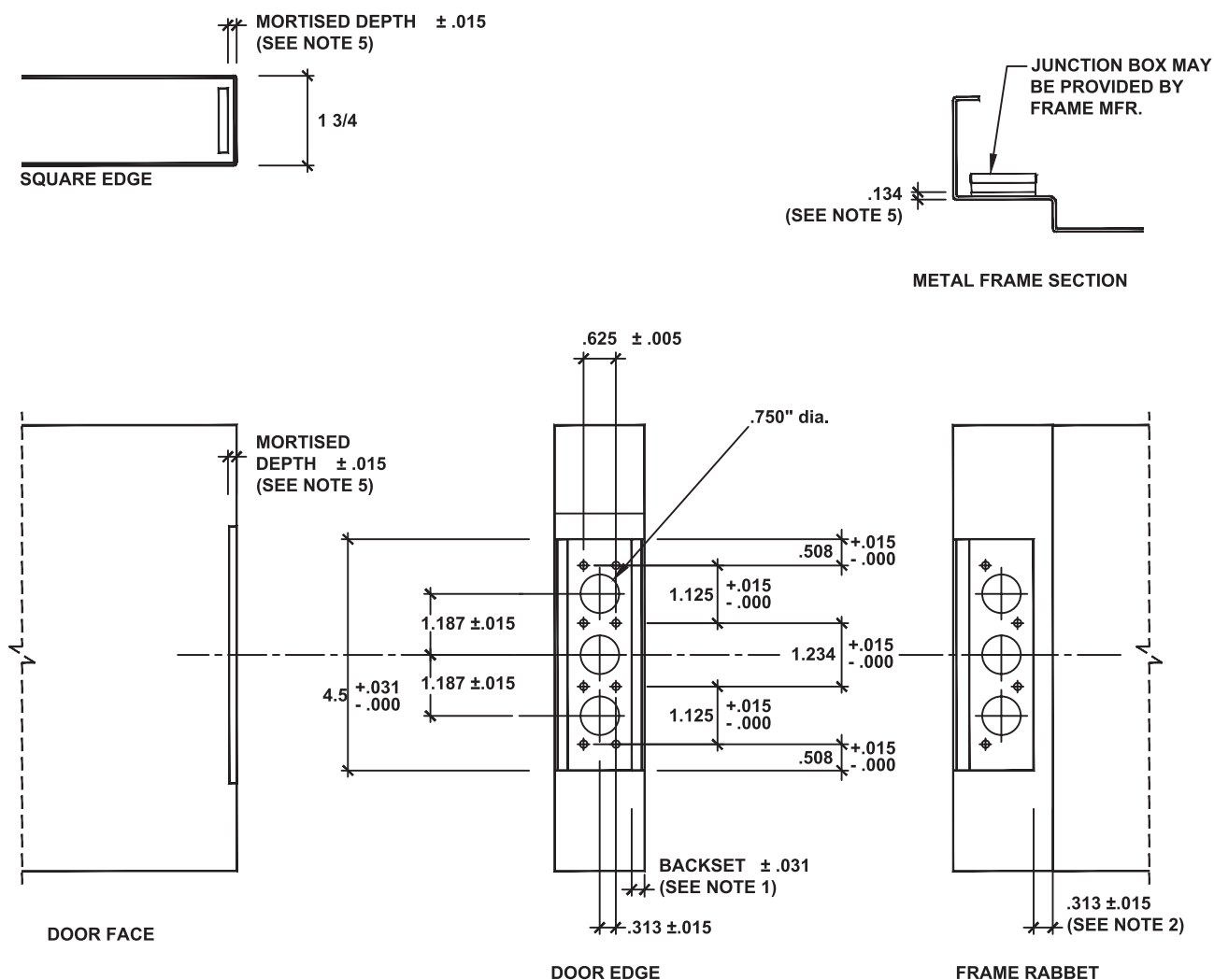
**Note 4:** Some manufacturers offer a removable feature (e.g. - wire, shim, standoff projection) to allow conversion of a standard weight preparation for use with heavy weight hinge butt.

**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 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**

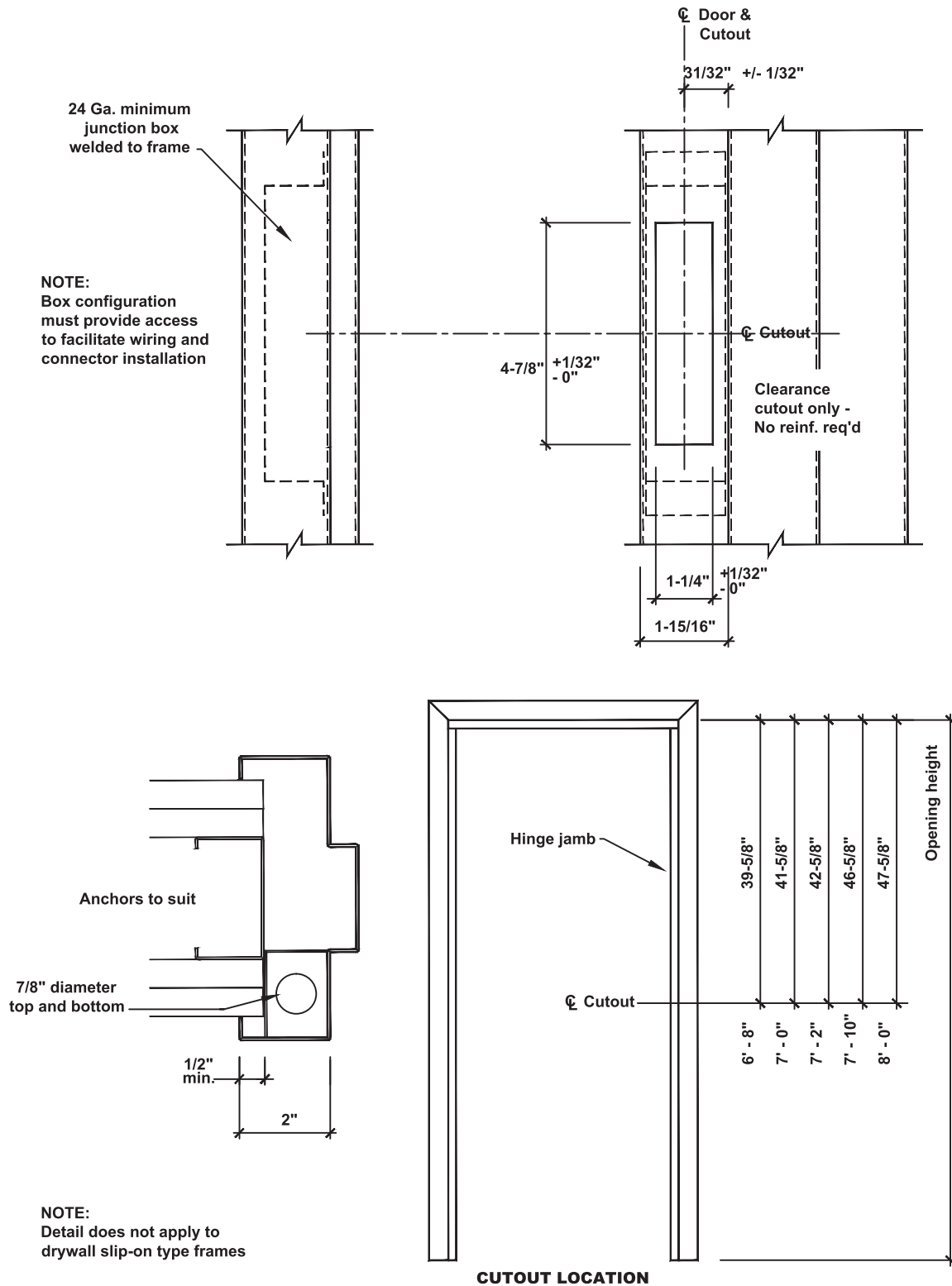


Figure 4 – Electrified Continuous Hinge Preparation on Standard Steel Frame

## 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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# **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

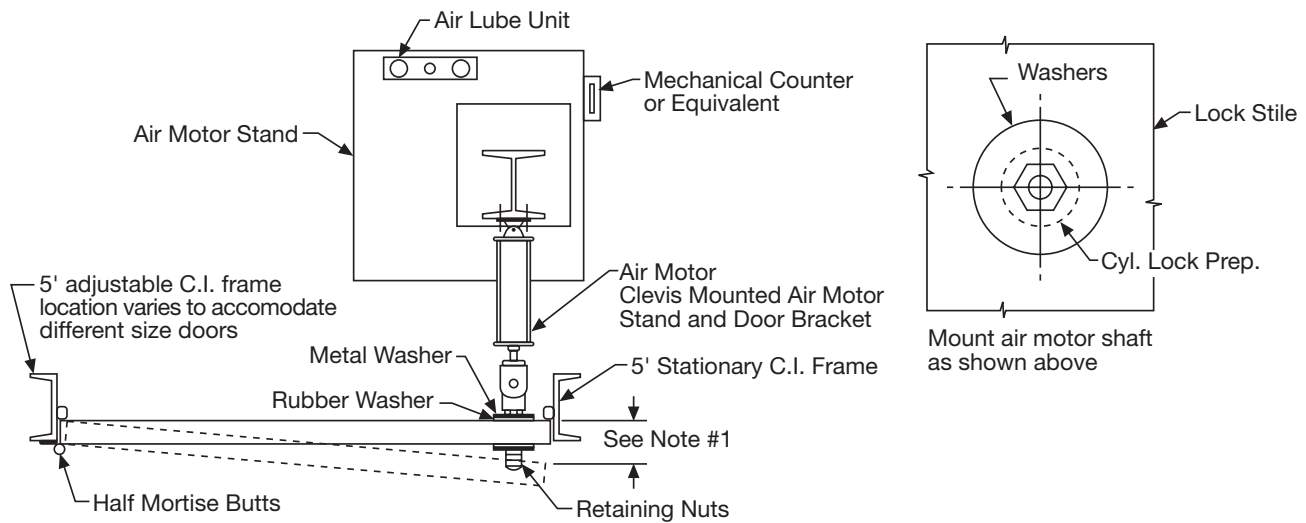
The test shall be performed on a 3'0" wide x 7'0" high nominal size door; although, other sizes are permitted to be evaluated at the discretion of the sponsor.

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.

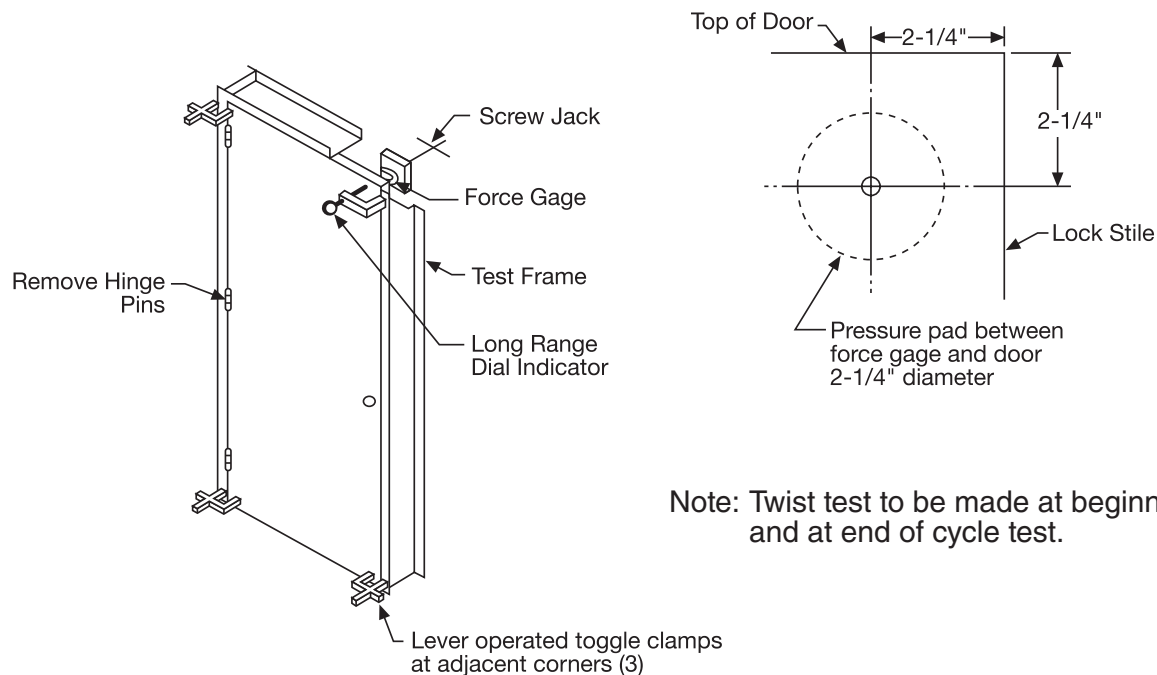
**7.3** Top, bottom, or edge channels must remain securely in place, with no signs of weld or bond breakage.

**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:

Door Model:

Hinge Manufacturer:

Weight of Door:

Door Size:

Hinge Model:

Test No.:

Start Test Date:

Finish Test Date:

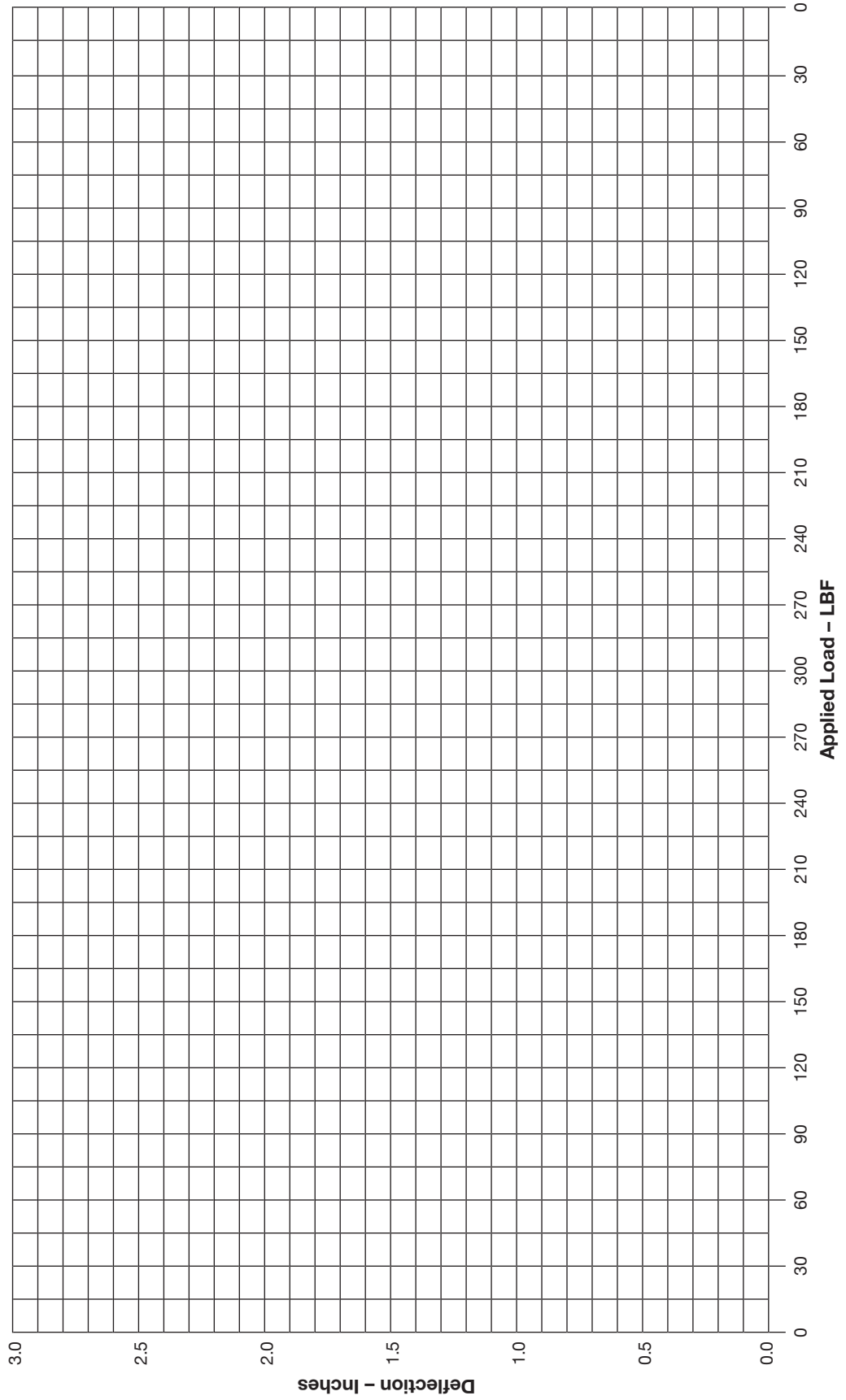
		Inspection Intervals – (000)																					
		25	50	75	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
Edge Condition	Hinge Preparations																						
		Top																					
		Intermediate																					
Bottom																							
Top Closer Condition																							
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-135** Guidelines to Measure for Replacement Doors in Existing Frame Openings

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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

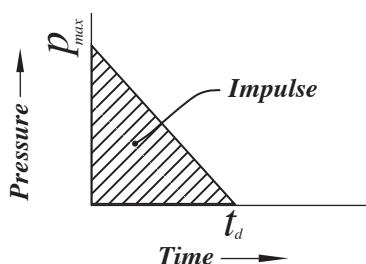
## 1 Introduction

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 3<sup>rd</sup> 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, typically specified as peak-reflected pressure.



**Blast Wave (Idealized)**

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

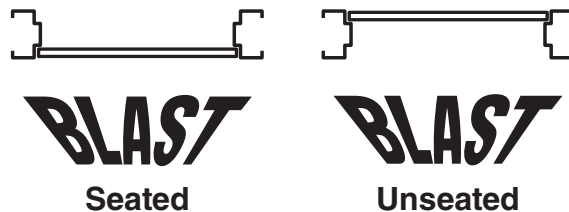
**2.4 Charge Weight:** The equivalent explosive weight (lbs or kg) of TNT in the blast event. Different agencies have specific requirements for charge weight to be used. See agency specific criteria for DoD, VA, GSA, and DOS to determine required charge weight and in some cases, the required standoff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

**2.5 Duration:** The amount of time it takes the peak pressure to decay to ambient conditions (or zero), typically specified in milliseconds (ms).

**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 Unified Facilities Criteria (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.

### Blast Product Response & Damage Categories

UFC 4-010-01 2018 – Levels of Protection	
<b>Below AT Standards</b>	Severe damage and/or collapse of structure
<b>Very Low</b>	Heavy structural damage
<b>Low</b>	Moderate damage, unable to be repaired economically
<b>Medium</b>	Minor damage, able to be repaired economically
<b>High</b>	Minimal damage, no permanent deformation

ASTM F2247-18 – Response Categories	
<b>Category I</b>	No permanent deformation to the specimen is present, and the door is fully operable.
<b>Category II</b>	Measurable permanent deformation is present, but the door is operable.
<b>Category III</b>	Non-catastrophic failure, however the unit is inoperable. For unseated loads, the latching mechanism is permitted to fail, allowing the door to swing open, but the door remains supported by the hinges.
<b>Category IV</b>	The unit is severely deformed and may become detached from the hinges; however the door will not become a flying debris hazard.

ASTM F2912-17 – Hazard Ratings	
<b>No Break (H1)</b>	No fractures are present in the glazing, and no damage is visible to the unit.
<b>No Hazard (H1)</b>	The glazing has fractured, but no breakage has occurred (no debris).
<b>Minimal Hazard (H2)</b>	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).
<b>Very Low Hazard (H3)</b>	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). The total fragment weight cannot exceed 15 grams.
<b>Low Hazard (H4)</b>	The glazing has fractured, and fragments have fallen between 40 and 120 inches from the specimen. The witness panel, which is 120 inches away, has 25 or less perforations below 20 inches above the floor, and 10 or less perforations above 20 inches above the floor. 5 or less perforations may fully penetrate the full layered witness panel.
<b>Moderate Hazard (H5)</b>	The glazing has fractured, and fragments have fallen between 40 and 120 inches from the specimen. The witness panel has numerous perforations below the 20 inch mark above the floor, and 25 or less perforations above the 20 inch mark. 5 or less perforations may fully penetrate the full layered witness panel.
<b>High Hazard</b>	The glazing has fractured and the witness panel, which is 120 inches away, has more than 25 perforations higher than the 20 inch mark above the floor. There are more than 5 perforations that fully penetrate the full layered witness panel.

ASTM F2927-21 – Door Response Damage Categories	
<b>Category I</b>	The door specimen is unchanged and fully operable.
<b>Category II</b>	The unit has acceptable permanent deformation but is still operable.
<b>Category III / S</b>	The door remains secure during and after the loading event. The door may get lodged in the frame, and cannot be opened or passed through by a person without the use of tools, from the threat side.
<b>Category III / U</b>	The door does not remain secure after the loading event. The door can be opened or passed through without the use of the supplied hardware, and without the use of tools. The door can swing open during rebound, but remains attached to the frame at the hinges.
<b>Category IV</b>	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.
<b>Category V</b>	The door or the door and frame unit together become dislodged and cause a flying debris hazard that will go further than 3 meters.

**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.

### 3 Blast Standard Test Methods and Design Criteria

**3.1 ASTM F2247-18** – *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 F2927-21** – *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 F2912-17** – *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 F1642-17** – *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, 2<sup>nd</sup> edition** – *Design of Blast Resistant Buildings in Petrochemical Facilities*

**3.7 PIP STC01018-2014** – *Blast Resistant Building Design Criteria*

**3.8 UFC 4-010-01 2018** – *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 Assembly	4'-0" x 4'-0" Window
Peak Reflected Pressure, Duration, & Rebound	4psi, 100ms, 50% Rebound	2psi, 200ms
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 F2912-17
Applicable Blast Test Standard	ASTM F2927-21	ASTM F1642-17
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, 12 December 2018



## Sample Blast Quote Request Form

Blast Resistant Door – Request for Quote													
Door				Blast Requirements ④				Frame ⑤		Hwr ⑥			
Opening ①		Door Type ②	UL 10c Fire Rating ③	Seated or Unseated	Peak Load (psi)	Reflected, Side-on or Free-Field	Impulse (psi-ms)	Duration (ms)	% Rebound Response	Response Category	Jamb Width	Wall Type (C, M, or S)	Lock Type
Qty	Swing	Width	Height	Material									
1													
2													
3													
4													
5													
<div style="display: flex; justify-content: space-around;"> <div> <p>Interior – Secure Area</p> <p>Exterior – Public Area (Key side of door)</p> <p>Door Swing</p> </div> <div> <p>Height</p> <p>Width</p> </div> </div>				<p><b>Material:</b> The doors material type (CR-Cold Rolled, GV-Galvanized, or SS-Stainless Steel) (Note: Stainless Steel doors may have mild steel internal reinforcements. Glavannealed doors may have cold-rolled or mild steel internal reinforcements)</p> <p><b>Hinges:</b> Heavy Duty S.S. Hinges 32D</p>									
<div style="display: flex; justify-content: space-around;"> <div> <p>(F) Flush</p> <p>(V) Vision</p> <p>(N) Narrow Light</p> </div> <div> <p>(G) Half Glass</p> <p>(FG) Full Glass</p> </div> </div>				<p>Glazing will be specified as necessary to meet the blast requirements. Please specify if the glazing is to be supplied by the Manufacturer or if you, the customer, will provide the glazing</p> <p><input type="checkbox"/> Glass by Manufacturer <input type="checkbox"/> Glass provided by customer</p>									
<p><b>③ Fire Rating</b> – Opening is required to withstand a fire for 1/3, 3/4, 1-1/2 or 3-hour rating.</p>				<p><b>Rebound Response</b> – Represents the expected psi capacity the door will be required to withstand in the opposite direction of the blast in percent form.</p> <p><b>0%</b> No rebound response required.</p> <p><b>50%</b> Rebound response is capable of 50% of the specified blast load (psi)</p> <p><b>100%</b> Rebound response capacity is equal to blast load.</p> <p>Note: Rebound is not applicable for an unseated blast load or static loading.</p>									
<p><b>④</b></p> <div style="display: flex; justify-content: space-around;"> <div> <p><b>Seated</b></p> <p>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><b>Unseated</b></p> </div> </div>				<p><b>Category:</b></p> <p><b>I</b> No permanent damage</p> <p><b>II</b> Permanent damage to the panel, but the door remains operable</p> <p><b>III</b> The door panel is damaged &amp; inoperable, and the latch may fail, allowing the door to swing open in rebound</p> <p><b>IV</b> Door panel is severely deformed with openings between the door and frame. Under dynamic load, the door may separate from the frame, and/or the frame anchorage may fail.</p>									
<p><b>⑤</b></p> <p>Jamb width – Overall width of the frame section profile (depth)</p>				<p>Contact Person:</p>									
<p>Wall type – Wall condition the frame will be anchored to (Concrete, Masonry or Structural Steel [Tube steel])</p>				<p>Title:</p>									
<p><b>⑥</b></p> <p>Lock Type – Mortise Panic Device (MP) or Mortise Lock (ML) – Stainless Steel Finish</p>				<p>Company:</p>									
<p>Test Method:</p>				<p>Phone:</p>									
<p>Revision:</p>				<p>E-mail:</p>									
				<p>Fax:</p>									
				<p>Date:</p>									



## AVAILABLE PUBLICATIONS

### Specifications

- ANSI/SDI A250.6** Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
- ANSI/SDI A250.8** Specifications for Standard Steel Doors and Frames (SDI-100)
- SDI-108** Recommended Selection & Usage Guide for Standard Steel Doors
- SDI-118** Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements
- SDI-128** Guidelines for Acoustical Performance of Standard Steel Doors and Frames
- SDI-129** Hinge and Strike Spacing
- SDI-133** Guideline for Specifying Steel Doors & Frames for Blast Resistance
- SDI-136** Guideline for Specifying Windstorm Products

### 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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# **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.

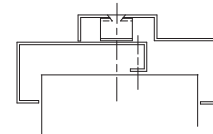
The following glossary is adapted with permission from the Hollow Metal Manufacturers Association's HMMA 801-12.

**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.

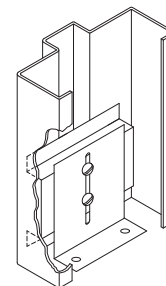
**ADJUSTABLE BASE ANCHOR:** See **ADJUSTABLE FLOOR ANCHOR**.

**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.

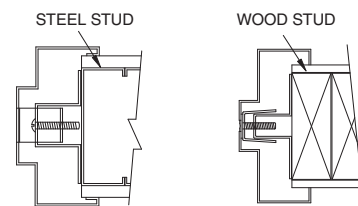


**ANCHOR:** A metal device provided inside of a jamb, head, sill or mullion used to secure the frame to the adjacent structure, such as wall, ceiling or floor. Also referred to as jamb anchor, wall anchor, floor anchor, etc. See listing;

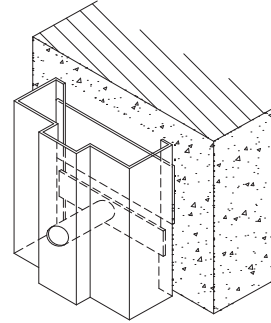
**ADJUSTABLE FLOOR:** A metal device used to secure a frame to floor at base which allows the jamb to be positioned at a location in height above floor. Typically used at a depressed slab or unlevel floor condition. Also referred to as Adjustable Base Anchor.



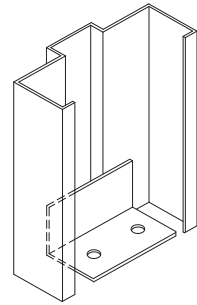
**COMPRESSION:** An adjustable metal device, used to secure, adjust and square a slip on frame.



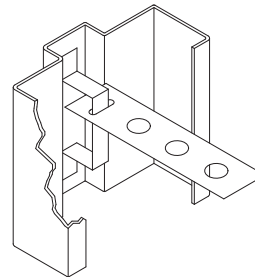
**EXISTING WALL:** A hole preparation, generally in the soffit of a frame member, with internal reinforcing and/or guide for an expansion bolt, machine bolt, or screw. Used to secure the frame to an existing opening.



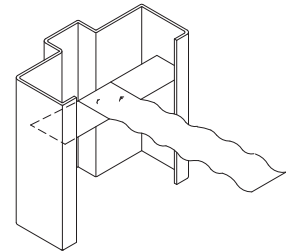
**FIXED FLOOR:** A metal device attached to the bottom of the frame to secure a frame to the floor. Also referred to as Base Anchor or Sill Anchor.



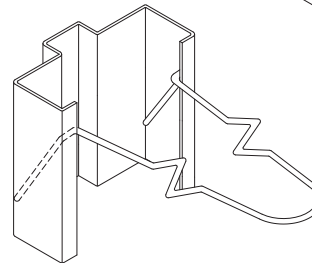
**MASONRY STRAP & STIRRUP:** A fixed metal device used to secure the frame to new masonry walls.



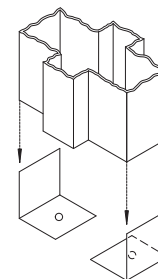
**MASONRY "T"-SHAPED:** A loose metal device used to secure the frame to new masonry walls.



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

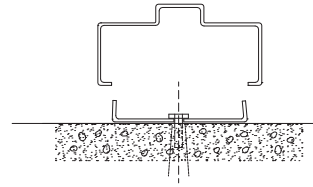


**MULLION:** A metal clip or angle in either 1 or 2 pieces, secured to the floor in which mullion is then positioned over.

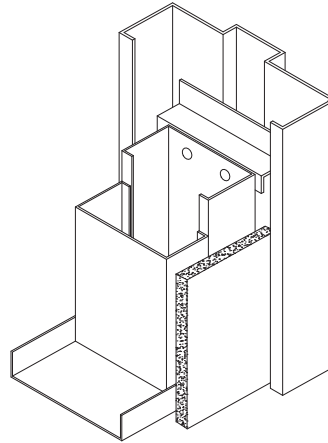


**POURED IN PLACE:** A metal device used to secure a frame to new concrete pour in place wall.

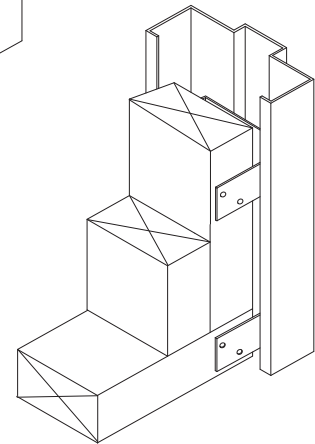
**SILL:** A metal channel secured to the floor in which the sill section of a hollow metal frame is positioned over.



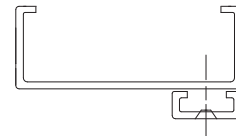
**STEEL STUD:** A metal device secured in a frame to be used for attachment to a wall built with steel studs.



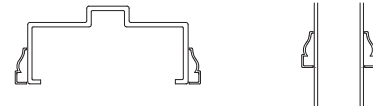
**WOOD STUD:** A metal device secured in a frame to be used for attachment in a wall built with wood studs.



**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.

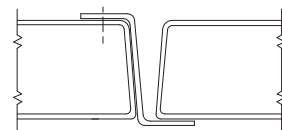
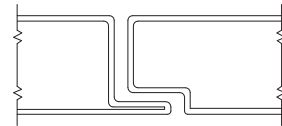
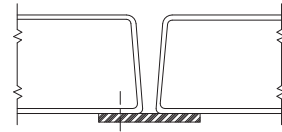


**ASTRAGAL:** A component or combination of components applied to; (a) a single door; (b) one or both doors of a pair at their meeting stiles to cover the door edge clearance; (c) the bottom edge of the flush transom panel; or (d) the bottom of the top leaf of a dutch door. The Astragal closes the clearance 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.

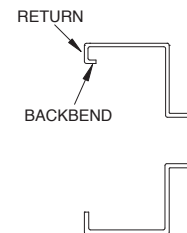
**FLAT SURFACE:** A one-piece steel strip attached to one door and overlapping the other door when in the closed position.

**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.

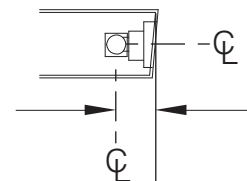


**BACKBEND:** The element of the frame profile which extends from the return and is formed parallel to the wall, inside the throat. Also referred to as second return, double return or drywall return. See **FRAME ELEMENTS** for additional details.

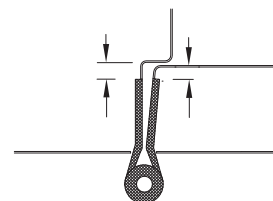


**BACKSET:** The distance from a cutout or datum line for a hardware preparation from a defined datum on a door or frame.

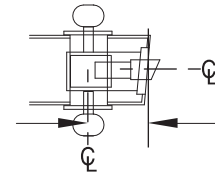
**FLUSH BOLT:** The distance from the centerline of the lock edge of a door to the centerline of the bolt. Shown on beveled edge door.



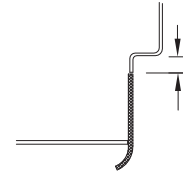
**HINGE:** On a door, the distance from the push side face sheet to the edge of the hinge cutout. On a frame rabbet, the distance from the stop to the edge of the hinge cutout.



**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**.

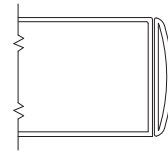
**BLAST RESISTANT:** Refers to a hollow metal assembly designed and manufactured to resist a specified series of impulse pressures of designated magnitude in pounds-force (Newtons).

**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.

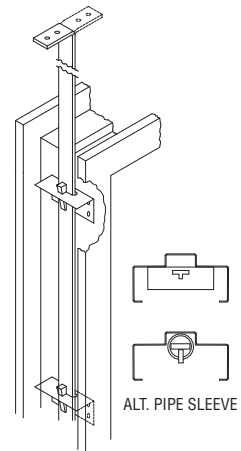
**BUTT JOINT:** Intersection of members, which are not mitered.

**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**.

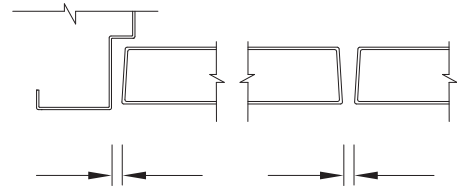
**CLASSIFIED:** "Products or material of a specific group category that are constructed, inspected, tested and subsequently reinspected in accordance with an established set of requirements." (Taken directly from NFPA 80.)

**CLEARANCE:** A term used to define a distance between two items.

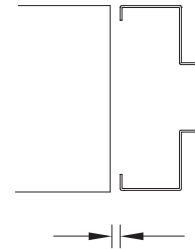
**FLOOR:** The distance between the bottom of the door and the top of the material directly below the door. This varies with applications, such as concrete, any floor covering and/or a threshold. (*For additional information, see HMMA TechNote HMMA 810-TN01-03, "Defining Undercuts".*)

**DESIGN:** The distance around a door established by the manufacturer, used to determine the Actual Door Size.

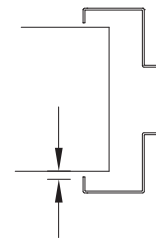
**DOOR EDGE:** The distance between either the edge of the door and frame rabbet, or the edges of two doors of a pair.



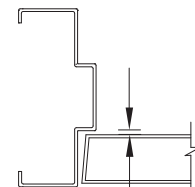
**FRAME INSTALLATION, BUTTING WALL:** The distance between a frame and the wall construction where the frames butts against the wall.



**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.



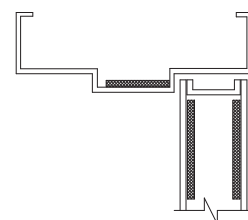
**STOP:** The distance between the frame stop and the face of the door when the door is in the closed position. Typically equal to the thickness of the silencer.



**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.

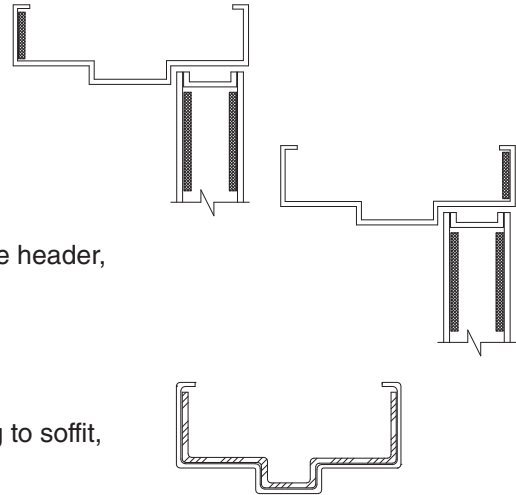
**PARALLEL ARM:** Reinforcing in soffit of frame header or transom mullion.



**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.

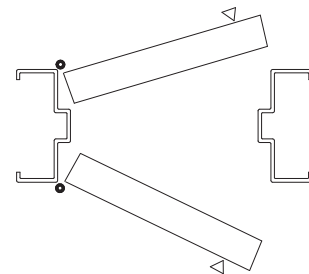


**CLOSURE CHANNEL:** An additional channel section fitted between the flanges of the top or bottom channel of a door, with its flanges projecting inward and its web in line with the door edge.

**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.

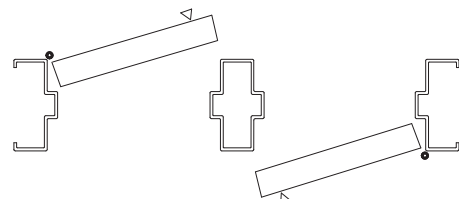


**COMPOSITE DOOR:** A door consisting of a nonmetal core bonded to a metal facing.

**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.



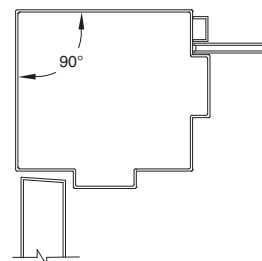
**CORE:** The material(s) of a hollow metal door or panel.

**CORNER CLIP:** See **REINFORCING GUSSET**.

**CORNER JOINT:** The intersection of either the perimeter members of a metal frame product or glass stops.

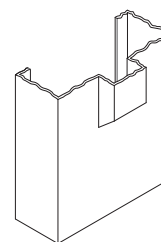
**CORNER GUSSET:** See **REINFORCING GUSSET**.

**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*.)

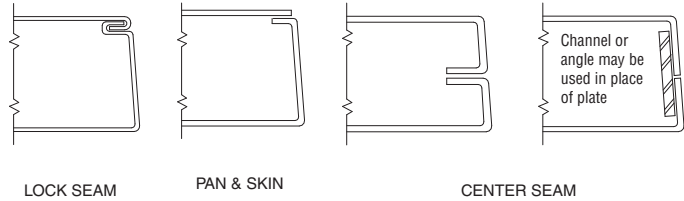
**DOOR CLEARANCE:** See **CLEARANCE**.

**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.

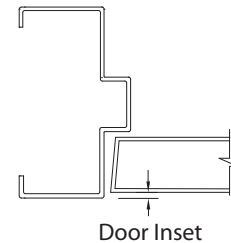
**DOOR EDGE SEAM:** The connection of face sheets at the vertical edge.



**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.

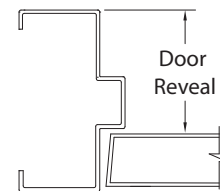
**DOOR OPENING:** The area in a frame product into which a door or doors are installed.

**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**.

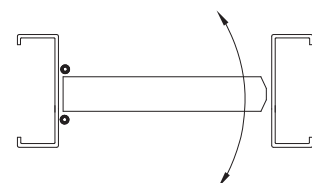
**DOOR REVEAL:** The distance from the face of the door to the face of the frame on the push side.



**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.

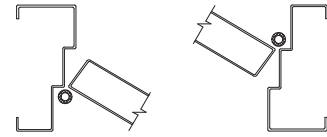
**DOOR STOP:** That part of a frame profile against which the door closes.

**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.

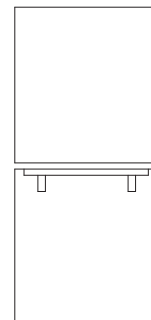
**DRYWALL PROFILE:** Description of a frame with backbends. Slip-on frames utilize this type of profile.

**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.

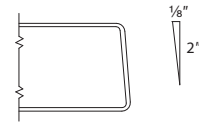
**DUTCH DOOR FRAME:** A frame prepared for a dutch door.



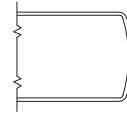


**EDGE PROFILE:** Description of the vertical door edge; beveled, bull nosed, rabbeted, or squared, Available on lock and/or hinge edge.

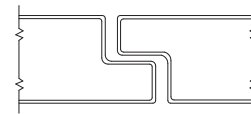
**BEVELED:** The vertical door edge has a 1/8" in 2" (3.1 mm in, 50.8 mm) slope from a plane perpendicular to the door pull side face.



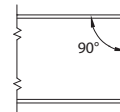
**BULL-NOSED:** The vertical door edge simulates a 2-1/8" (54 mm) radius.



**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**

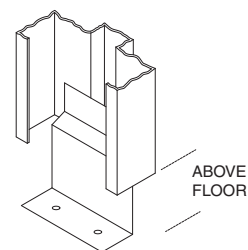
**FLOOR:** The top of the concrete or structural slab. Also referred to as finished floor. *(For additional information, see HMMA TechNote HMMA-810 TN01-03 “Defining Undercut.”)*

**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.



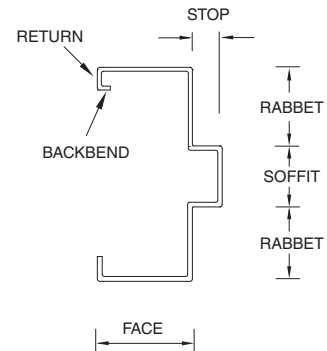
**FLUSH DOOR:** A door having no glass lights, panels, louvers or grilles.

**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.

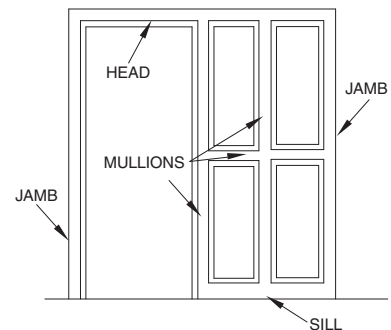
**FRAME ELEMENTS:** Within a Frame profile, a specific part such as; soffit, stop, rabbets, faces and returns. (For additional information, see HMMA TechNote HMMA-820 TN 02-03, "Continuously Welded Frame")



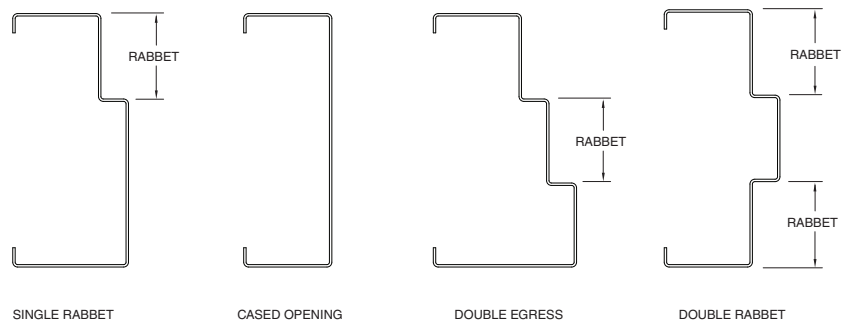
**FRAME GASKET:** See **GASKETING**.

**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.

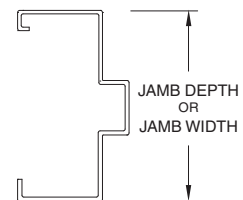
**BLANK:** A jamb without mortised hardware preparation.

**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.

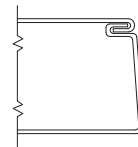
**LOUVER:** A series of slats, blades, or piercings to allow passage of air through an opening.

**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.



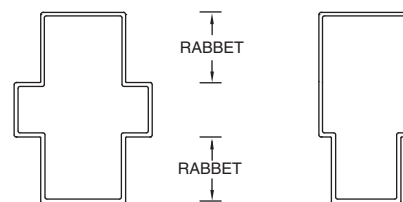
**MORTAR:** See **GROUT**.

**MORTAR GUARD:** See **GROUT GUARD**.

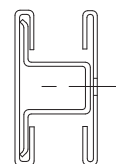
**MORTISE:** A recess on a minimum of 3 sides of a hardware item closely surrounding the contour of the item allowing its faceplate to finish flush with the door or frame finished surface.

**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.

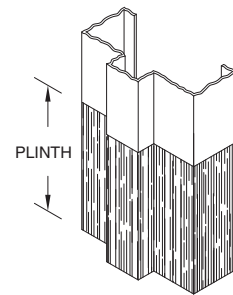
**PANEL, INFILL:** An assembly comprised of steel sheet secured to each face of a backing material (gypsum or cement board, etc.), installed like glazing materials, in doors, transom, sidelight and window assemblies.

**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.

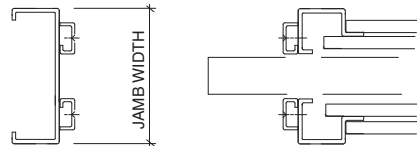
**PLASTER GUARD:** See **GROUT GUARD**:

**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.

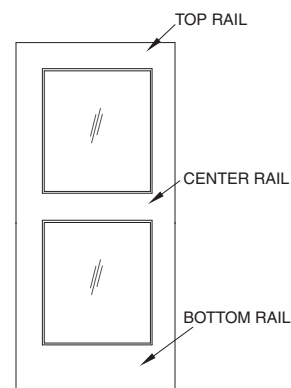
**PUSH SIDE OF DOOR:** The face of door, which contacts the frame stops. Also referred to as stop side or narrow side.

**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.

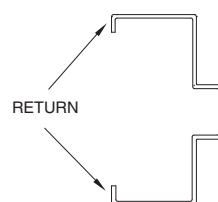


**REINFORCING GUSSETT:** A flat or formed component at junction of head and jamb used in interlocking of knock-down (KD) frames. May be used as an alignment feature on punch mitered frames.

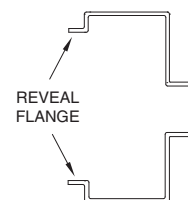
**REMOVABLE MULLION:** A frame member designed for temporary removal. See **MULLION** for detail.

**REMOVABLE STOP:** See **STOP**

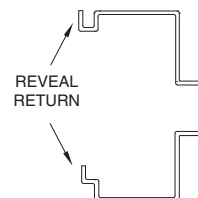
**RETURN:** The element of the frame profile, which extends inward from the face to the throat.



**REVEAL FLANGE:** The element of the frame profile, which extends from the return. Typically formed parallel to the wall.



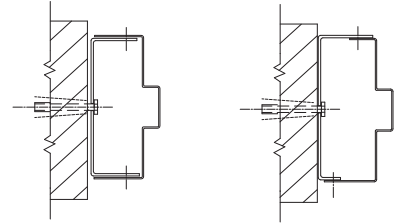
**REVEAL RETURN:** The element of the frame profile, which extends from the reveal flange.



**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.

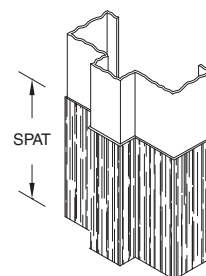
**SLIP-ON FRAME:** Frame designed to be installed after the wall is erected.

**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.

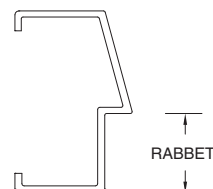
**SOFFIT:** The element of a door frame; (a) between the stops on a double rabbeted frame, (b) between the stop and face opposite door side of a single rabbeted frame. See **FRAME ELEMENT** for detail.

**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**.

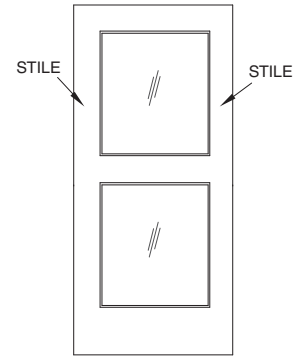
**SPOT WELD:** See **WELDING**.

**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.

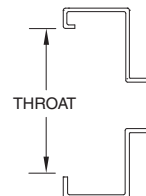
**TEMPERATURE RISE RATED DOOR:** A fire rated door designed to limit the transfer of heat over a specified duration to a specified temperature.

**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  $\pm 2$  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.

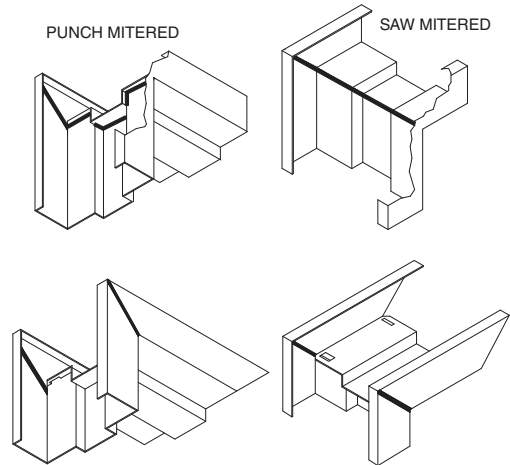
**WELD/WELDING:** A process for the joining of metal parts, with the necessary heat being provided by an electric arc struck between an electrode and the metal or between two electrodes.

**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
- SDI-136** Guideline for Specifying Windstorm Products

### 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  $\pm 2$  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.

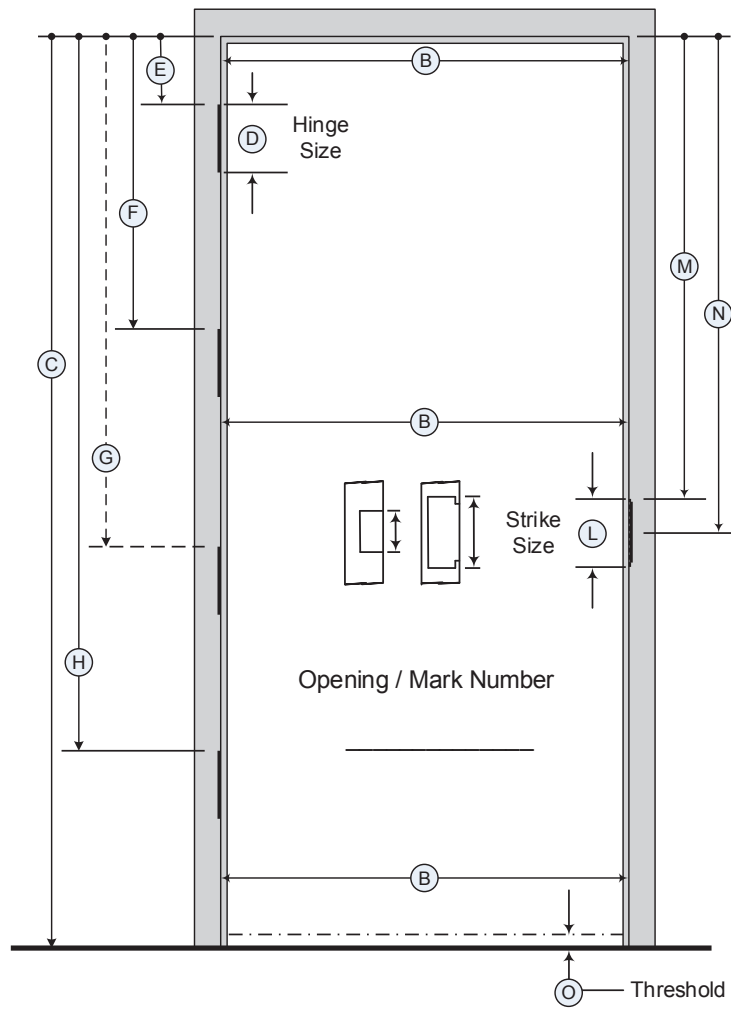
Hardware preparations of the replacement door must be sized and located to coincide with those on the existing frame to ensure proper fit, positioning and clearances for door operation.

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	Hanging	
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

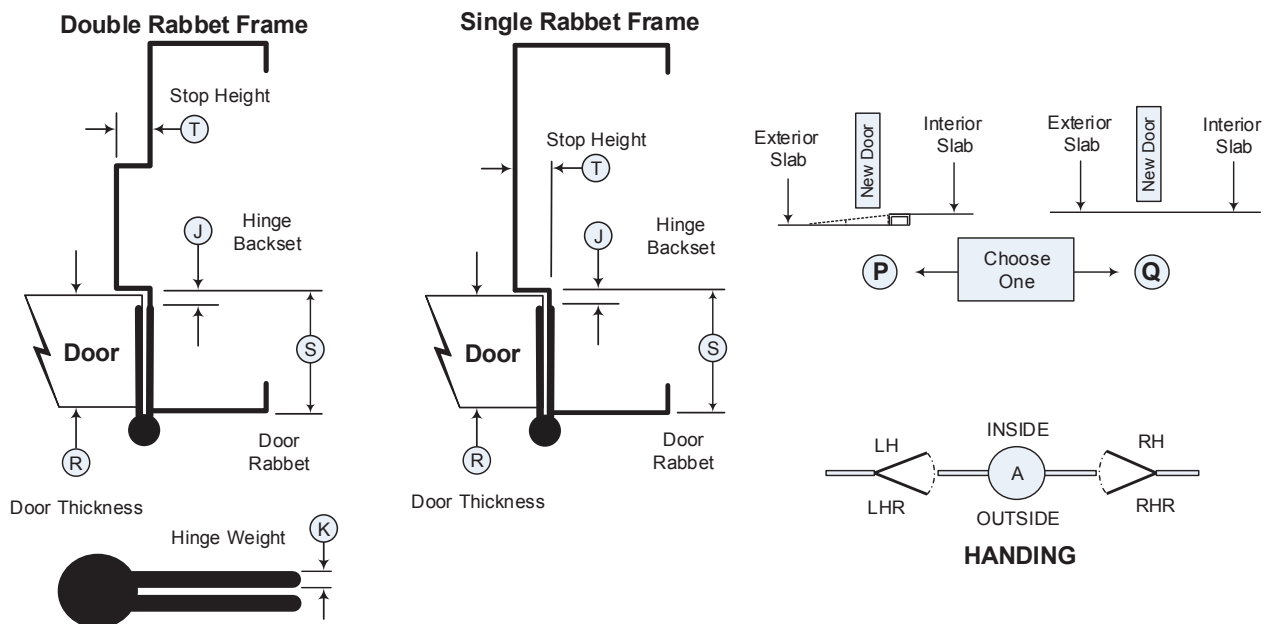


Figure 1 – Existing Frame Opening – Single Door

## 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
3-1/2"	—	—	—	0.123	0.123	>0.085
4"	—	—	—	0.130	0.130	>0.085
4-1/2"	—	—	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.

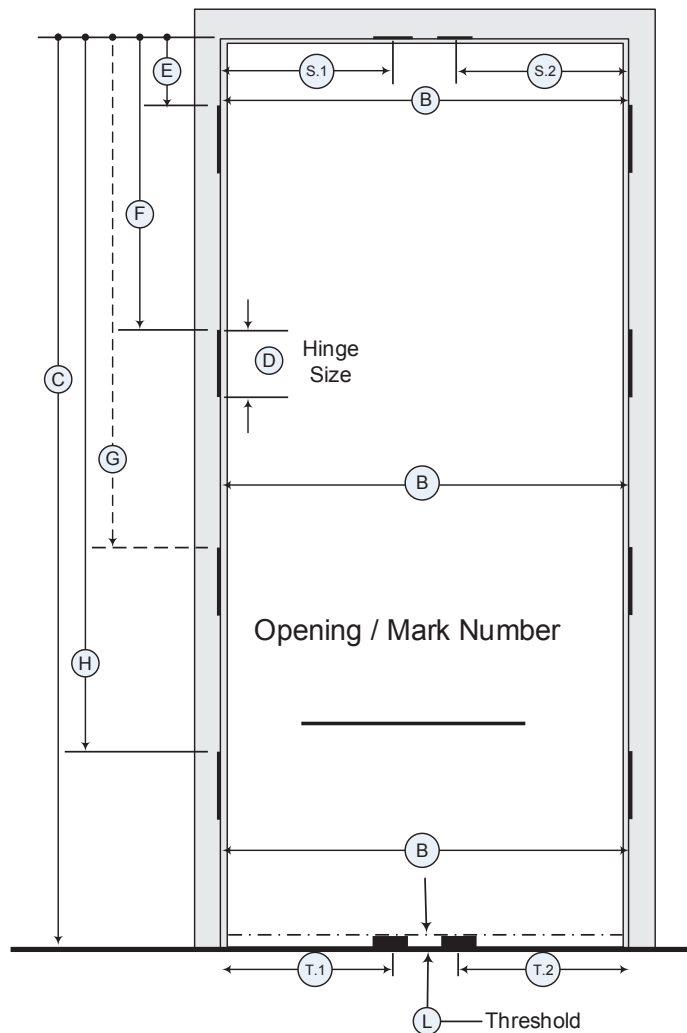
### 9.1 Glass kits / inserts

**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

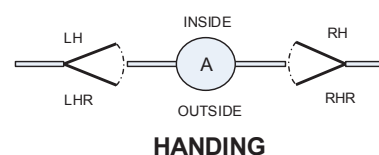
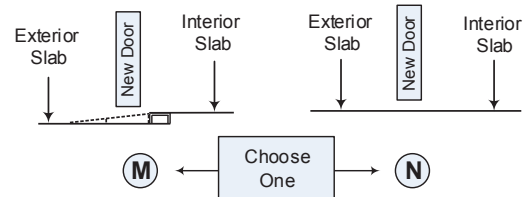
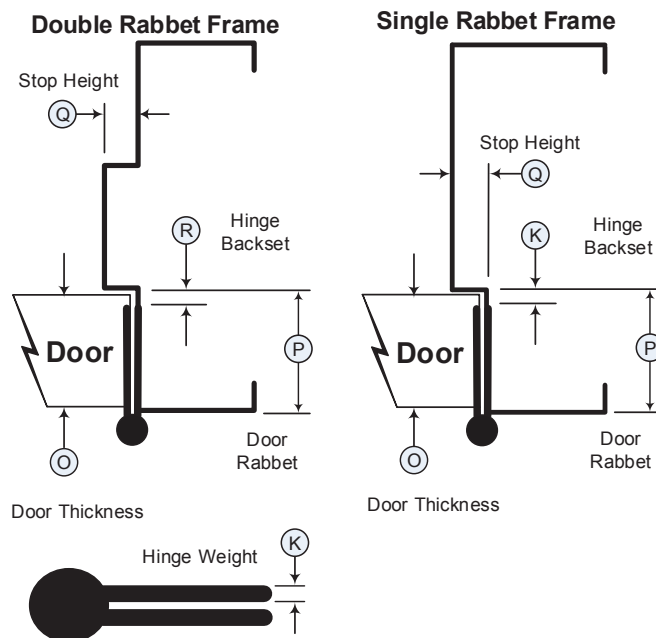
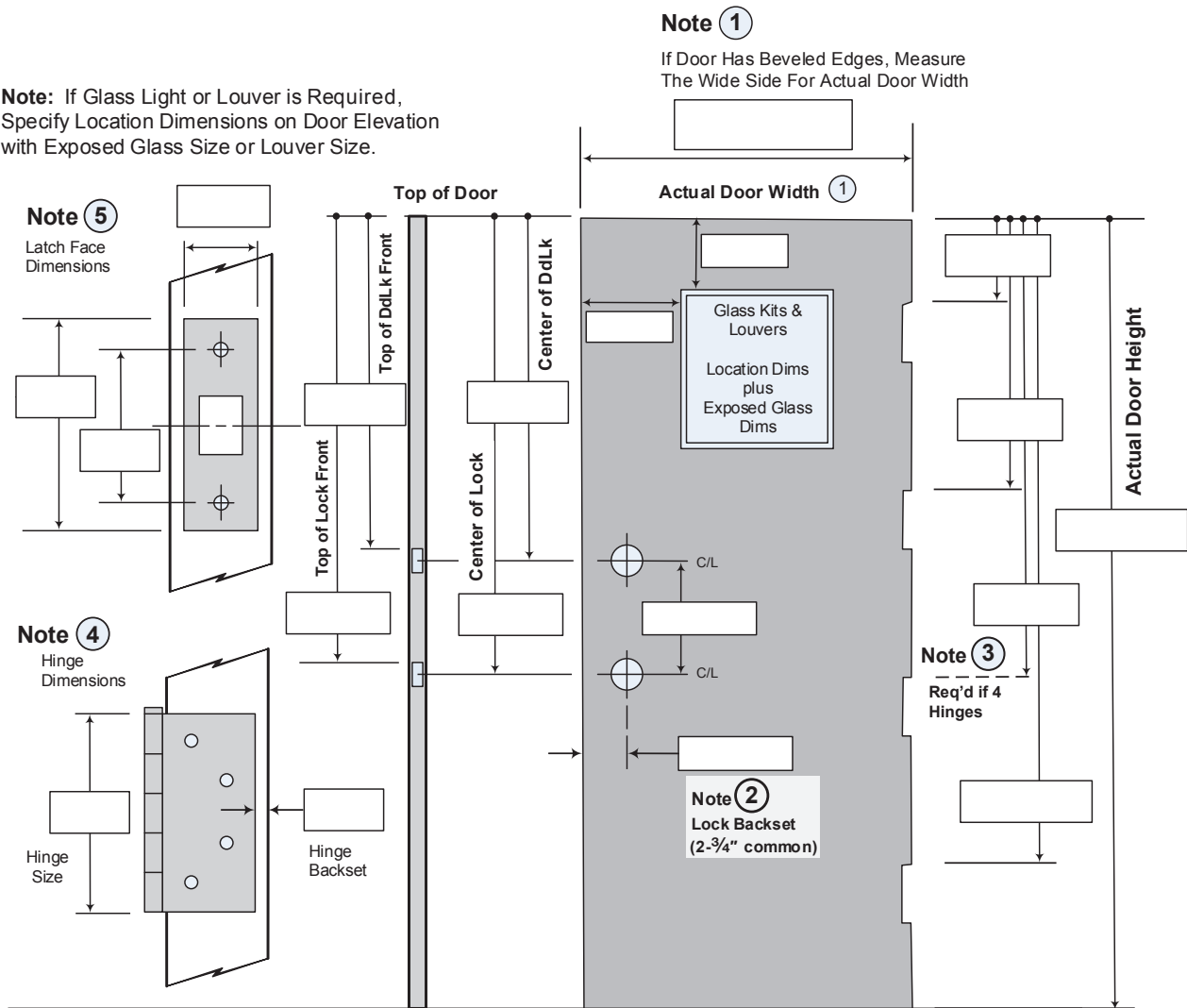


Figure 3 – Existing Frame Opening – Door Pair

**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 \_\_\_\_\_

<p><b>A Hand of Door</b></p> <p><input type="checkbox"/> LH      <input type="checkbox"/> RHR  <input type="checkbox"/> RH      <input type="checkbox"/> LHR</p> <p style="text-align: center;"> </p> <p><b>B Door Thickness</b></p> <p><input type="checkbox"/> 1-3/4"      <input type="checkbox"/> 1-3/8"</p> <p><b>C Material</b></p> <p><input type="checkbox"/> 20 GA      <input type="checkbox"/> COLD ROLLED  <input type="checkbox"/> 18 GA      <input type="checkbox"/> GALVANIZED  <input type="checkbox"/> 16 GA      <input type="checkbox"/> STAINLESS  <input type="checkbox"/> 14 GA</p> <p><b>Fill in all dimensions</b> <span style="border: 1px solid black; display: inline-block; width: 50px; height: 15px;"></span></p> <p><b>Respond to all</b> <span style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; transform: rotate(45deg);"></span></p>	<p><b>D Lock Provisions</b></p> <p><input type="checkbox"/> CYL. GOV'T. 161 - 1-1/8" x 2-1/4" EDGE  <input type="checkbox"/> MORTISE EDGE - 1-1/4" x 8"  <input type="checkbox"/> BLANK - NO CUTOUT  <input type="checkbox"/> DEADLOCK - 1-1/8" x 2-1/4" EDGE  <input type="checkbox"/> PANIC : <input type="checkbox"/> RIM    <input type="checkbox"/> VERTICAL ROD    <input type="checkbox"/> CONCEALED</p> <p><b>E Hinge Provisions</b></p> <p><input type="checkbox"/> 3-1/4"      <input type="checkbox"/> STD. WGT.  <input type="checkbox"/> 4-1/4"      <input type="checkbox"/> HEAVY WGT.  <input type="checkbox"/> 5"      <input type="checkbox"/> _____</p> <p><b>F Closer Reinforcements</b></p> <p><input type="checkbox"/> REQUIRED      <input type="checkbox"/> NOT REQUIRED</p> <p><b>G If Inactive Leaf:</b></p> <p><input type="checkbox"/> ASTRAGAL      <input type="checkbox"/> NO ASTRAGAL (WIDTH + 3/32")  <input type="checkbox"/> FLUSH BOLTS</p> <p><b>OTHER</b> _____</p>
--	---

**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**

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- SDI-130** Electronic Hinge Preparations
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# **Guideline for Specifying Windstorm Products**



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30200 DETROIT ROAD • CLEVELAND, OHIO 44145

# 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 6<sup>th</sup> 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

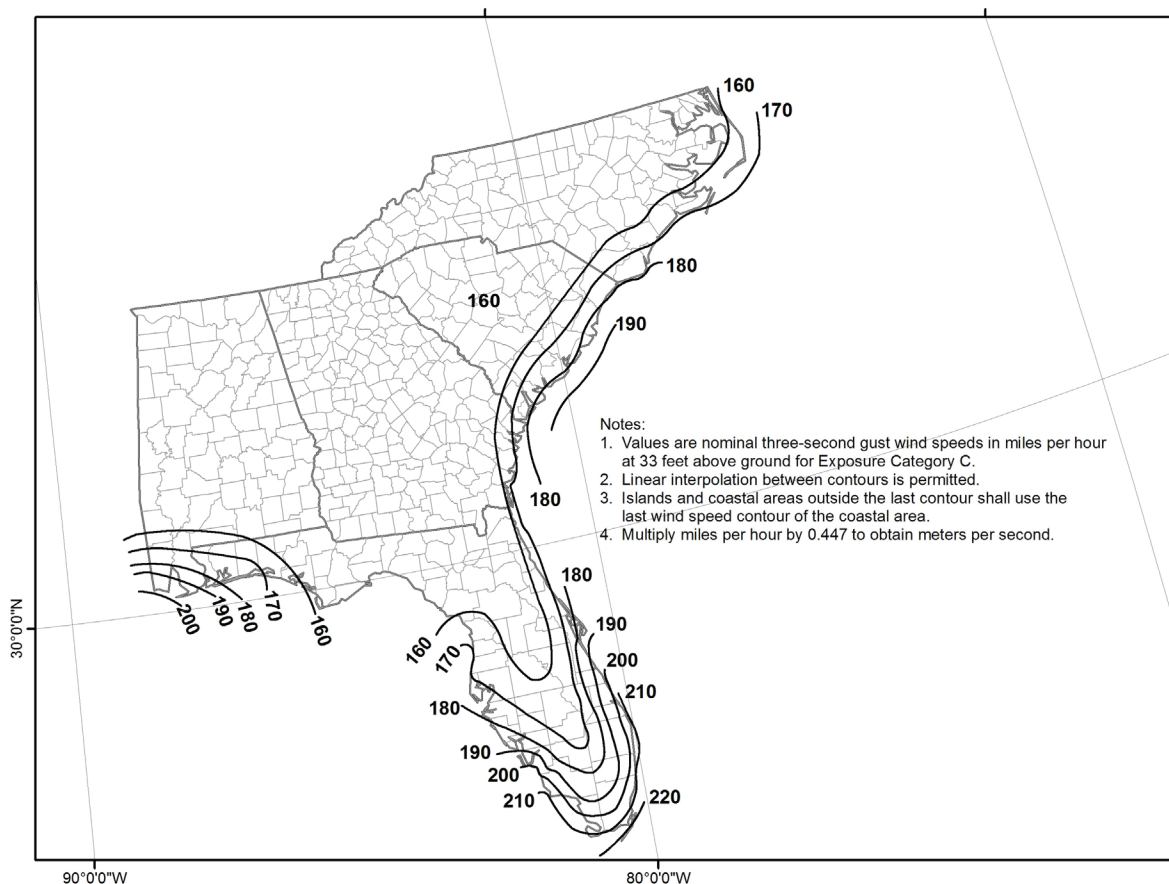


Figure 1 – Wind speed map



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.

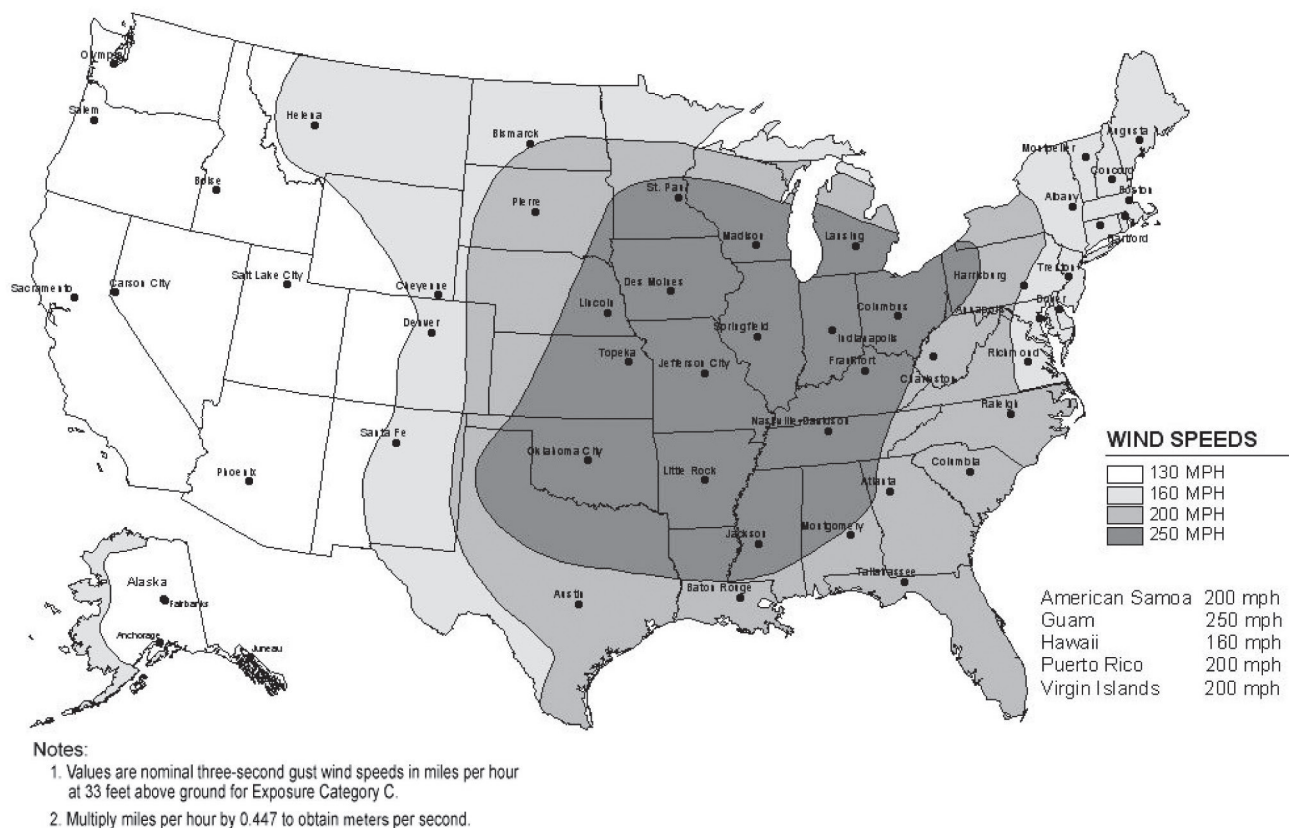
Design pressures, missile impact requirements and the specific attributes (size, swing, and glazing) of an opening, most often found in a door schedule, provide the basis for the selection of hurricane resistant door opening assemblies.

#### 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](http://www.asce.org)

Florida Building Commission,  
[www.floridabuilding.org](http://www.floridabuilding.org)

Intertek SpecDIRECT,  
[spec-direct.com](http://spec-direct.com)

International Code Council,  
[www.iccsafe.org](http://www.iccsafe.org)

Underwriters Laboratories Directory,  
[www.ul.com/ul-databases-and-directories](http://www.ul.com/ul-databases-and-directories)

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*Test Procedure and Acceptance Criteria for —  
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**American National Standards Institute, Inc.**

# American National Standard

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Consensus is established when, in the judgement of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

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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:

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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  
Intertek  
Ray and Associates  
Steel Door Institute  
Therma-Tru  
Underwriters Laboratories Inc.  
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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  
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## 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**

<b>Rust Grade</b>	<b>Maximum % of rusted area</b>
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**

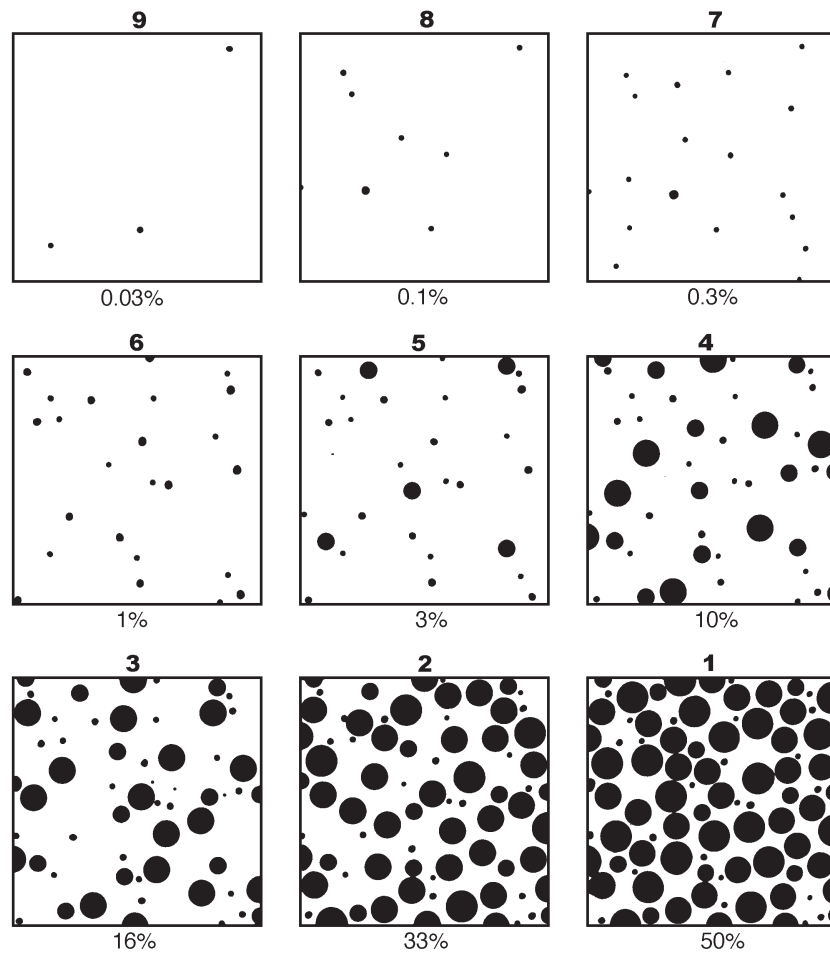
All tests shall be conducted and certified by a nationally recognized, independent testing laboratory.

#### **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

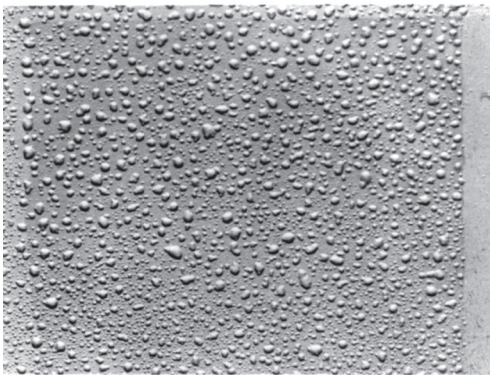
**Figure 1 – Visual reference for percentage of rust**



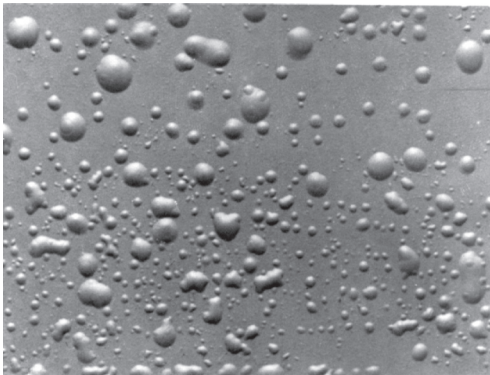
Visual examples illustrating degrees of blistering



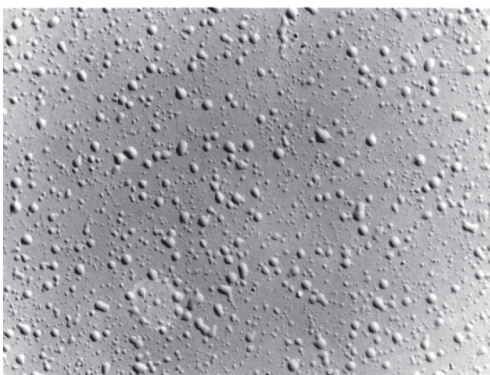
DENSE



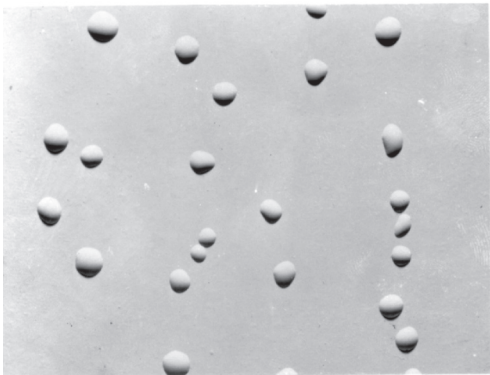
DENSE



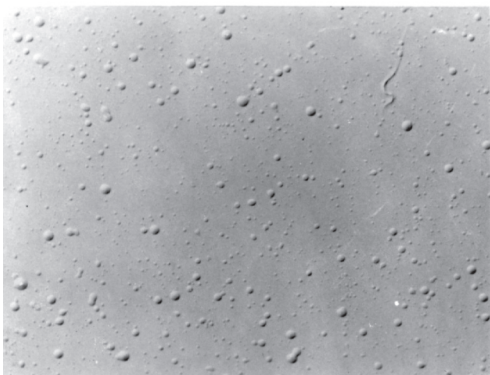
MEDIUM DENSE



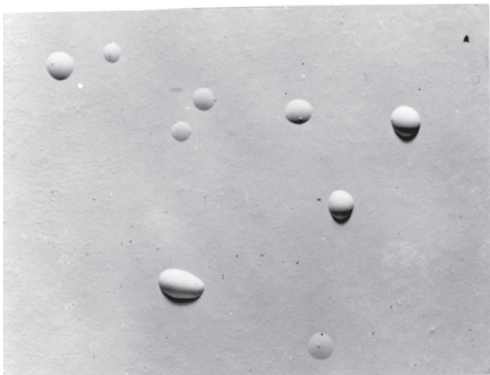
MEDIUM DENSE



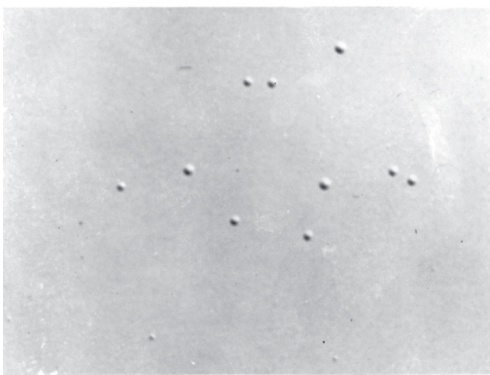
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MEDIUM



FEW



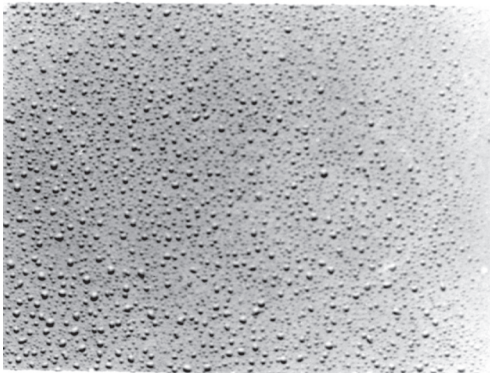
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Figure 2 – Blister size #2

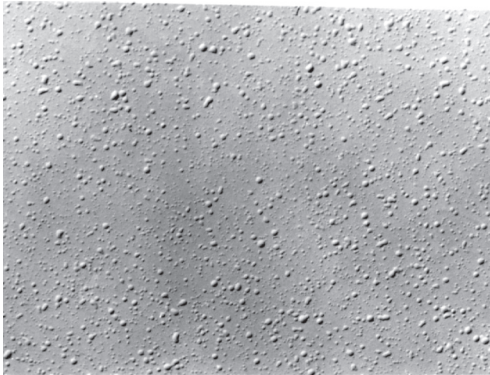
Figure 3 – Blister size #4



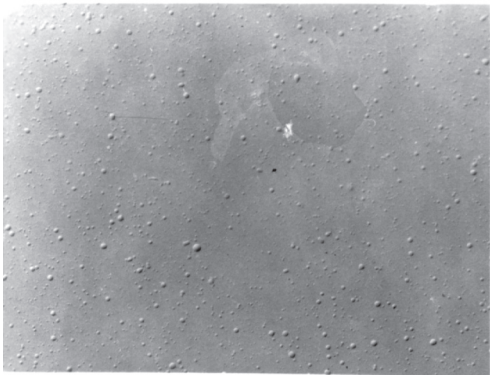
Visual examples illustrating degrees of blistering



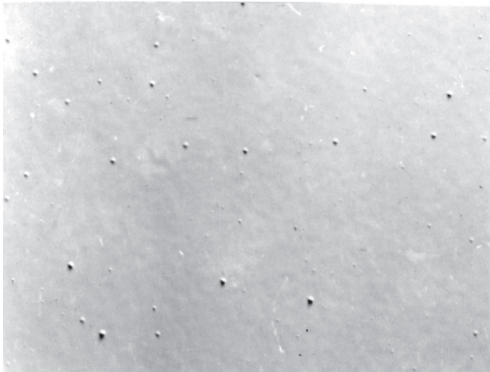
DENSE



MEDIUM DENSE

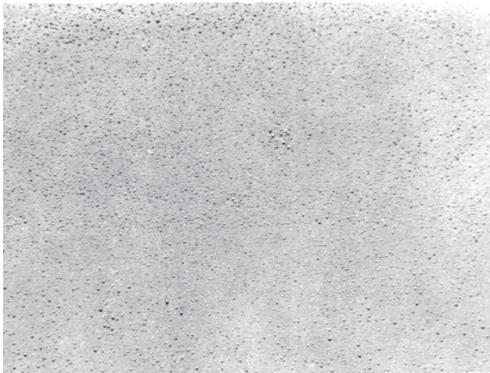


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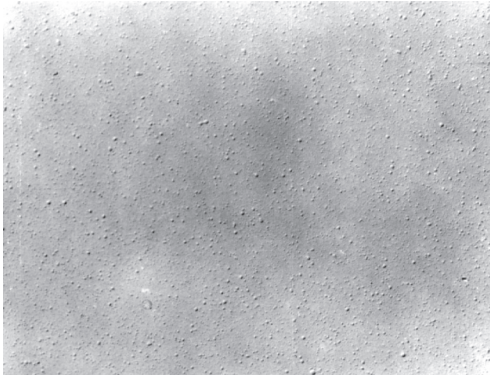


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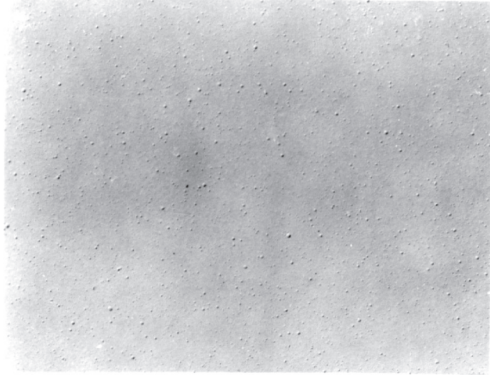
Figure 4 – Blister size #6



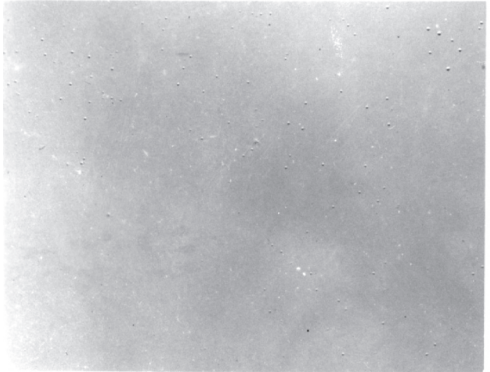
DENSE



MEDIUM DENSE



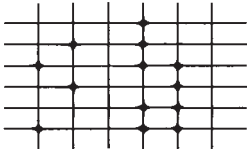
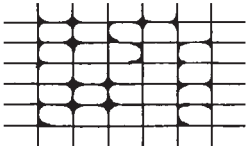
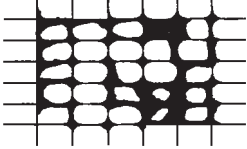

MEDIUM



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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
- SDI-136** Guideline for Specifying Windstorm Products

### 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  
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Secretariat  
**Steel Door Institute**

Approved October 17, 2022  
**American National Standards Institute, Inc.**

# American National Standard

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ANSI/SDI A250.4-2022

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**Foreword** (This Foreword is not part of American National Standard A250.4-2022)

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, 2011 and 2018. The current edition is a revision of the 2018 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:

Builders Hardware Manufacturers Association  
Canadian Steel Door Manufacturers Association  
Cedar Valley Associates  
D.H. Pace Company  
Door Control Services  
ESTM Services, LLC  
HMMA/Division of NAAMM  
Intertek  
MasterSpec  
Ray and Associates  
Steel Door Institute  
UL Solutions  
Vetrotech Saint-Gobain

The Technical Committee of the Steel Door Institute, which developed this standard, had the following personnel at the time of approval:

David McConnell, Chairman  
David Bill, Vice Chairman  
J. Jeffery Wherry, Managing Director

<i>Organization Represented</i>	<i>Name of Representative</i>
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Mesker Door .....	Mike Mehaffy
MPI .....	David McConnell
Pioneer .....	Kamal Sheikh
Premier .....	Jason Lisewski
Republic .....	Marilyn Latham
Steelcraft .....	Tim Weller



## 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 A156.1-2021 *Butts and Hinges*

ANSI/BHMA A156.3-2020 *Exit Devices*

ANSI/BHMA A156.4-2019 *Door Controls – Closers*

## 1.2 Disclaimers

### 1.2.1 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  $\pm 2$  degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

### 1.2.2 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 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  $65^\circ$  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  $60^\circ \pm 5^\circ$ , 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,  $\pm 1$ , 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 prop-

erly 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.

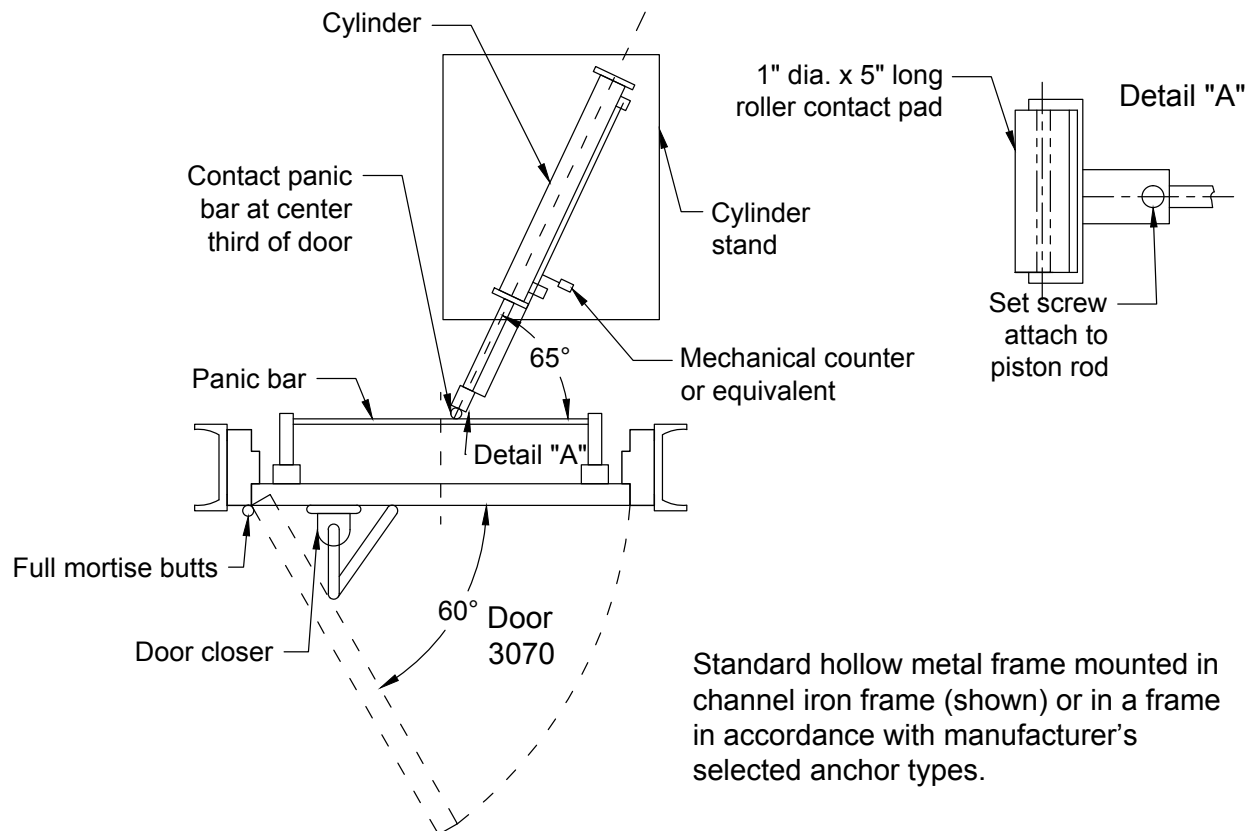


Figure 1 – Swing test detail for standard frame

## 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.

A detailed description of the frame and anchoring system which shall cover all details of the anchors,

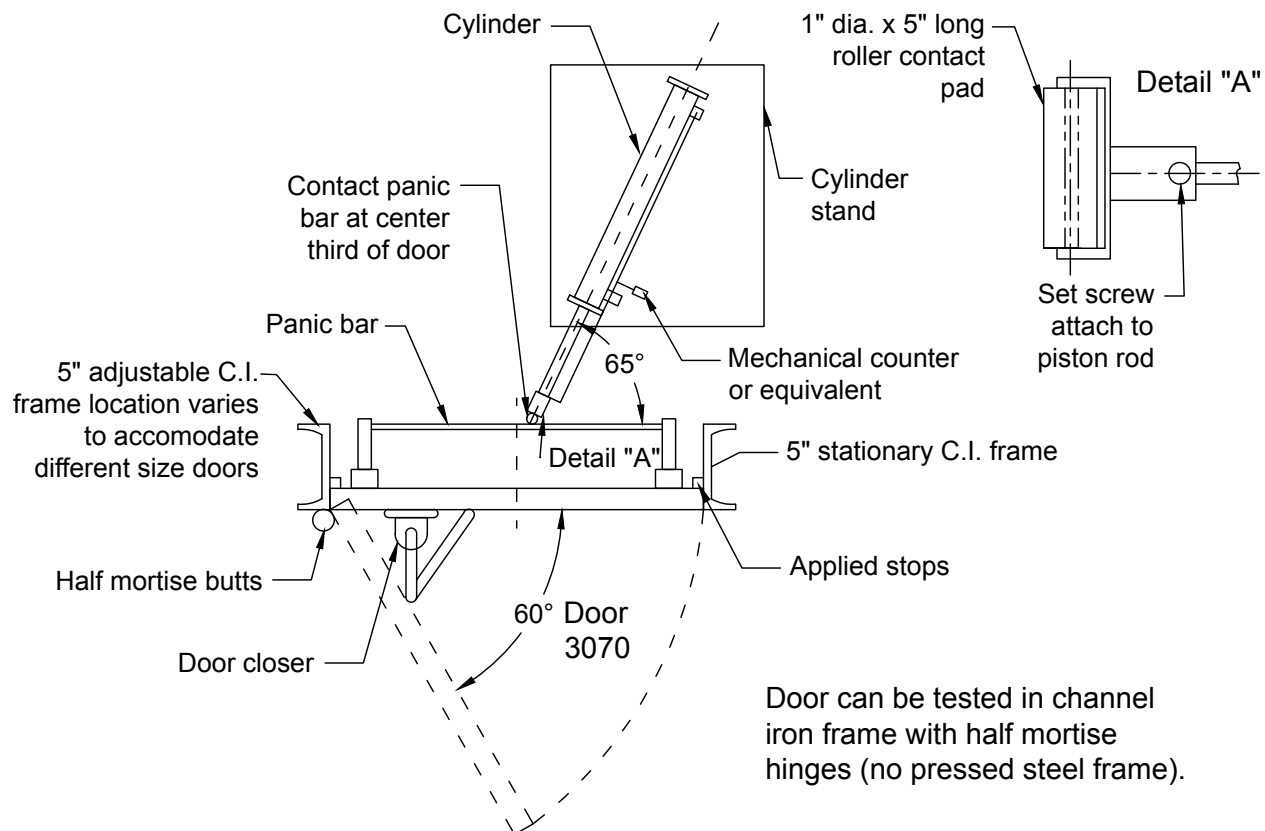
as well as the means of attachment in the frame and the weight of the door used for the test shall be recorded in the test report, Swing Test Form 2.

## 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 channels, end closures, hinge reinforcements, and lock body/face plate reinforcements and shall cover the



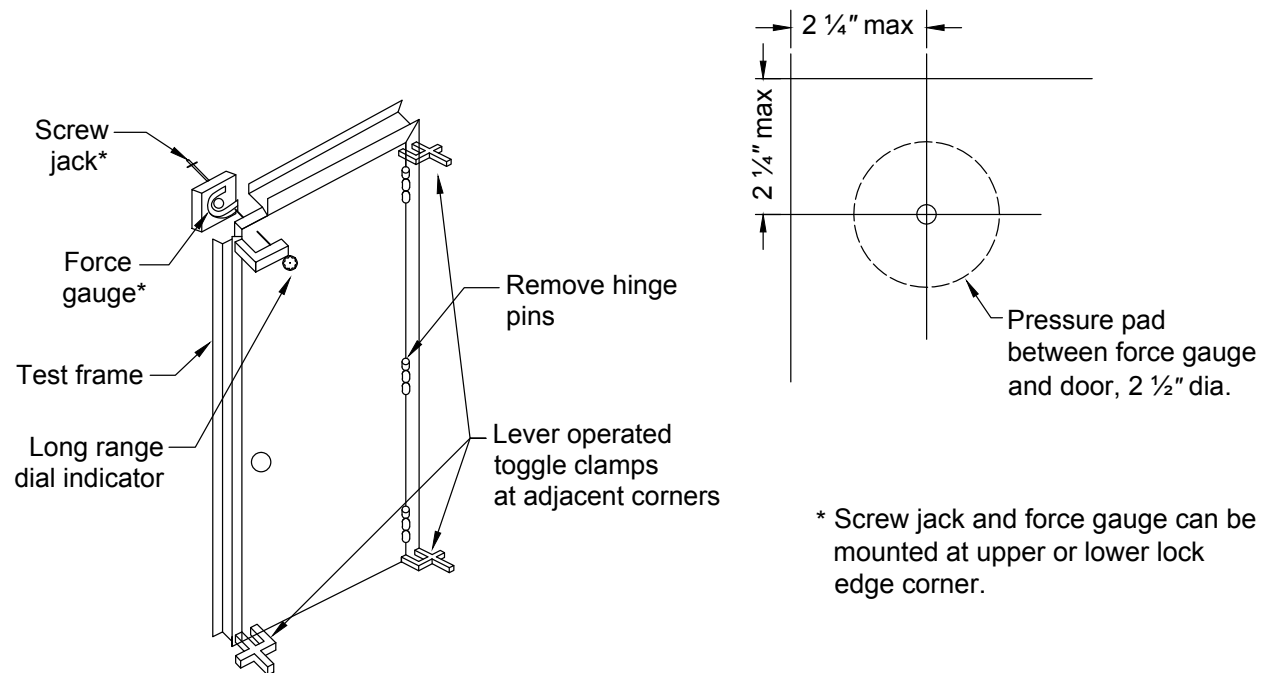


Figure 2 – Twist test detail

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 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 \_\_\_\_\_

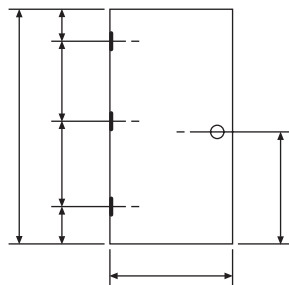
Weight of Door \_\_\_\_\_

Inspection at indicated cycle intervals <sup>(1)</sup>	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 ▲									

<sup>(1)</sup> Indicates condition in appropriate columns:

S — Satisfactory

Use footnotes under Remarks for further explanation



Hinge Manufacturer &amp; Number \_\_\_\_\_

Lock Manufacturer &amp; Number \_\_\_\_\_

Closer Manufacturer &amp; Number \_\_\_\_\_

Remarks:

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**Performance Report — Swing Test Form 2**

Date \_\_\_\_\_

Manufacturers \_\_\_\_\_

Test# \_\_\_\_\_

Jamb Width \_\_\_\_\_

Type and Size of Frame \_\_\_\_\_

Weight of Door \_\_\_\_\_

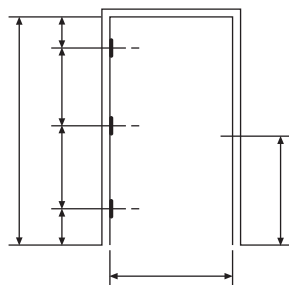
Type of Anchors \_\_\_\_\_

Inspection at indicated cycle intervals <sup>(1)</sup>	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 ↑									

<sup>(1)</sup> Indicates condition in appropriate columns:

S — Satisfactory

Use footnotes under Remarks for further explanation



Hinge Manufacturer &amp; Number \_\_\_\_\_

Lock Manufacturer &amp; Number \_\_\_\_\_

Remarks:

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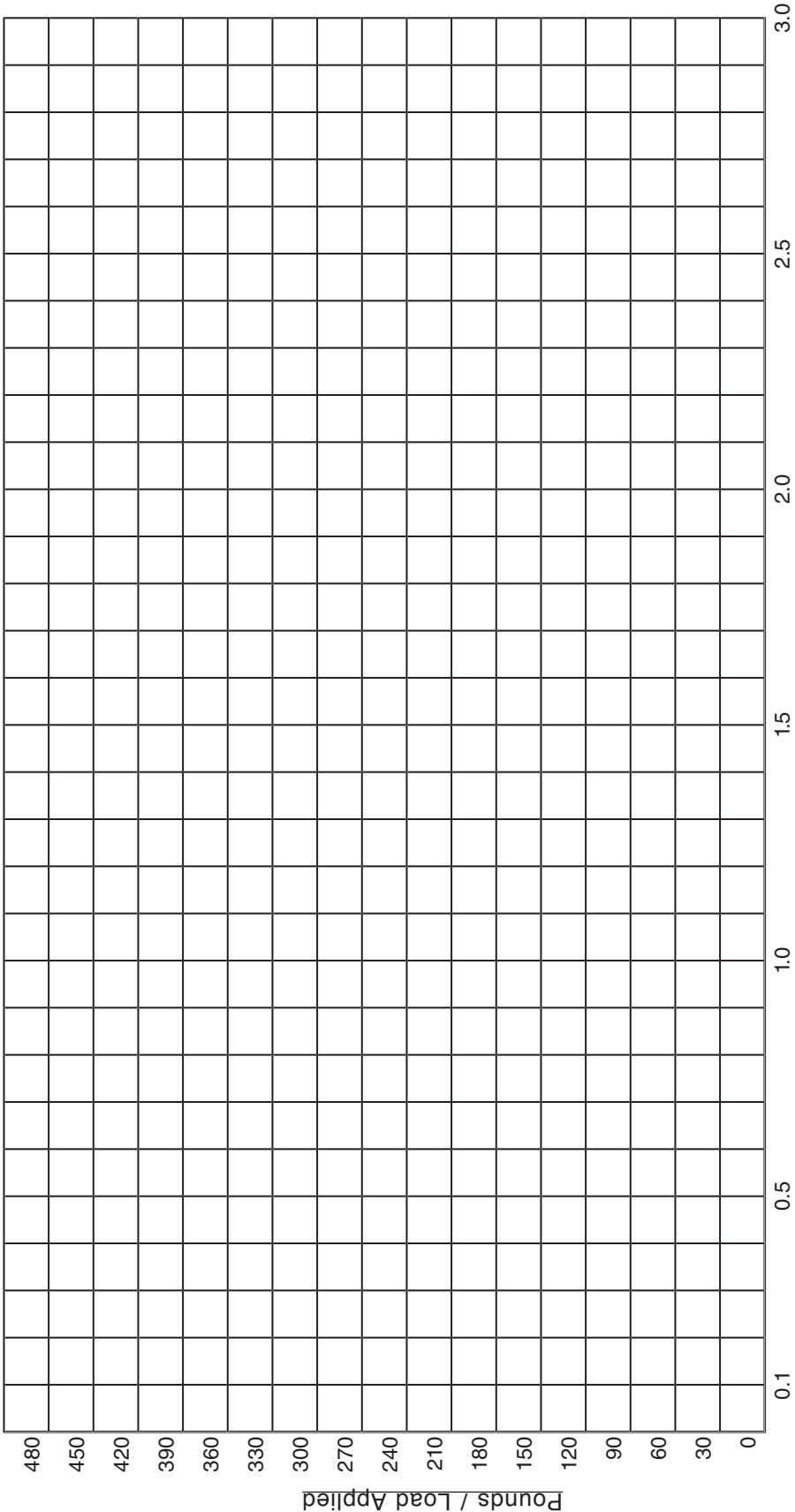


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Performance Report — Twist Test Form 3

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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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*Recommended Practice for  
Hardware Reinforcing  
on Standard Steel Doors and Frames*

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Approved August 18, 2020



# American National Standard

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ANSI/SDI A250.6-2020

American National Standard

Recommended Practice  
for Hardware Reinforcing  
on Standard Steel Doors and Frames

Secretariat  
**Steel Door Institute**

Approved August 18, 2020  
**American National Standards Institute, Inc.**

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## **Foreword** (This Foreword is not part of American National Standard A250.6-2020)

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.”

In 2015, A250.6 was revised due to the following updates: Figure 1 – title changed from “Rigidity of angle or channel versus plate” to “Examples of equivalent reinforcing methods”; Figure 6 – Sex-bolted changed to “proper thru-bolting. Description changed from sex nut full door thickness” to “Grommet nut of sex bolt or barrel nut spans full door thickness”; Figure 7 – “Grommet nut does not span full door thickness changed to “Grommet nut of sex bolt or barrel nut does not span full door thickness”; Section 1.3.1 – “equal strength” was changed to “equal strength, pull-out strength”

In 2020 the standard was balloted and approved as a revision, due to updates in the “Reference documents” section.

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:

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 had the following personnel at the time of approval:

Craig Ordmandy, Chairman  
J. Jeffery Wherry, Secretary

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Curries Company	
An ASSA ABLOY Door Group Company.....	David Bill
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Steel Door Institute.....	J. J. Wherry
Underwriters Laboratories LLC .....	Luke Woods
Vetrotech Saint-Gobain .....	Kevin Norcross



## 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 A250.8-2017 *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

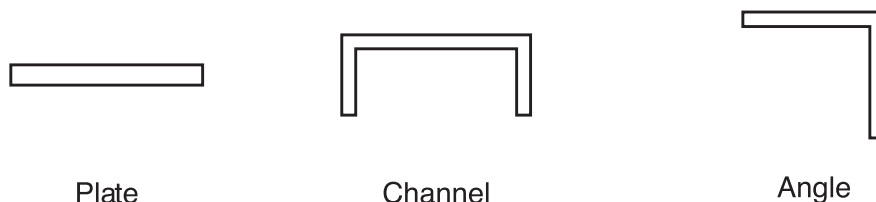
This standard recognizes as equal a variety of reinforcing methods produced by unique manufacturing processes. These processes include forming options (see figure 1) or integral gussets or fillets on lighter gauge members to achieve strength and performance equal to heavier gauge members.

**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.

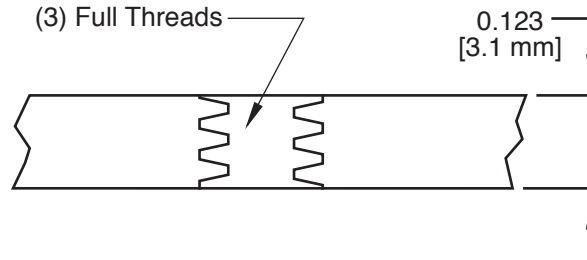
## 2 Metrication

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).

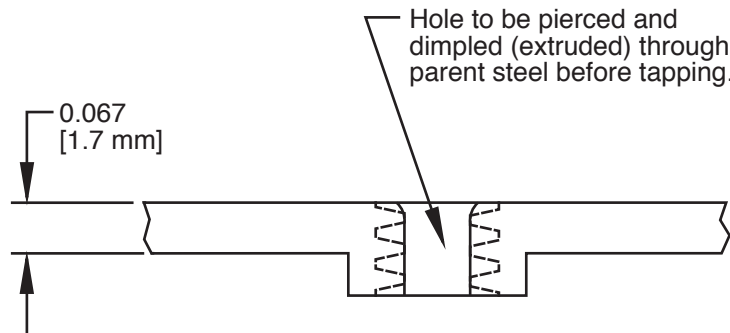
Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.



**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 A250.8-2017 *Specifications for Standard Steel Doors and Frames (SDI-100)*

ANSI/SDI A250.4-2019 *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

The hardware installer shall carefully follow the hinge manufacturer's instructions for fastener preparations.

#### 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. <sup>(6)</sup>	inches	mm	MSG No. <sup>(6)</sup>
Mortise Hinge 1-3/8" [34.9 mm] Door <sup>(1)</sup>	0.093	2.3	12	0.093	2.3	12
Mortise Hinge 1-3/4" [44.5 mm] Door <sup>(1)(2)</sup>	0.123	3.1	10	0.123	3.1	10
Mortise Lock or Deadbolt <sup>(1)</sup>	0.067	1.7	14	0.067	1.7	14
Bored Lock or Deadbolt <sup>(1)</sup>	0.067	1.7	14	0.067	1.7	14
Flush Bolt Front <sup>(1)</sup>	0.067	1.7	14	0.067	1.7	14
Surface Bolt <sup>(3)</sup>	0.067	1.7	14	0.067	1.7	14
Surface Applied Closer <sup>(4)</sup>	0.067	1.7	14	0.067	1.7	14
Hold Open Arm <sup>(3)</sup>	0.067	1.7	14	0.067	1.7	14
Pull Plates and Bar <sup>(3)</sup>	0.053	1.3	16	0.053	1.3	16
Surface Exit Device <sup>(3)</sup>	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 <sup>(5)</sup>	Per Specification			Per Specification		
Kick / Push Plate	Per Specification			Per Specification		

**Note:** The minimum steel thickness for each specific gage is derived from the published figures of Underwriters Laboratories, Inc. Thickness listed is in addition to door/frame specified thickness.

<sup>(1)</sup> Thinner steel may be employed as long as tapped holes used for mounting the hardware are extruded to produce an equivalent number of threads.

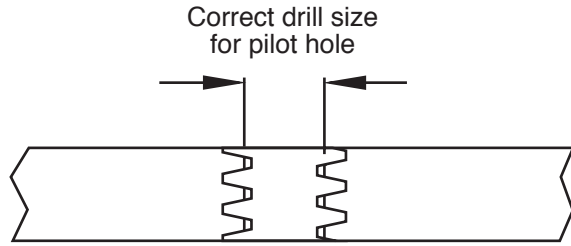
<sup>(2)</sup> If reinforcing is angular or channel shaped, 0.093" (2.3 mm) is permitted.

<sup>(3)</sup> When reinforcing is omitted, thru-bolting via the use of spacers or sex-bolts is required.

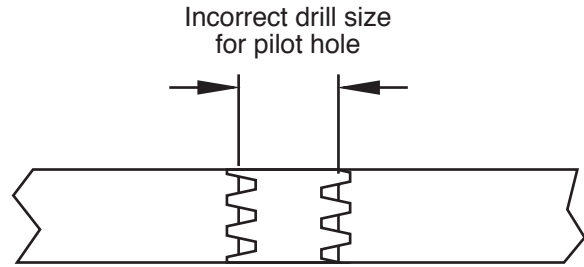
<sup>(4)</sup> Reinforcement shall occur on both sides.

<sup>(5)</sup> Refer to section 6.

<sup>(6)</sup> 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%
<b>#25</b>	<b>0.149"</b>	<b>75%</b>
#26	0.147"	79%
#27	0.144"	85%
"Machinery's Handbook" recommendation in <b>BOLD</b>		

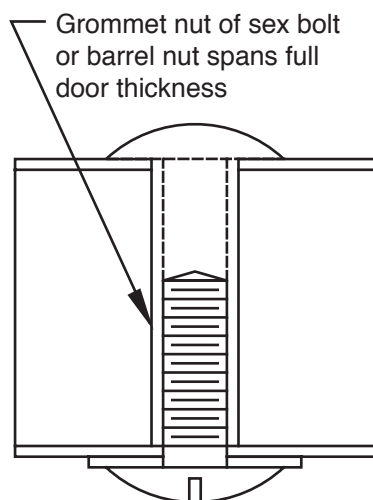
**Table 3 – #12-24 thread (nm)**

Drill Size	Drill Diameter	% Full Thread
#15	0.180"	66%
<b>#16</b>	<b>0.177"</b>	<b>70%</b>
#17	0.173"	75%
"Machinery's Handbook" recommendation in <b>BOLD</b>		

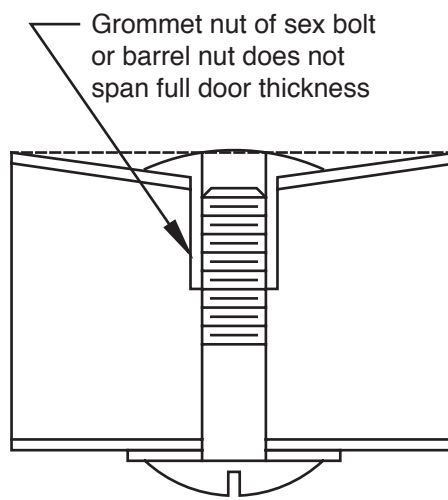
**Table 4 – Tap drills and clearance drills for machine screws  
with American National Thread form (nm)**

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.

## **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*





## 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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*Specifications for  
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American National Standard

Specifications for  
Standard Steel Doors and Frames  
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Approved April 6, 2023  
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# American National Standard

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgement of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

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ANSI/SDI A250.8-2023

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## **Foreword** (This Foreword is not part of American National Standard A250.8-2023)

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/SDI A250.8-2017 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.

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:

Builders Hardware Manufacturers Association  
Canadian Steel Door Manufacturers Association  
Cedar Valley Associates  
D.H. Pace Company  
Door Control Services  
Door and Hardware Institute  
ESTM Technical Services, LLC  
HMMA/Division of NAAMM  
Intertek  
MasterSpec  
Ray and Associates  
Steel Door Institute  
UL Solutions  
Vetrotech/Saint-Gobain

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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UL Solutions .....	Michael Nicasio
Vetrotech/Saint-Gobain.....	Kevin Norcross

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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-108-2023 *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 (R23) *Zinc Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames*
- SDI-113-2013 (R18) *Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies*

- SDI-117-2019 *Manufacturing Tolerances for Standard Steel Doors and Frames*
- SDI-118-2021 *Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements*
- SDI-124-2022 *Maintenance of Standard Steel Doors and Frames*
- SDI-134-2020 *Glossary of Terms for Hollow Metal Doors and Frames*

#### 1.2.2 ANSI Standards

- UL 9 *Standard for Fire Tests of Window Assemblies*, 8th Edition, Dated July 2, 2009, including revisions through March 20, 2020
- UL 10B *Standard for Fire Tests of Door Assemblies*, 10th Edition, February 7, 2008, revisions up to and including May 4, 2020
- UL 10C *Standard for Positive Pressure Fire Tests of Door Assemblies*, 3rd Edition, June 9, 2016, revisions up to and including May 27, 2021
- UL 1784, *Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives*, 4th Edition, February 17, 2015, revisions up to and including February 21, 2020
- NFPA 80-2022 *Standard for Fire Doors and Other Opening Protectives*
- NFPA 252-2022 *Standard Methods of Fire Tests of Door Assemblies*
- NFPA 257-2022 *Standard Methods of Fire Tests of Window Assemblies*
- ANSI/SDI A250.3-2019 *Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames*

- ANSI/SDI A250.4-2022 *Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors*
- ANSI/SDI A250.6-2020 *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames*
- ANSI/SDI A250.10-2020 *Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames*
- ANSI/SDI A250.11-2022 *Recommended Erection Instructions for Steel Frames* (Formerly SDI-105)
- ANSI/BHMA A156.115-2016 *Hardware Preparation in Steel Doors or Steel Frames*

### 1.2.3 ASTM Standards

- ASTM A1008-2021a *Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable*
- ASTM A568-2019a *Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for*
- ASTM A1011-2018a *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 A653-2022 *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*
- ASTM A879-2022 *Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface*
- ASTM A924-2022 *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 informa-

tion. 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

**Table 1 – Standard opening sizes**

<b>Widths*</b>	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.

<b>Heights</b>	<b>1-¾" Doors</b>	Ft-in	6'8"	7'0"	7'2"	7'10"	8'0"	9'0"	10'0"
		mm	2032	2134	2184	2388	2438	2743	3048

	<b>1-⅜" Doors</b>	Ft-in	6'8"	7'0"	7'2"
		mm	2032	2134	2184

#### **Level 4 and Physical Performance Level A**

Maximum-duty 1-¾" (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.

### **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, Required Hardness, 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, *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* 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/ft<sup>2</sup> (122 g/m<sup>2</sup>), 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/ft<sup>2</sup> (122 g/m<sup>2</sup>).

#### **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 UL 9, *Fire Tests of Window Assemblies*, UL10B, *Standard for Fire Tests of Door Assemblies*, UL10C, *Standard for Positive Pressure Fire Tests of Door Assemblies*, or NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*, or NFPA 257 *Standard Methods of Fire Tests of Window 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 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 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  $\pm 2$  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*.



**Table 2 – Steel thickness / door faces**

Level	Model	Minimum Thickness		MSG No. <sup>(1)</sup>
		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

<sup>(1)</sup> MSG No. to be used for reference purposes only.

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

## 2.1.8 Design Clearances

**2.1.8.1** The clearance between the door and frame shall be a maximum of  $\frac{1}{8}$ " (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  $\frac{3}{16}$ " (4.8 mm)  $\pm \frac{1}{16}$ " (1.6 mm). For fire rated applications, the clearances between the meeting edges of pairs of doors shall be  $\frac{1}{8}$ " (3.2 mm)  $\pm \frac{1}{16}$ " (1.6 mm).

**2.1.8.3** The clearance measured from the bottom of the door to the bottom of the frame or finished floor (Undercut) shall be a maximum of  $\frac{3}{4}$ " (19.1 mm) unless otherwise specified. Fire door undercuts shall comply with 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 Gauge (MSG) vs. Minimum Steel Thickness

The minimum steel thickness for each specific gauge is derived from the published figures of UL Solutions, 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 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.

The thermal transmittance of the steel door assembly is determined by subjecting the assembly to the testing defined in SDI-113. This standard establishes a specimen size, test conditions and a rating system.

### 2.3.3 Construction Features – Stile and Rail – Flush Panel

Stiles and rails shall be made of steel at a minimum of 0.053" (1.3 mm) in thickness. 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 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

**Table 3 – Minimum steel thickness / frames**

Level	Thickness		MSG No. <sup>(1)</sup>
	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

<sup>(1)</sup> MSG No. to be used for reference purposes only.

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 may be of the slip-on drywall type. These frames are not available with welded corners. A welded frame may be used in an existing opening when butted against wall and/or stud. Frame with existing wall anchors may also be installed in existing drywall wall construction.

#### **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 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 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 welded. Faces and returns may be 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 Gauges for Frames**

Table 3 shall be used to determine the proper gauge 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

**Table 4 – Minimum hardware reinforcing thickness**

Hardware Item	inches	mm	MSG No. <sup>(5)</sup>
Mortise Hinge 1- $\frac{3}{8}$ " [34.9 mm] Door <sup>(1)</sup>	0.093	2.3	12
Mortise Hinge 1- $\frac{3}{4}$ " [44.5 mm] Door <sup>(1) (2)</sup>	0.123	3.1	10
Mortise Lock or Deadbolt <sup>(1)</sup>	0.067	1.7	14
Bored Lock or Deadbolt <sup>(1)</sup>	0.067	1.7	14
Flush Bolt Front <sup>(1)</sup>	0.067	1.7	14
Lock or Dead Bolt	0.067	1.7	14
Surface Bolt <sup>(3)</sup>	0.067	1.7	14
Surface Applied Closer	0.067	1.7	14
Hold Open Arm <sup>(3)</sup>	0.067	1.7	14
Pull Plates and Bar <sup>(3)</sup>	0.053	1.3	16
Surface Exit Device <sup>(3)</sup>	0.067	1.7	14
Floor Checking Hinge	0.167	4.2	7
Pivot Hinge	0.167	4.2	7
Continuous Hinge <sup>(4)</sup>	Not Required		
Kick / Push Plate	Not Required		

**Note:** The minimum steel thickness for each specific gauge is derived from the published figures of Underwriters Laboratories LLC.

<sup>(1)</sup> Thinner steel may be employed as long as tapped holes used for mounting the hardware are extruded to produce an equivalent number of threads.

<sup>(2)</sup> If reinforcing is angular or channel shaped, 0.093" (2.3 mm) is permitted.

<sup>(3)</sup> When reinforcing is omitted on doors, thru-bolting via the use of spacers or sex-bolts is required.

<sup>(4)</sup> Refer to ANSI/SDI A250.6, *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames*.

<sup>(5)</sup> MSG No. to be used for reference purposes only.

specified, vertical mullions shall be provided with floor anchors.

#### **2.4.4 Frame Anchors for Wall Conditions**

Each jamb for openings up to and including 60 inches (1520 mm) high shall be provided with two anchors, and an additional anchor shall be provided on each jamb for each additional 30 inches (762 mm) of height or fraction thereof. Provide anchors of not less than 0.042" (1.0 mm) in thickness or 0.167" (4.2 mm) diameter wire.

##### **2.4.4.1 Slip-On Drywall Frame Anchors**

Slip-on drywall frames shall have an anchoring system that 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 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, smoke and draft control, or lead-lined doors are not available.

## 3 Hardware Preparation

### 3.1 Reinforcings

Provide minimum hardware reinforcing gauges 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. Two reinforcements shall be provided for openings not exceeding 60 inches (1520 mm) in height, an additional reinforcement shall be provided for each additional 30 inches (762 mm) of height or fraction thereof. 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.

**Table 5 – Hardware locations**

**Cylindrical and Mortise Deadlock strikes shall be located at 48" (1219 mm) from bottom of frame unless otherwise specified by local authority.**

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		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- <sup>3</sup> / <sub>4</sub> " (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

Other items of hardware shall be located according to the door and/or hardware manufacturer's directions. This includes, but is not limited to, 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 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. 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. Exception: Frames for acoustical STC openings are permitted to be pre-grouted prior to installation into drywall 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. See "How to Shim Door Hinges" article at [steeldoors.org](http://steeldoors.org).

### **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 NFPA 80, *Standard for Fire Doors and Other Opening Protectives*.

Prior to any repair contact the manufacturer, per NFPA 80.



## 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 UL 10B, *Fire Tests of Door Assemblies*, and is referred to as neutral pressure; the second is 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, NFPA-105 *Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives* and 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.

**1 Hour** — Openings in interior exit stairways, interior exit ramps, and exit passageways (where specified by the code)

**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. Two ratings, 250°F (139°C) or 450°F (250°C) are recognized, with the 250°F (139°C) rating being the most thermally efficient. Ratings over 450°F (250°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, may 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 less.

Frame labels may be of metal (installed by welding, riveting, adhesive, 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 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 gauge. This thickness is generally at the low end of the range for a specific gauge. For example, the nominal thickness of 16 gauge 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 gauges, 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.

#### **Thermal transmittance**

The thermal transmittance of the steel door assembly is determined by subjecting the assembly to the testing defined in SDI 113. This standard establishes a specimen size, test conditions and a rating system.

#### **Metric disclaimer**

Values stated without parenthesis are the requirement. Values in the parenthesis are explanatory or informative information.

## **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.

## **Back coating of frames**

Some architectural specifications require steel frames to have their throat areas coated with a material that improves corrosion protection or sound control performance. This material can be a bituminous coating or other more environmentally friendly products. Back coating, bituminous coating, etc., may or may not be offered by the manufacturer. Consult manufacturer for availability and specifications.

## Appendix C (informative)

### Section 081113 Hollow Metal Doors and Frames (intended as a sample specification)

#### GENERAL NOTES TO SPECIFIER

This Specification Section has been prepared by the Steel Door Institute [www.steeldoor.org](http://www.steeldoor.org) to assist design professionals in the preparation of project specific, or office master, specifications. It follows the guidelines of the Construction Specifications Institute's (CSI) "SectionFormat" and "PageFormat," and therefore may be used with most commercial guide specification systems with minor editing.

Edit to suit project requirements by deleting and inserting appropriate text. Green text preceded by \*\*\*\* and ending with \*\*\*\* offers suggestions on editing this Section. Delete the \*\*\*\* green text \*\*\*\* before publication of specification.

Verify that referenced section numbers and titles are coordinated with remainder of Project Manual. Section numbers and titles used in this specification are based on CSI's MasterFormat 2020 edition.

Select and/or delete [bracketed] options as appropriate for the door assemblies applicable for the Project.

ANSI/SDI and SDI standards used in this specification are available for free from the SDI website [www.steeldoor.org](http://www.steeldoor.org)

SDI is not liable in any way for revisions to, or use of, this specification by any end user.

Contact the Steel Door Institute at [info@steeldoor.org](mailto:info@steeldoor.org) regarding questions or comments.

#### PART 1 – GENERAL

##### 1.01 SUMMARY

###### A. Section Includes:

1. Interior standard hollow-metal doors and frames.
2. Exterior standard hollow-metal doors and frames.
3. Interior borrowed lites.

###### B. Related Requirements:

1. Section 087100 - Door Hardware, for door hardware applicable for hollow-metal door and frames.
2. Section 088000 - Glazing, for glazing installed in hollow-metal door and frames.
3. Section 099100 - Painting, for field painting of hollow-metal door and frames.

##### 1.02 REFERENCES

\*\*\*\* After editing specification, retain only references below that remain in the specification. Consider deleting "Reference" Article, in its entirety, if Project Manual includes Section 014200 - References and Section 014200 includes all references incorporated into the edited version of this Section. \*\*\*\*

- A. American National Standards Institute (ANSI):
  - 1. ANSI/BHMA A156.115-2016: Hardware Preparation in Steel Doors and Steel Frames.
  - 2. ANSI/SDI A250.3-2019: Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames.
  - 3. ANSI/SDI A250.4-2022: Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors.
  - 4. ANSI/SDI A250.6-2020: Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
  - 5. ANSI/SDI A250.8-2017: Specifications for Standard Steel Doors and Frames (SDI-100).
  - 6. ANSI/SDI A250.10-2020: Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
  - 7. ANSI/SDI A250.11-2022: Recommended Erection Instructions for Steel Frames.
- B. ASTM International (ASTM):
  - 1. ASTM A153/A153M-16a: Standard Specification for Zinc(Hot-Dip) on Iron and Steel Hardware.
  - 2. ASTM A568/A568M-19a: Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
  - 3. ASTM A653/A653M-20: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 4. ASTM A879/A879M-22: Standard Specification for Steel Sheet, Zinc-Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
  - 5. ASTM A924/A924M-22: Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - 6. ASTM A1008/A1008M-21a: Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
  - 7. ASTM A1011/A1011M-18a: 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.
  - 8. ASTM C518-21: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 9. ASTM C665-17: Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - 10. ASTM C1363-19: Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
  - 11. ASTM E136-19a: Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.
  - 12. ASTM E1423-21: Standard Practice for Determining Steady State Thermal Transmittance of Fenestration Systems.
- C. Code of Federal Regulations:
  - 1. 16 CFR 1201-2012: Safety Standard for Architectural Glazing Materials.
- D. National Fire Protection Association (NFPA):
  - 1. NFPA 80-2022: Standard for Fire Doors and Other Opening Protectives.
  - 2. NFPA 252-2022: Standard Methods of Fire Tests of Door Assemblies.

3. NFPA 257-2022: Standard on Fire Test for Window and Glass Block Assemblies.

E. Steel Door Institute (SDI):

1. SDI 108-2023: Recommended Selection and Usage Guide for Standard Steel Doors.
2. SDI 111-2009: Recommended Details for Standard Steel Doors, Frames, Accessories and Related Components.
3. SDI 112-2008 (Reaffirmed 2023): Zinc-Coated (Galvanized/Galvannealed) Steel Doors and Frames.
4. SDI 113-2013 (Reaffirmed 2018): Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door & Frame Assemblies.
5. SDI 117-2023: Manufacturing Tolerances for Standard Steel Doors and Frames.
6. SDI 118-2021: Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements.
7. SDI 124-2022: Maintenance of Standard Steel Doors and Frames.

F. Underwriters Laboratories, Inc. (UL):

1. UL9-2020: Standard for Fire Tests of Window Assemblies.
2. UL 10B-2020: Standard for Fire Tests of Door Assemblies.
3. UL 10C-2021: Standard for Positive Pressure Fire Tests of Door Assemblies.
4. UL 1784-2020: Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives.

### 1.03 ADMINISTRATIVE REQUIREMENTS

\*\*\*\* Preinstallation Conference in first paragraph below is typically not required. Retain for complex installations. If retaining, consider adding text describing purpose of conference, and required attendees. \*\*\*\*

- A. Preinstallation Conference: Conduct conference at Project site.

### 1.04 ACTION SUBMITTALS

- A. Product Data: For the following, include material descriptions, core descriptions, construction details, **[Fire-resistance ratings,]** **[Temperature-rise ratings,]** and factory finishes:

1. Doors.
2. Frames.
3. Frame anchors.
4. **[Vision panel frames.]**
5. **[Louvers.]**

- B. Shop Drawings: Include the following:

1. Elevation of each door type.
2. Details of each type of door, including the following:
  - a. Vertical and horizontal edge details.
  - b. Metal thicknesses.
3. Details of each type of frame, including the following:
  - a. Frame profile and dimensions.
  - b. Metal thicknesses.
4. Locations of hardware reinforcing.

5. [Details of electrical raceways.]
6. [Details of door and frame preparations for electrified door hardware.]
7. [Details of vision panel frames.]
8. [Details of louvers.]
9. Details of filed splices.
10. Jamb and head details of each type of wall opening.
11. Details of frame anchorages and spacing.

C. Product Schedule: Prepared by or under the supervision of supplier.

1. Format: Use same door numbers indicated on Drawings.
2. Content: Include the following:
  - a. Opening location.
  - b. Opening size.
  - c. Door thickness.
  - d. Door type.
  - e. Door material.
  - f. Frame type.
  - g. Frame material.
  - h. Fire-rating.
  - i. Hand of door.

D. Samples: For doors and frames specified to be factory color finished.

E. Certificates:

\*\*\*\* Retain first subparagraph below if Project includes oversize fire-rated openings. \*\*\*\*

1. Oversize Opening Certification: For fire-rated door assemblies exceeding limitations of labeled openings.
2. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
3. For manufacturer, indicating Steel Door Institute certification.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Statements:

1. For manufacturer.

\*\*\*\* Retain first subparagraph below if Project includes fire-rated openings. \*\*\*\*

2. For fire-rated door inspector.

\*\*\*\* Retain first paragraph below if Project includes fire-rated openings. \*\*\*\*

B. Field Quality Control Submittals:

1. Field quality control reports.

C. Sustainable Design Submittals:

\*\*\*\* Retain first two subparagraphs below and insert additional submittal requirements if applicable to Project's sustainability program. \*\*\*\*

1. Recycled Content: Indicate postconsumer and preconsumer recycled content and cost.
2. Energy Performance Certificates: For each type of exterior door, from manufacturer, stating NFRC-certified energy performance values, including air leakage rate, U-value and SHGC.

#### 1.06 CLOSEOUT SUBMITTALS

\*\*\*\* Retain first paragraph below if Project includes fire-rated openings. \*\*\*\*

- A. Record Drawings: For fire-rated doors, listing door numbers and applicable room names and numbers to which fire-rated door accesses.

#### 1.07 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Certified under the Steel Door Institute's certification program.

\*\*\*\* Retain first paragraph below if Project includes fire-rated openings. \*\*\*\*

- B. Fire-Rated Door Inspector Qualifications: Comply with qualifications listed in NFPA 80, section 5.2.3.1, and one of the following:
  1. Certified under the Door and Hardware Institute's Fire and Egress Door Assembly Inspector (FDAI).
  2. Certified under Door Safety, LLC's Door Safety Inspector (DSI).

\*\*\*\* Retain first paragraph below if Project is designed under NFPA 101. \*\*\*\*

- C. Egress Door Inspector Qualifications: Comply with qualifications listed in NFPA 101, section 7.2.1.14.4, and one of the following:
  1. Certified under the Door and Hardware Institute's Fire and Egress Door Assembly Inspector (FDAI).
  2. Certified under Door Safety, LLC's Door Safety Inspector (DSI).

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames in a manner that provides protection during transit and Project site storage.
  1. Mark each door and frame with Architect's opening number.
  2. Do not use non-vented plastic or canvas for packaging.
  3. Provide welded frames with temporary bottom spreaders welded to jambs and mullions.
- B. Store doors and frames vertically under cover, placed on at least 4-inch (102-mm) high wood blocking or in a manner that will promote air circulation and prevent rust or damage.
  1. Provide a minimum ¼-inch (6.3 mm) space between doors to promote air circulation.
  2. Remove and replace damaged or wet packaging material immediately.

## PART 2 – PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
  1. Republic Doors & Frames/Allegion
  2. Steelcraft/Allegion
  3. Ceco, An ASSA ABLOY Group Company

4. Curries, An ASSA ABLOY Group Company
5. Pioneer, An ASSA ABLOY Group Company
6. DCI
7. Deansteel Manufacturing Company
8. De La Fontaine Industries, Inc.
9. Hollow Metal Express (HMX)
10. Mesker Door
11. MPI
12. Premier Steel Doors and Frames
13. Stiles, An ASSA ABLOY Group Company

## 2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Comply with NFPA 80, and be listed and labeled by either Underwriters Laboratories, Inc. (UL) or Intertek Group plc, as acceptable to authorities having jurisdiction, for the fire-protection ratings **[and temperature-rise limits]** indicated on the Drawings, based on positive pressure testing in accordance with NFPA 252 or UL 10C.
  1. Oversize Fire-Rated Assemblies: For assemblies exceeding sizes of tested assemblies, provide certification by a qualified testing agency, acceptable to authorities having jurisdiction, certifying that doors and frames comply with the construction requirements for tested and labeled fire-rated assemblies except for size.
  2. Temperature-Rise Limit: At locations indicated on Drawings, provide door assemblies that have a maximum transmitted temperature end point of not more than 450 degrees F **(250 degrees C)** above ambient after 30 minutes of standard fire-test exposure.
- B. Smoke and Draft Control Assemblies: Comply with NFPA 105, and be listed and labeled by either Underwriters Laboratories or Intertek Group plc, as acceptable to authorities having jurisdiction, based testing in accordance with UL 1784.
- C. Fire-Rated Borrowed-Lite Assemblies: Comply with NFPA 80, and be listed and labeled by either Underwriters Laboratories or Intertek Group plc, as acceptable to authorities having jurisdiction, for the fire-protection ratings indicated on Drawings, based on testing in accordance with NFPA 257 or UL 9.
- D. Thermally-Rated Door Assemblies: For exterior locations, provide door assemblies with U-factor of not more than **[0.60 degrees Btu per degree per hour per square foot (2.84 W/K per square meter)] [Insert U-factor]** when tested in accordance with ASTM C518, ASTM C1363, or ASTM E1423.

## 2.03 EXTERIOR DOORS AND FRAMES

- A. Standard Exterior Doors: Comply with ANSI/SDI A250.8 as follows:

\*\*\*\* Select one of four Classification Levels below and coordinate with Physical Endurance Level. Classification Level 1, for standard-duty doors, is associated with Physical Endurance Level C; Classification Level 2, for heavy-duty doors, is associated with Physical Endurance Level B; Classification Level 3, for extra heavy-duty doors, is associated with Physical Endurance Level A; and Classification Level 4, for maximum-duty doors, is associated with Physical Endurance Level A. \*\*\*\*

1. Classification Level: **[1] [2] [3] [4]**.
2. Model: **[1, Full flush] [2, Seamless] [3, Stile and rail]**.



3. Physical Endurance: When tested in accordance with ANSI/SDI A250.4, pass the following:
  - a. Swing Test: **[Level A]** **[Level B]** **[Level C]**.
  - b. Twist Test: **[Level A]** **[Level B]** **[Level C]**.
4. Door Type: As indicated on Drawings.
5. Door Thickness: 1-3/4 inches (44.4 mm).
6. Face: ASTM A653/A653M, **[A40]** **[A60]**, Commercial Steel (CS), Type B, metallic-coated steel sheet.

\*\*\*\* Face thickness is associated with Classification Level above. First option is for Level 1; second option is for Level 2; third option is for Level 3; and fourth option is for Level 4. First option represents the outdated “20 gauge”; second option represents the outdated “18 gauge”; third option represents the outdated “16 gauge”; and the fourth option represents the outdated “14 gauge.” \*\*\*\*

- a. Thickness: **[0.032 inches (0.8 mm)]** **[0.042 inch (1.0 mm)]** **[0.053 inches (1.3 mm)]** **[0.067 inch (1.7 mm)]**.
  7. Edge Design: **[Manufacturer’s standard design]** **[Square]** **[Beveled]**.
  8. Core: **[Polyurethane]** **[Polystyrene]** **[Polyisocyanurate]** **[Kraft-paper honeycomb]** **[Mineral board]** **[Vertical steel stiffeners with insulation]**.
    - a. Fire-Rated Doors: As required to provide fire-protection rating indicated on Drawings.
  9. Top Closure: 0.042-inch (1.0 mm) thick flush channel.
  10. Bottom Closure: 0.042-inch (1.0 mm) thick **[flush]** **[inverted]** channel.
- B. Standard Exterior Door Frames: Comply with ANSI/SDI A250.8 as follows:
1. Classification Level: **[1]** **[2]** **[3]** **[4]**.
  2. Material: ASTM A653/A653M, **[A40]** **[A60]**, Commercial Steel (CS), Type B, metallic-coated steel sheet.

\*\*\*\* Material thickness is associated with Classification Level above. First option is for Level 1; second option is for Level 2 and Level 3; third option for Level 4. First option represents the outdated “18 gauge”; second option represents the outdated “16 gauge”; and the third option represents the outdated “14 gauge.” \*\*\*\*

- a. Thickness: **[0.042 inch (1.0 mm)]** **[0.053 inches (1.3 mm)]** **[0.067 inch (1.7 mm)]**.
3. Sidelite **[and Transom]** Frames: Same material and thickness as door frame.
4. Constructed: **[Face welded]** **[Full profile welded]** **[Knockdown]**.

## 2.04 INTERIOR DOORS AND FRAMES

- A. Standard Interior Doors: Comply with ANSI/SDI A250.8 as follows:

\*\*\*\* Select one of four Classification Levels below and coordinate with Physical Endurance Level. Classification Level 1, for standard-duty doors, is associated with Physical Endurance Level C; Classification Level 2, for heavy-duty doors, is associated with Physical Endurance Level B; Classification Level 3, for extra heavy-duty doors, is associated with Physical Endurance Level A; and Classification Level 4, for maximum-duty doors, is associated with Physical Endurance Level A. \*\*\*\*

1. Classification Level: **[1]** **[2]** **[3]** **[4]**.
2. Model: **[1, Full Flush]** **[2, Seamless]** **[3, Stile and rail]**.
3. Physical Endurance: When tested in accordance with ANSI/SDI A250.4, pass the following:

- a. Swing Test: [**Level A**] [**Level B**] [**Level C**].
- b. Twist Test: [**Level A**] [**Level B**] [**Level C**].
- 4. Door Type: As indicated on Drawings.
- 5. Door Thickness: 1-3/4 inches (44.4 mm).
- 6. Face: [**ASTM A1008/A1008M, Commercial Steel (CS), Type B or ASTM A1011. A1011M, Commercial Steel (CS), Type B**] [**ASTM A653/A653M, A40, Commercial Steel (CS), Type B, metallic-coated steel sheet**].

\*\*\*\* Face thickness is associated with Classification Level above. First option is for Level 1; second option is for Level 2; third option is for Level 3; and fourth option is for Level 4. First option represents the outdated “20 gauge”; second option represents the outdated “18 gauge”; third option represents the outdated “16 gauge”; and the fourth option represents the outdated “14 gauge.” \*\*\*\*

- a. Thickness: [**0.032 inches (0.8 mm)**] [**0.042 inch (1.0 mm)**] [**0.053 inches (1.3 mm)**] [**0.067 inch (1.7 mm)**].
- 7. Edge Design: [**Manufacturer’s standard design**] [**Square**] [**Beveled**].
- 8. Core: [**Polyurethane**] [**Polystyrene**] [**Polyisocyanurate**] [**Kraft-paper honeycomb**] [**Mineral board**] [**Vertical steel stiffeners with insulation**].
  - a. Fire-Rated Doors: As required to provide fire-protection rating indicated on Drawings.
- 9. Top Closure: 0.042-inch (1.0 mm) thick [**flush**] [**inverted**] channel.
- 10. Bottom Closure: 0.042-inch (1.0 mm) thick [**flush**] [**inverted**] channel.
- B. Standard Interior Door Frames: Comply with ANSI/SDI A250.8 as follows:
  - 1. Classification Level: [**1**] [**2**] [**3**] [**4**].
  - 2. Material: [**ASTM A1008/A1008M, Commercial Steel (CS), Type B or ASTM A1011. A1011M, Commercial Steel (CS), Type B**] [**ASTM A653/A653M, A40, Commercial Steel (CS), Type B, metallic-coated steel sheet**].

\*\*\*\* Material thickness is associated with Classification Level above. First option is for Level 1; second option is for Level 2 and Level 3; third option for Level 4. First option represents the outdated “18 gauge”; second option represents the outdated “16 gauge”; and the third option represents the outdated “14 gauge.” \*\*\*\*

- a. Thickness: [**0.042 inch (1.0 mm)**] [**0.053 inches (1.3 mm)**] [**0.067 inch (1.7 mm)**].
- 3. Sidelite [**and Transom**] Frames: Same material and thickness as door frame.
- 4. Constructed: [**Face welded**] [**Full profile welded**] [**Knockdown**].
- 2.05 BORROWED LITE FRAMES:
  - A. Material: [**ASTM A1008/A1008M, Commercial Steel (CS), Type B or ASTM A1011. A1011M, Commercial Steel (CS), Type B**] [**ASTM A653/A653M, A40, Commercial Steel (CS), Type B, metallic-coated steel sheet**].
    - 1. Thickness: [**0.042 inch (1.0 mm)**] [**0.053 inches (1.3 mm)**].
  - B. Construction: [**Face welded**] [**Full profile welded**] [**Knockdown**].
- 2.06 ACCESSORIES
  - A. Hollow-Metal Panels: Match material, construction, and finish of adjacent door.
  - B. Interior Louvers: Comply with SDI-111C.

1. Frames: ASTM A1008/A1008M, Commercial Steel (CS), Type B or ASTM A1011.A1011M, Commercial Steel (CS), Type B.
    - a. Thickness: 0.032 inch (0.8 mm).
  2. Blade: ASTM A1008/A1008M, Commercial Steel (CS), Type B or ASTM A1011.A1011M, Commercial Steel (CS), Type B.
    - a. Thickness: 0.024 inch (0.6 mm).
    - b. Style: [**Inverted “V”**] [**“Z” Blade**] [**Inverted “Y”**] [**Chevron-type**] [**Lightproof**] [**Adjustable blade**].
  3. Fire-Rated Automatic Louvers: Fusible-link, self-closing at 135 degrees F (57 degrees C).
    - a. Fire-Rating: Comply with fire-rating of door assembly; UL or Intertek Group plc listed.
- C. Vision Lite Frames:
1. Material:
    - a. Exterior Locations: ASTM A653/A653M, [**A40**] [**A60**], Commercial Steel (CS), Type B, metallic-coated steel sheet.
      - 1) Thickness: 0.032 inch (0.8 mm).
    - b. Interior Locations: ASTM A1008/A1008M, Commercial Steel (CS), Type B or ASTM A1011.A1011M, Commercial Steel (CS), Type B.
      - 1) Thickness: 0.032 inch (0.8 mm).
  2. Profile: Flush type, with [**Square**] [**Beveled**] stops.
  3. Corner Construction: [**Butted**] [**Mitered**], welded.
  4. Fasteners: Countersunk type.
  5. Locate fixed stops as follows:
    - a. Exterior Doors: Interior side.
    - b. Interior Doors: Keyed side.
  6. Fire-Rated Doors: Comply with NFPA 80, and NFPA 252 or UL 10C.
- D. Frame Anchors: Comply with ANSI/SDI A250.4.
1. Material:
    - a. Exterior Locations: ASTM A653/A653M, [**A40**] [**A60**], Commercial Steel (CS), Type B, metallic-coated steel sheet.
      - 1) Thickness: 0.042 inch (1.0 mm) for sheet metal anchors and 0.167-inch (4.2 mm) diameter for wire anchors.
    - b. Interior Locations: ASTM A1008/A1008M, Commercial Steel (CS), Type B or ASTM A1011.A1011M, Commercial Steel (CS), Type B.
      - 1) Thickness: 0.042 inch (1.0 mm) for sheet metal anchors and 0.167-inch (4.2 mm) diameter for wire anchors.
  2. Jamb Anchors:, Suitable for adjoining wall construction.
    - a. Quantity: Other than at slip-on drywall frames, provide the following:
      - 1) Frames Up to 7'-6" in Height: Three anchors per jamb.
      - 2) Frames Over 7'-6" in Height: Three anchors per jamb plus one additional anchor per jamb for each 2 feet of additional height.
    - b. Floor Anchors: Provide one floor anchor for each jamb and mullion extending to floor.

- E. Mineral-Fiber Insulation: ASTM C665, Type I.
  - 1. Combustibility: Pass ASTM E136.
- F. Glazing: As specified in Section 088000 - Glazing.
- G. Shop Primer: Door manufacturer's standard lead and chromate free primer complying with ANSI/SDI A250.10, compatible with field-applied finishes.
- H. Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
  - 1. Power-Actuated Fasteners in Concrete: Type applicable for required installation; corrosive-resistant material.

## 2.07 FABRICATION

- A. Fabrication of Doors **[and Hollow-Metal Panels]**: Comply with ANSI/SDI A250.8.
  - 1. Form metal to sizes and profiles required, with minimum radius for thickness of metal.
  - 2. Factory cut glazed lite openings in doors.
  - 3. Door Astragals: When required to comply with fire-rating of door assembly, provide overlapping astragal on inactive leaf of pairs of doors.
  - 4. Hardware Preparation: Comply with ANSI/BHMA A156.115, where applicable.
  - 5. Hardware Reinforcing: Comply with ANSI/SDI A250.6 and ANSI/SDI A250.8, Table 4.

\*\*\*\* Retain first two paragraphs below for exterior doors. \*\*\*\*

- 6. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
- 7. Seal joints in top edges of exterior doors to prevent water intrusion.
- 8. Attach fire-rating label to each fire-rated door.
- 9. Attach S label to each smoke and draft control door.

- B. Fabrication of Frames: Comply with ANSI/SDI A250.8.
  - 1. Form metal to sizes and profiles required, with minimum radius for thickness of metal.
  - 2. Fabricate frames in single unit, except where handling and transporting limitations require multiple units.
    - a. Provide concealed alignment plates at each joint for multiple unit frames.
  - 3. Termination Stops: Where indicated on Drawings, terminate stops 6 inches (152 mm) above finish floor at a 45 degree downward angle.
    - a. Close open end of stop with metal to match material and thickness of door frame.
    - b. Fill open portion of frame below termination stop with metal to match material and thickness of door frame.
    - c. Weld all joints with welds ground smooth and flush with adjacent frame.
  - 4. Door Silencers: Except for doors scheduled to receive weatherstripping or sound seals specified under Section 087100, drill frame stops to receive door silencers.
    - a. Quantity:
      - 1) Single Door Frames: Three holes in strike jamb stop.
      - 2) Double Door Frames: Two holes in head stop.
  - 5. Hardware Preparation: Comply with ANSI/BHMA A156.115, where applicable.
  - 6. Hardware Reinforcing: Comply with ANSI/SDI A250.6 and ANSI/SDI A250.8, Table 4.
  - 7. Attach fire-rating label to each fire-rated frame.
  - 8. Attach S label to each smoke and draft control frame.

- C. Fabrication Tolerances: Comply with SDI-117 and ANSI/SDI A250.8.

## 2.08 SHOP FINISHING

### A. Primer Finish:

1. Clean and prepare doors and frames to receive shop primer.
2. Shop finish in compliance with ANSI/SDI A250.10.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Verification of Conditions: Examination areas and conditions under which Work is to be performed and identify conditions detrimental to proper and timely completion.

1. Verify rough-in openings and built-in anchorage are correctly sized, installed, and located.
2. Do not proceed until unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Remove factory-installed welded-in door frame shipping spreaders.

1. Restore appearance and finish of door frames at weld locations to result in a smooth, flush surface.
  - a. Touch-up primer using same primer as applied in shop.
2. Drill and tap doors and frames schedule to receive field-applied non-templated, mortised, and surface-mounted hardware.

### 3.03 INSTALLATION

- A. Installation of Frames: Comply with ANSI/SDI A250.11.

1. Fire-Rated Assemblies: Comply with NFPA 80.
2. Smoke Control Assemblies: Comply with NFPA 105.
3. Install frames plumb and level, in alignment with adjacent construction.
4. Provide temporary supports and braces for frames installed prior to wall erection.
  - a. Remove temporary supports and braces after wall erection is completed.
5. At field splices, secure separate units of frames by continuous welds.
  - a. Restore appearance and finish of frames at weld locations to result in a smooth, flush surface.
  - b. Touch-up primer using same primer as applied in shop.
6. At STC-rated walls, install mineral-fiber insulation inside frames.
7. At in-place concrete and masonry walls, secure frames using post-installed anchors with spacer tube between frame and wall.
  - a. Countersink anchors, and fill recess to create a smooth, flush surface.

- B. Installation of Doors:

1. Install doors in frames using hardware specified in Section 087100.
2. Install doors to within specified installation tolerances.
  - a. Shim as necessary using metal shims.
3. Fire-Rated Assemblies: Comply with NFPA 80.

4. Smoke Control Assemblies: Comply with NFPA 105.

C. Installation Tolerances for Doors and Frames:

1. Non-Fire-Rated Assemblies: Comply with ANSI/SDI A250.8.

2. Fire-Rated Assemblies: Comply with NFPA 80.

### 3.04 REPAIR

A. Immediately after installation, repair rusted and damages areas of shop primer.

B. Touch-up primer using same primer as applied in shop.

C. FIELD QUALITY CONTROL

\*\*\*\* Retain this Article for fire-rated assemblies \*\*\*\*

D. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports.

E. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.

\*\*\*\* Retain “Egress Door Inspections” Subparagraph below for projects under NFPA 101, for Assembly, Educational, Day-Care, and Residential Board and Care occupancies. \*\*\*\*

2. Egress Door Inspections: Inspect each door equipped with exit panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements, in accordance with NFPA 101, Section 7.2.1.15.

F. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

G. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

H. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in [NFPA 80] [and] [NFPA 101].

### 3.05 ADJUSTING

A. Adjust doors to function smoothly and correctly.

### 3.06 CLEANING

A. Clean exposed surfaces, hardware [, and glass materials].

END OF SECTION

## 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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*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

**American National Standards Institute, Inc.**

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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

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Steel Door Institute .....	J. J. Wherry
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.

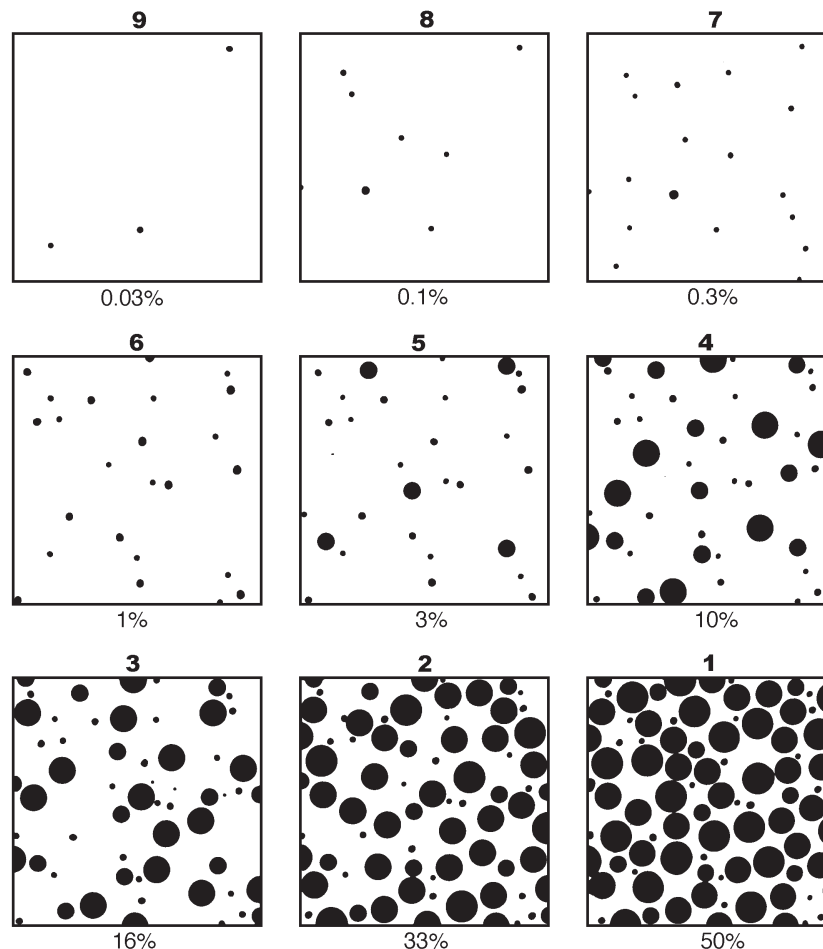
## 6 General

### 6.1 Test laboratory

All tests shall be conducted by a testing laboratory accredited to the standards referenced in this document.

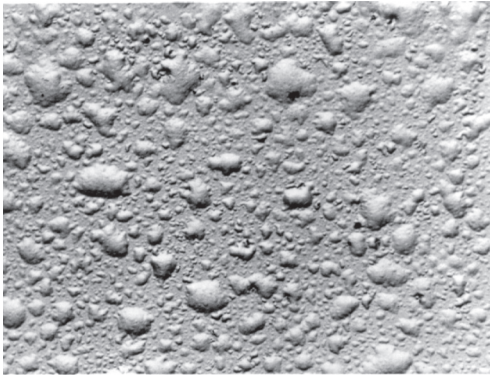
### 6.2 Certification

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."

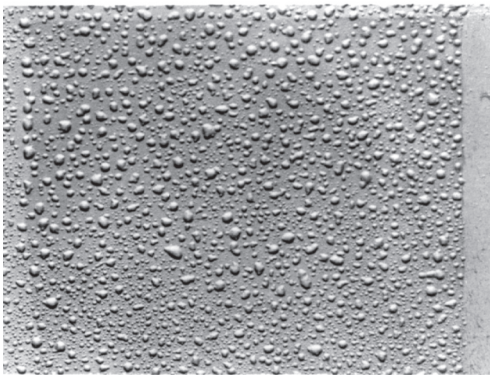


**Figure 1 – Visual reference for percentage of rust**

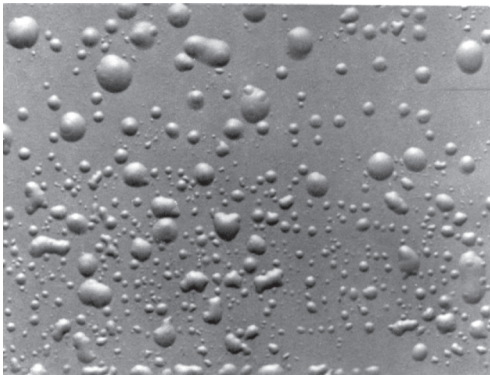
Visual examples illustrating degrees of blistering



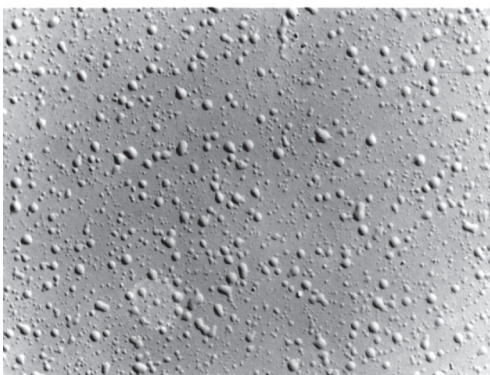
DENSE



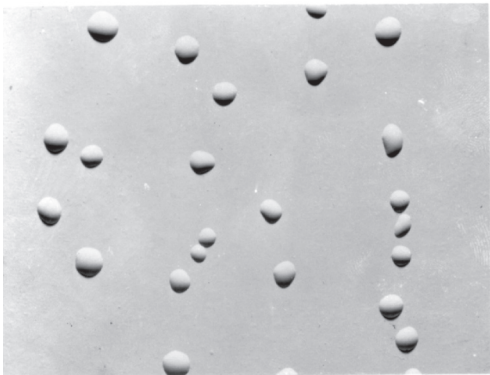
DENSE



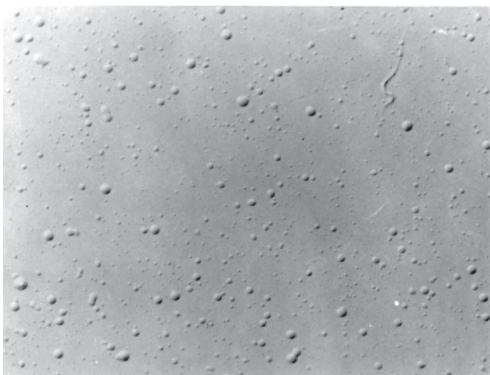
MEDIUM DENSE



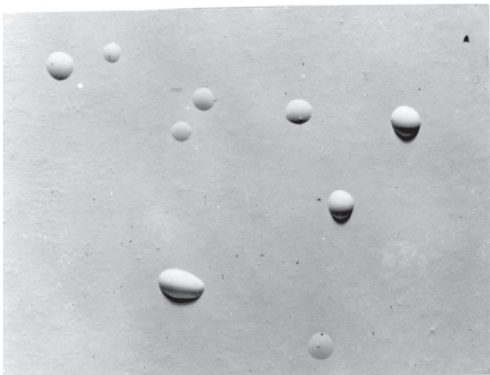
MEDIUM DENSE



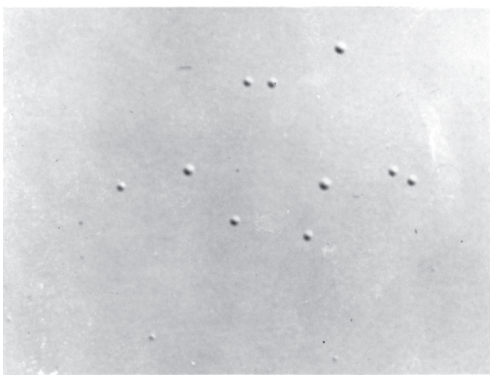
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MEDIUM



FEW



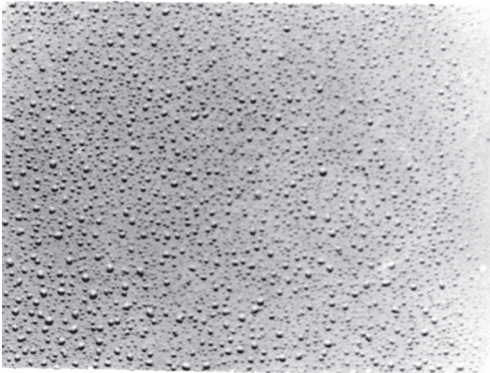
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Figure 2 – Blister size #2

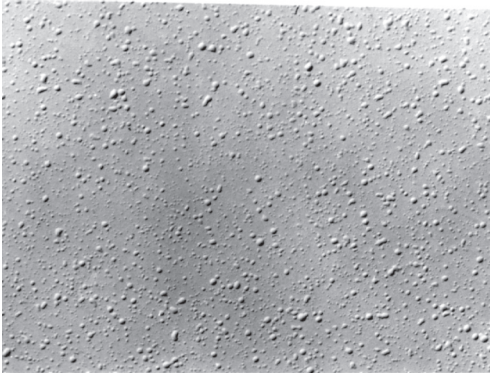
Figure 3 – Blister size #4



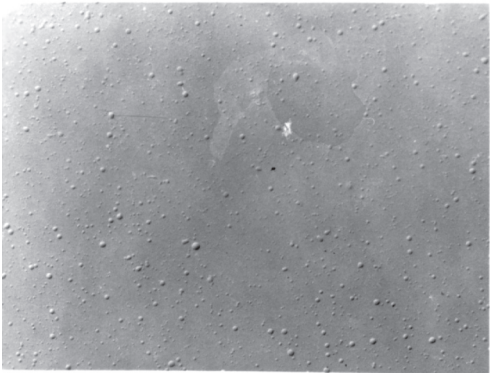
Visual examples illustrating degrees of blistering



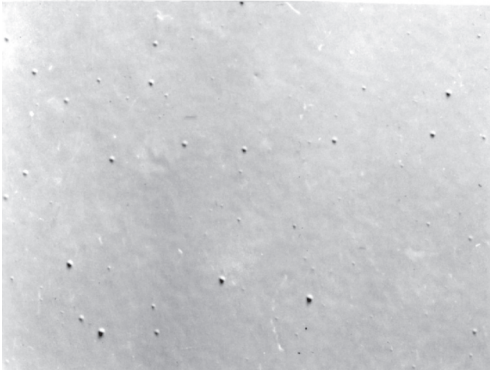
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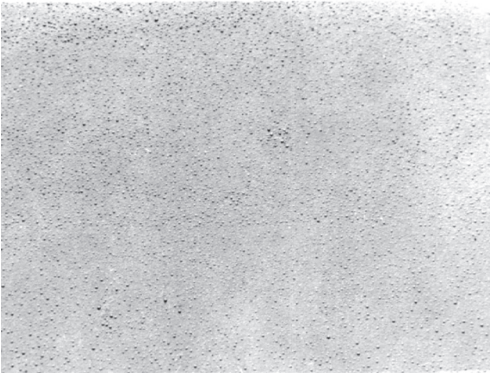


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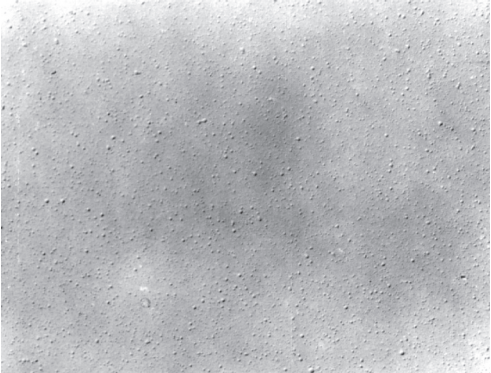


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Figure 4 – Blister size #6



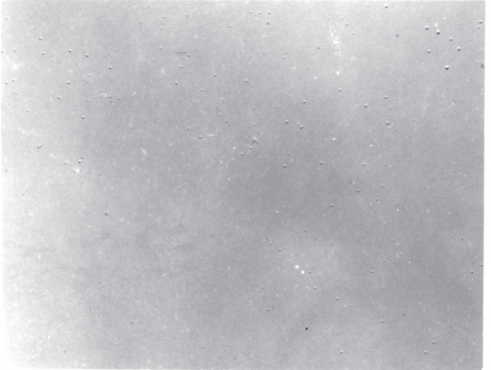
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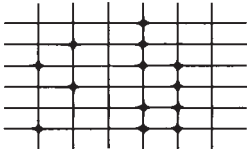
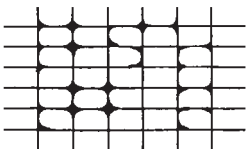
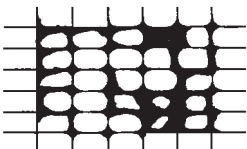

MEDIUM



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

### 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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**Steel Door Institute**

Approved March 17, 2022

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ANSI/SDI A250.11-2022

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**Foreword** (This Foreword is not part of American National Standard A250.11-2022)

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:

Builders Hardware Manufacturers Association  
Canadian Steel Door Manufacturers Association  
Cedar Valley Associates  
D. H. Pace  
Door and Hardware Institute  
Door Control Services  
ESTM Services  
HMMA / Division of NAAMM  
MasterSpec  
Intertek Testing Services  
Ray & Associates  
UL Solutions  
Vetrotech / Saint Gobain

The Technical Committee of the Steel Door Institute, which developed this standard, had the following personnel at the time of approval:

David McConnell, *Chairman*  
David Bill, *1<sup>st</sup> Vice Chairman*  
Claus D. Heide, *2<sup>nd</sup> Vice Chairman*  
J. Jeffery Wherry, *Manager*

<i>Organization Represented</i>	<i>Name of Representative</i>
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Curries Company .....	David Bill
Deansteel Manufacturing Co.....	Claus Heide
DCI .....	Henry Ray
HMX .....	Jason Lisewski
Mesker Door.....	Mike Mehaffy
MPI .....	David McConnell
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Premier .....	Joey Meggs
Republic .....	Marilyn Latham
Steelcraft .....	Tim Weller
Steel Door Institute.....	J. Jeffery Wherry

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## 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 (R2021), *Prime Painted Materials Alert*

SDI 127F-2019, *Butted Frames Rough Opening Sizes*

SDI 127J-2010 (R2018), *Back Coating of Frames*

SDI 117-2019, *Manufacturing Tolerances for Standard Steel Doors and Frames*

NFPA 80-2022, *Standard for Fire Doors and Other Opening Protectives* (National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269; [www.nfpa.org](http://www.nfpa.org))

UL10C-2009 (R2021), *Standard for Safety Positive Pressure Fire Tests of Door Assemblies*

ANSI/SDI A250.8-2017, *Recommended Specifications for Standard Doors and Frames*

HMMA 840-16, *Installation and Storage of Hollow Metal Doors and Frames*

HMMA 841-13, *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 110-2018, *Standard Steel Doors and Frames for Modular Masonry Construction*

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

SDI 122-2015, *Installation and Troubleshooting Guide for Standard Steel Doors and Frames*

SDI 127D-2006 (R2019), *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.

Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

## 1.4 Notes

### 1.4.1 Tolerances

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  $\pm 2$  degrees. Where only minus tolerances are given, the dimensions are permitted to be exceeded at the option of the manufacturers.

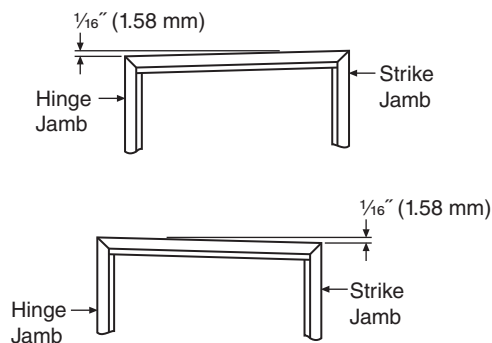
### 1.4.2 Gauge vs. Thickness

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.

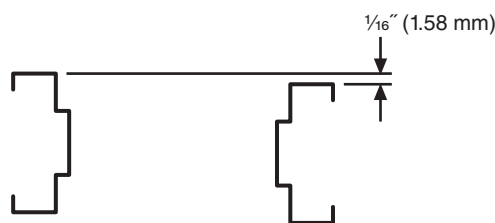
### 1.4.3 Frame Installation in Cast-In-Place Concrete Walls

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.



Maximum  $\frac{1}{16}$ " allowable tolerance on total opening.

1a – Squareness



1c – Alignment

## 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.

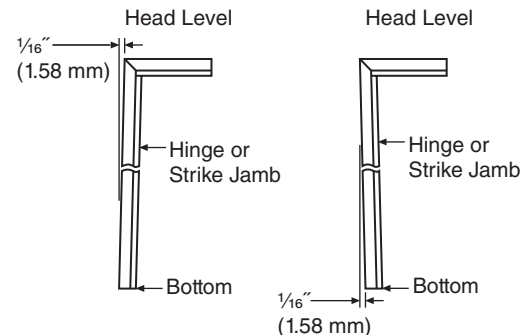
**2.1.2** Assembled frames shall be stored vertically. The units shall be placed on at least 4" (102 mm) high wood sills or in a manner that will prevent rust or damage.

**2.1.3** Non-vented plastic or canvas shelters that can create a humidity chamber shall not be used.

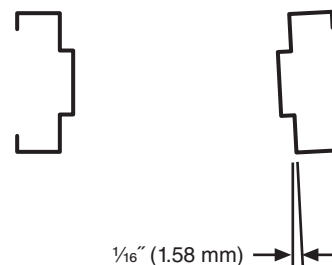
**2.1.4** Refer to project specifications for required cleanup and touchup work.

**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



1b – Plumbness



1d – Twist

**Figure 1 – Examples of the accuracy to be maintained while setting frames**



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 (self-consolidating grout), 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.

### 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** 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 spreaders for bracing frames. Spreader bars

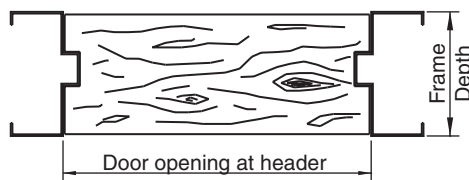


Figure 2 – Spreader

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  $+1/16"$ ,  $-0"$  (+1.6 mm, -0). Cut clearance notches for frame stops. Spreader shall be nearly as wide as frame jamb depth for proper installation.

### 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. Any bare metal surfaces shall be retouched with suitable primer.

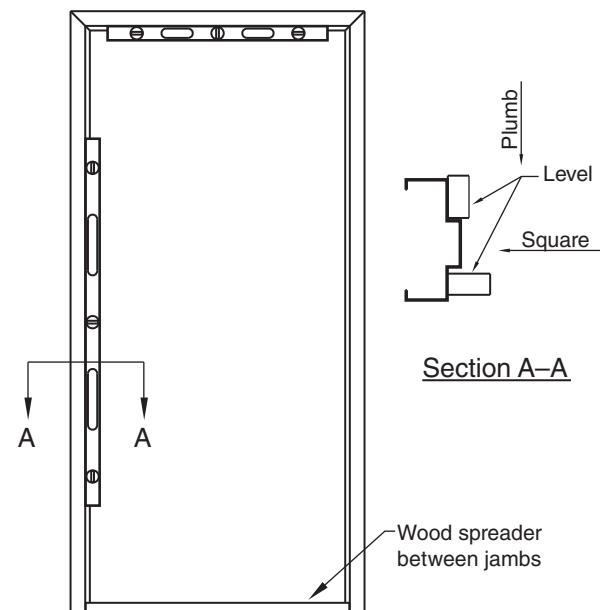
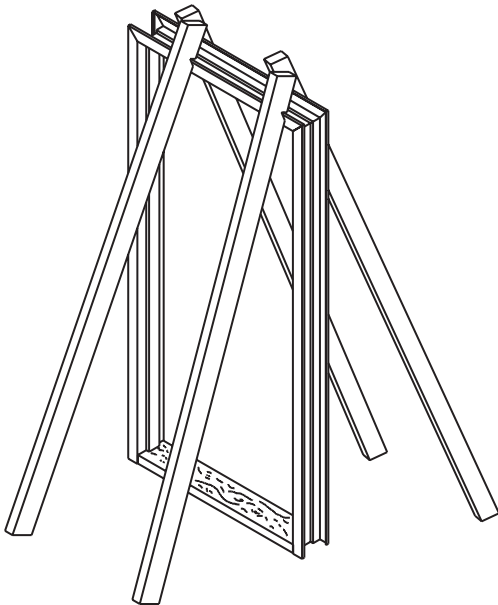


Figure 3 – Plumbing the frame

### 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

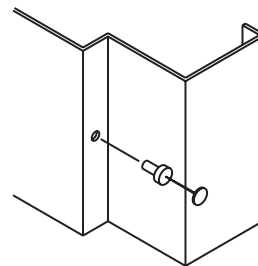
**3.4.1** Set the frame in the desired location and level the header. Square jambs to header. Shim under jambs if necessary. With frame properly aligned, insert wood spreaders at bottom and mid-height and fasten jambs to floor through floor anchors.

**3.4.2** Plumb and square jambs. Install vertical brace to support header for openings over 4'-0" (1219 mm) wide.

**3.4.3** Do not remove spreaders until wall is erected and cured.

## 4 Accessories

### 4.1 Install rubber silencers where required (see Figure 5)



**Figure 5 – Rubber silencers**

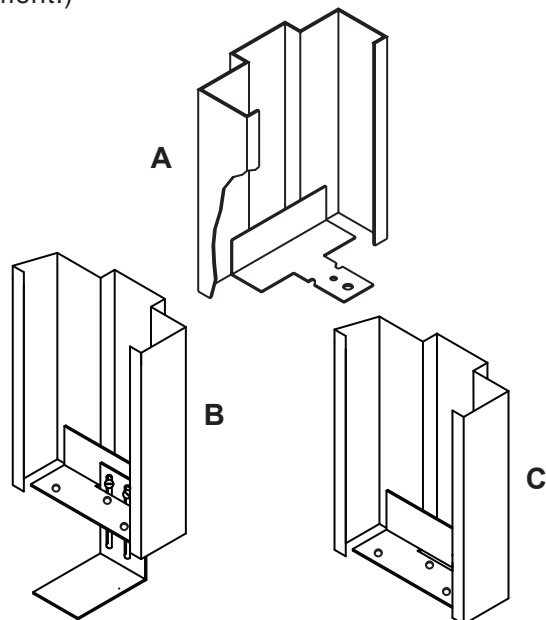
**4.1.1** Install rubber silencers before frame erection to avoid grout filling rubber silencer holes. In some cases rubber silencers are factory installed.

**4.1.2** 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.

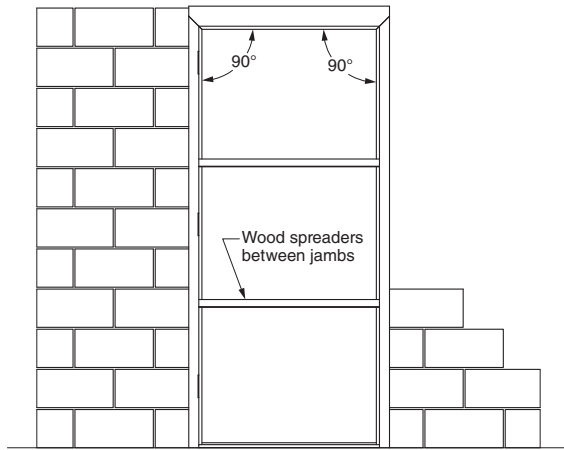
### 4.2 Extended base anchor (see Figure 6)

**4.2.1** Extended base anchors are supplied upon request only. (If required for tool attachment.)



**Figure 6 – Extended base anchor**

## 5 New masonry construction (see Figure 7)



**Figure 7 – New masonry construction**

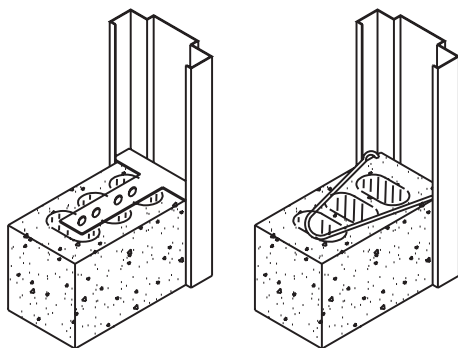
**5.1** Assemble frame per manufacturer's instructions.

**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. See Annex B for proper spacing of spreaders.

**5.4** Install anchors (See Figure 8). Utilize mortar in the area of all anchors ensuring each anchor is embedded into the masonry joint. When grouting of frames is specified or required, adhere to the project specifications listed therein (See SDI's *Risks of Grouting Hollow Metal Frames* at [www.steeldoor.org](http://www.steeldoor.org)).



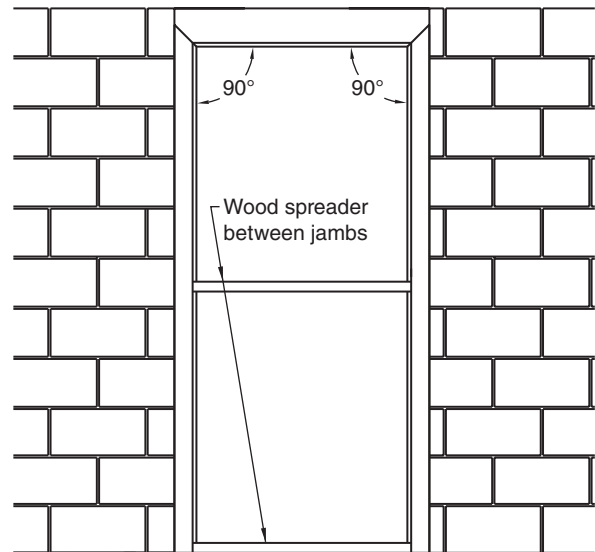
**Figure 8 – Masonry anchors**

**5.4.1** Frames may also be supplied with anchors welded in place.

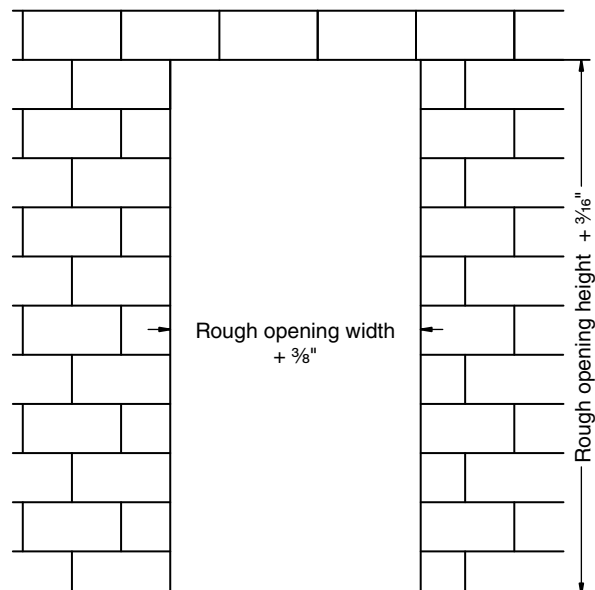
**5.5** Continually check plumb and square as wall progresses.

## 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



**Figure 9 – Existing masonry construction**



**Figure 10 – Rough Opening**

than  $\frac{3}{16}$ " (4.8 mm) larger than 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 sealant/painting process.

**6.1.2** Refer to architectural specifications for the appropriate sealant material to be used at fire or smoke control doors.

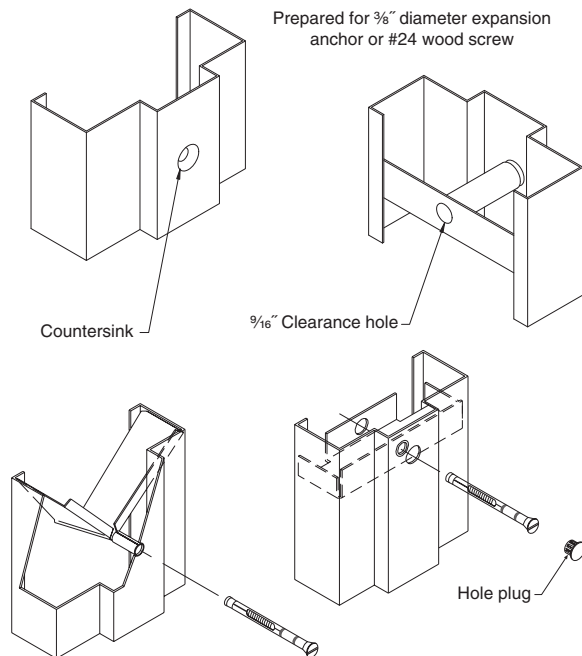
**6.2** Assemble frame per manufacturer's instructions.

**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.

**6.4** Slide frame into wall opening; install wood spreaders.

**6.5** Where needed, use shims between the wall and frame at the location of anchors and spreaders to maintain squareness and alignment of frame, and to maintain door opening sizes.



**Figure 11 – Existing masonry or concrete wall anchors**

**6.5.1** Drill appropriate size hole (per fastener manufacturer's instructions) for one-piece anchor bolts. Leave holes "rough" for added grip.

**6.6** Insert anchor bolts and tighten securely, checking for frame alignment periodically.

**6.7** Install plugs to cover bolt heads (if so equipped).

**6.8** Backer rod and/or sealant shall be used where gaps occur between frame and wall.

## **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.

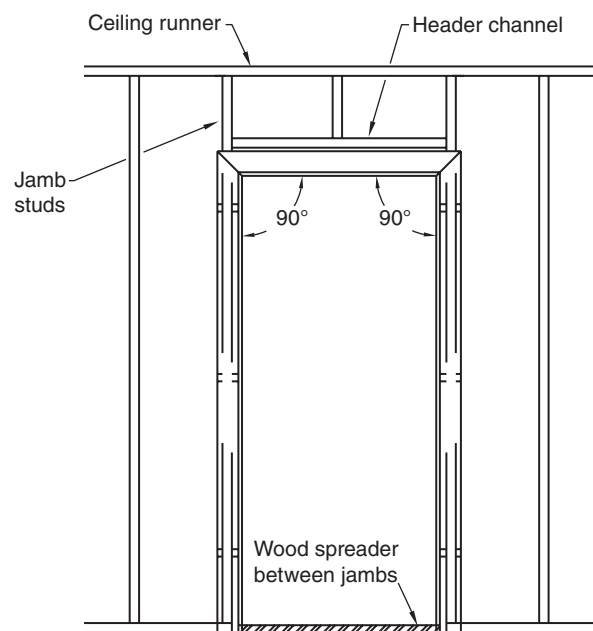
**7.2.1** Frames may also be supplied with anchors welded in place.

**7.3** Erect, brace, square and plumb frame as shown.

**7.4** Install wood spreaders.

**7.5** Attach jambs to floor through floor anchor.

**7.6** Install jamb studs to floor, header channels, and ceiling runners butted tightly against



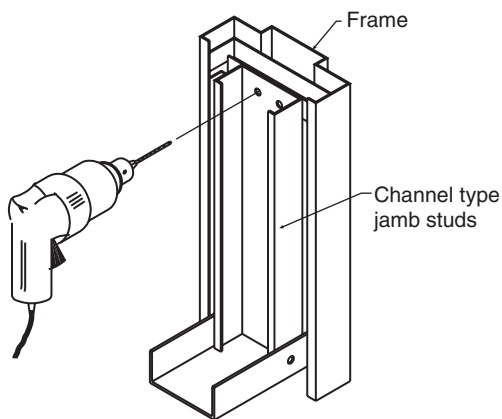
**Figure 12 – Steel stud wall construction**

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.

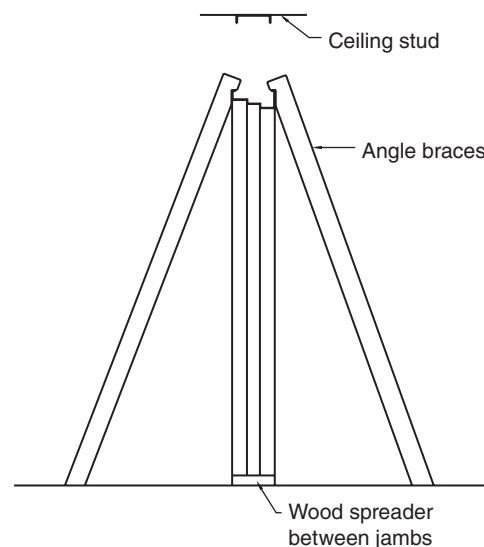
## 8 Double egress frames in steel stud wall construction

**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.

### 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.

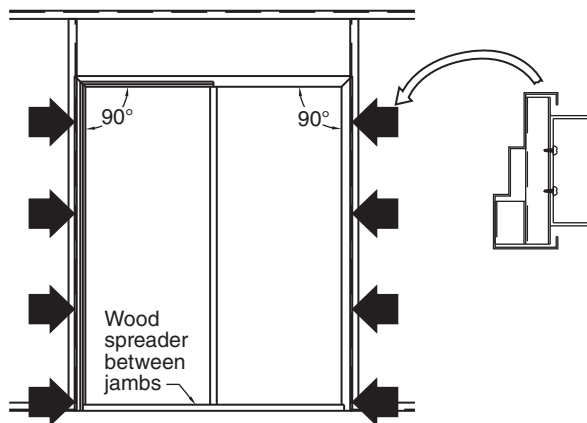


Figure 15 – Anchor jambs

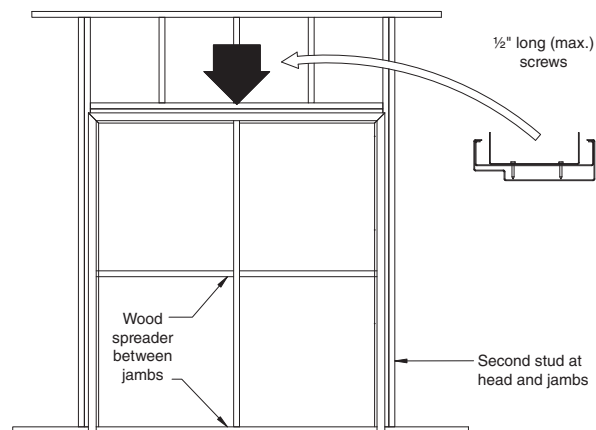


Figure 16 – Anchor header

### 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.

**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).

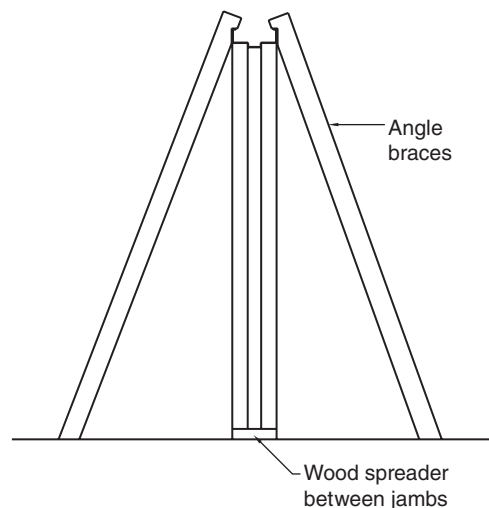


Figure 17 – Erect frame

**9.4** Install wood spreaders (see Figure 18).

**9.5** Attach jambs to floor through floor anchor.

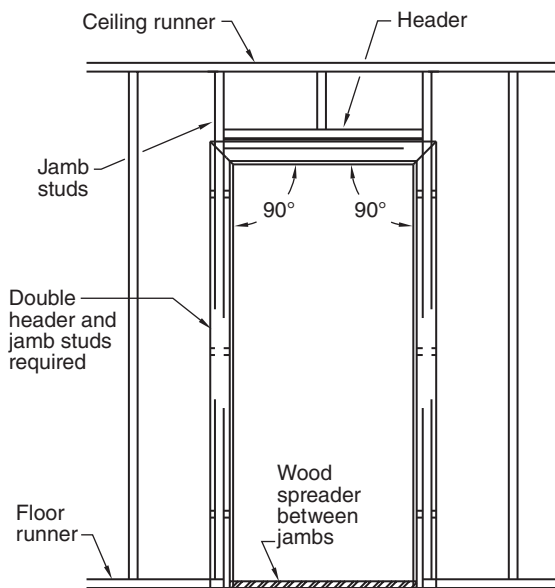
**9.6** Install jamb studs (jack stud and king stud) butted tightly against anchors and properly positioned in frame throat for wallboard (see Figure 18).

**9.6.1** Attach header stud(s) or header assembly between jamb studs making sure they are above the frame head. This will assure ample

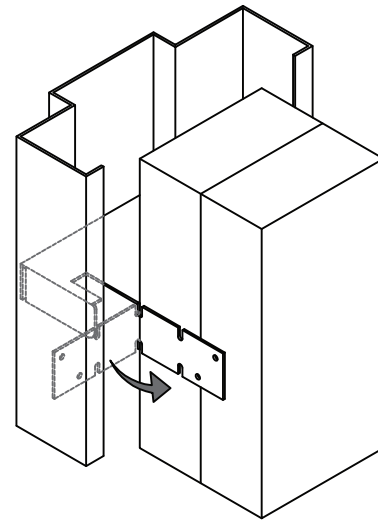
room for attaching plaster lath or drywall and will not interfere with installation of hardware attached to frame head (see Figure 18).

**9.7** Bend anchor straps around stud leaving sufficient clearance between frame return and stud for inserting finished wall material (see Figure 19, Figure 20 and Figure 21).

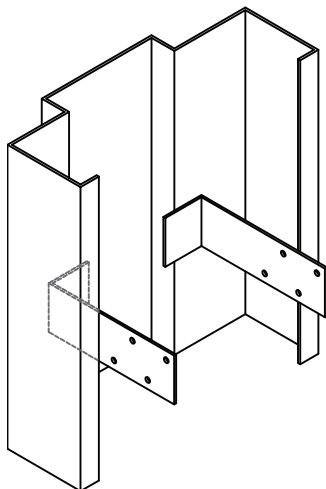
**9.7.1** If there is insufficient room for wall finish, notch jamb studs no more than  $\frac{1}{16}$ " (1.6 mm) deep for anchor straps.



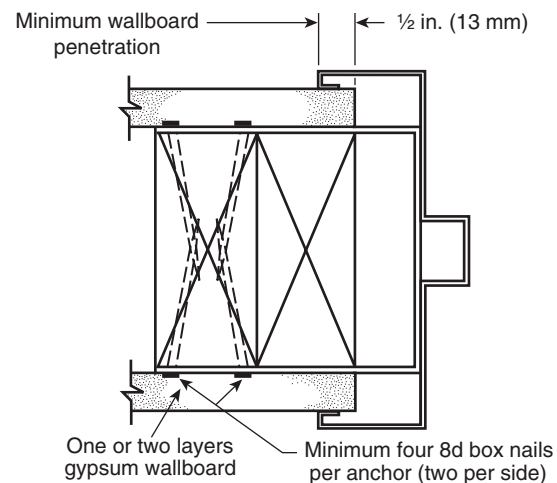
**Figure 18 – Wood stud wall construction**



**Figure 20 – Snap or weld in anchors wood/steel studs**

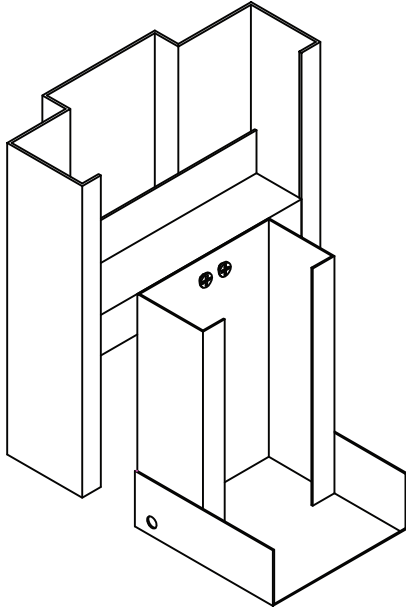


**Figure 19 – Weld in strap anchors wood/steel studs**



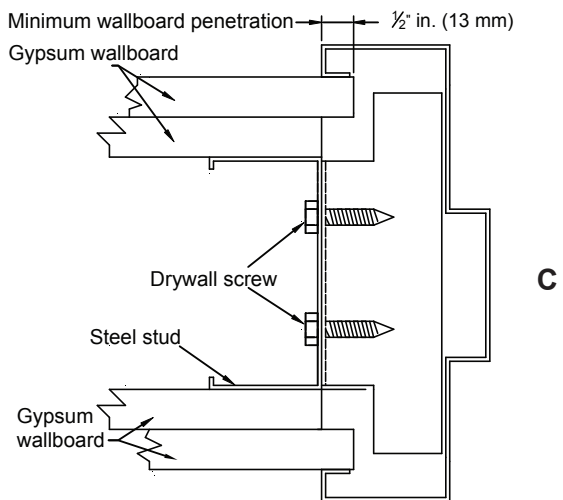
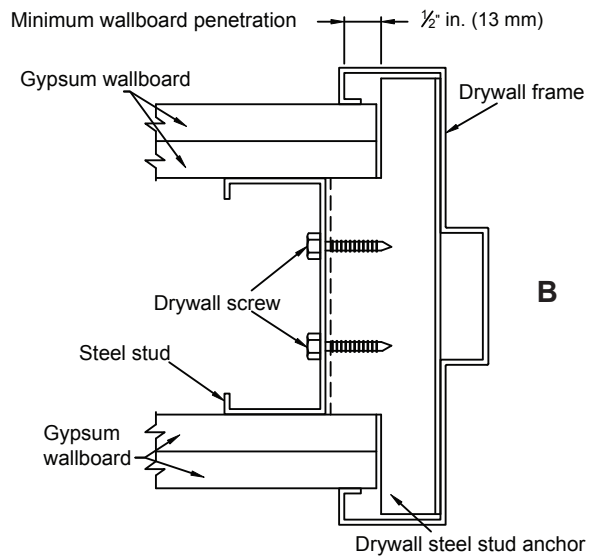
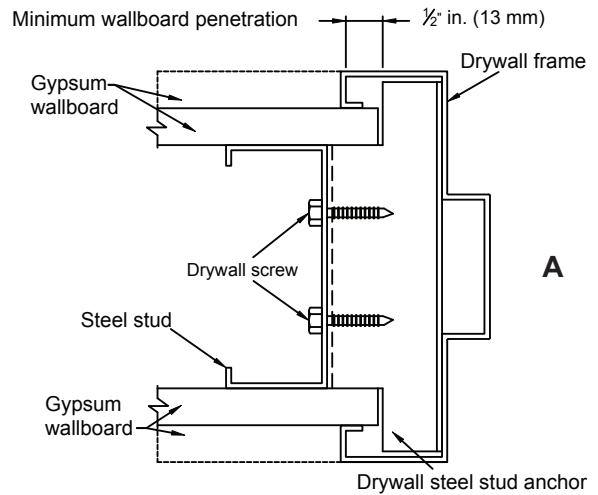
**Figure 21 – Hollow metal steel door frame with wood stud anchors**

**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 22).



**Figure 22 – Z Type weld in anchors steel studs**

**9.8.1** At wrap-around installations in fire-rated walls, at least one layer of drywall on each side shall extend a minimum of  $\frac{1}{2}$ " (12.7 mm) into the frame throat. See Figure 23-A, B and C.

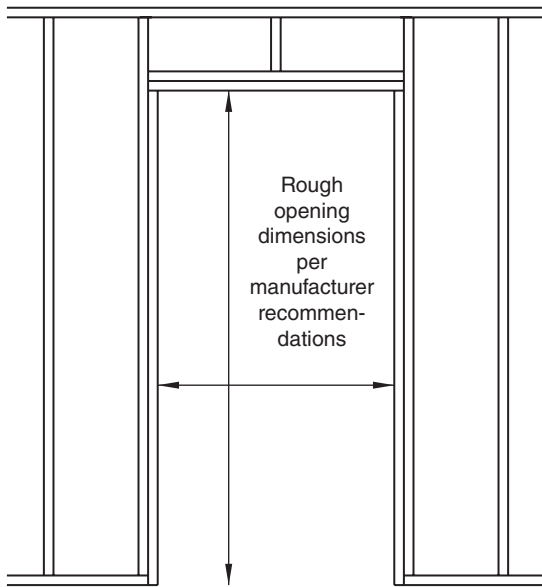


**Figure 23 – Hollow metal door frame with steel stud anchors**

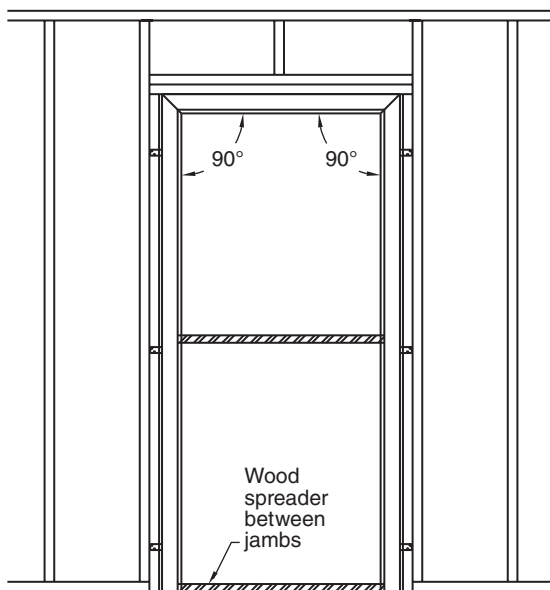


## 10 Wood/steel stud construction (studs erected before frame)

**10.1** Build rough opening (see Figure 24) according to dimensions and clearances in frame manufacturer's installation instructions.



**Figure 24 – Rough opening shown in wood stud**



**Figure 25 – 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.

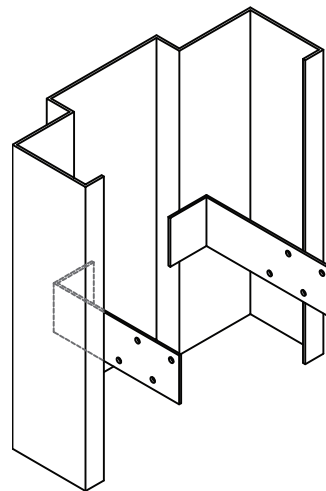
**10.3.2** If base anchors cannot be used add one anchor per jamb at bottom.

**10.3.3** Install fire-rated frames with the anchor quantity and spacing as per the individual manufacturer's listings and instructions.

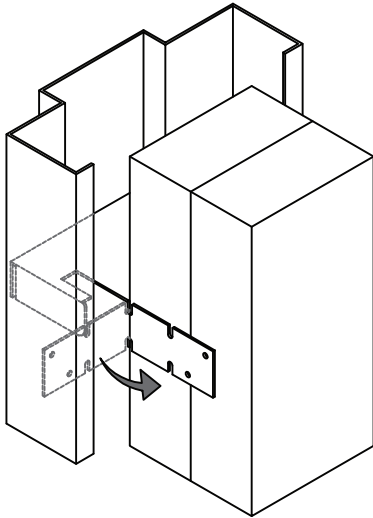
**10.4** Slide frame into wall opening.

**10.4.1** Install wood spreaders at bottom and mid-height. Square and level frame. Shim jambs if necessary (see Figure 25).

**10.5** Bend anchor straps around stud leaving sufficient clearance between frame return and stud for inserting finished wall material (see Figure 26 and Figure 27).

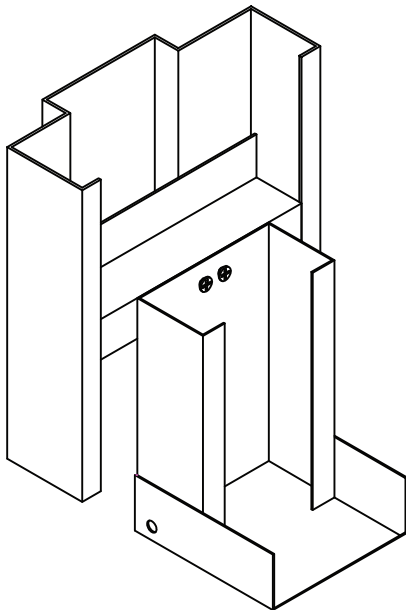


**Figure 26 – Weld in strap anchors wood/steel studs**



**Figure 27 – 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 28).

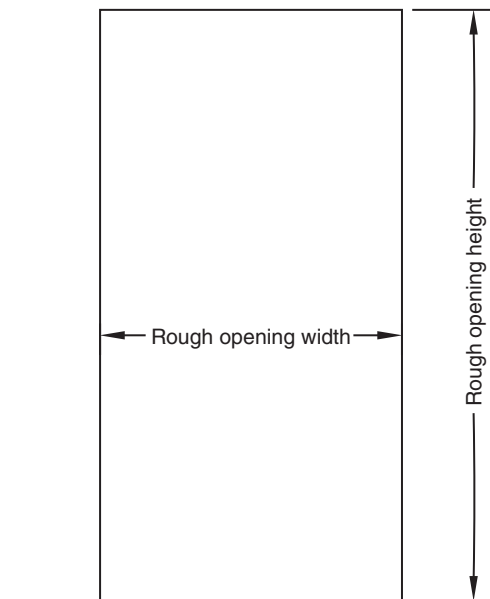


**Figure 28 – Z Type weld in anchors steel studs**

**10.6.1** NOTE: At wrap-around installations in fire-rated walls, at least one layer of drywall on each side shall extend at least ½" (12.7 mm) into frame throat. See Section 12 for frame installations in butted or existing stud walls. See Figure 23-A, B and C.

## 11 Slip-on drywall

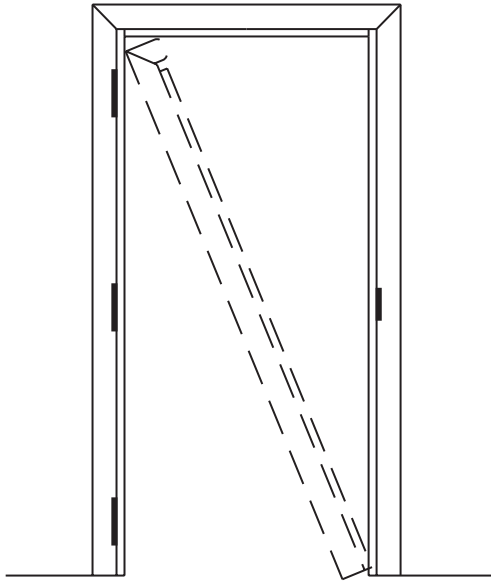
**11.1** Prepare rough opening (see Figure 29) per frame manufacturer's recommendations.



**Figure 29 – Rough opening per manufacturer 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.

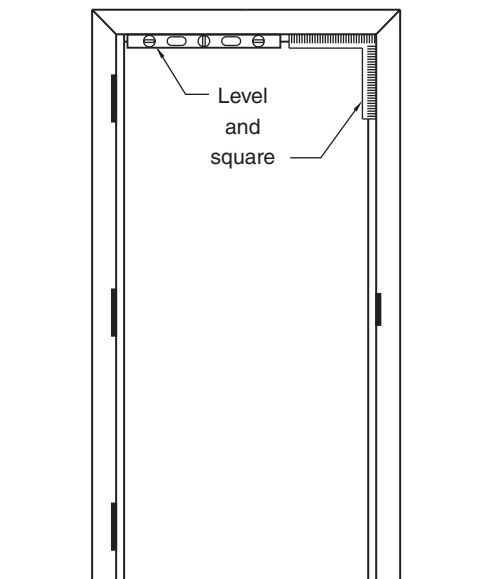


**Figure 30 – Align corner gussets**

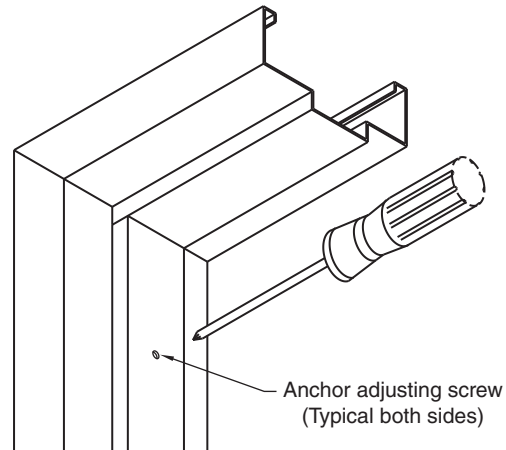
**11.3** Install jambs and header onto wall per manufacturer's instructions, taking care to align corner gussets (if so equipped). See Figure 30.

**11.4** Level and square frame (see Figure 31).

**11.4.1** Install wood spreaders.



**Figure 31 – Level and square frame**



**Figure 32 – Anchor adjusting screw**

**11.5** Turn adjusting screws hand tight (DO NOT USE SCREW GUN) until compression anchor contacts jamb studs (see Figure 32).

**11.6** Re-check level and square. Adjust using anchor screws as needed.

**11.7** Fasten base anchors to wall stud (see Figure 33) or fasten to wall studs through prepared holes in face of jambs at bottom.

## **12 Butted or Existing Steel or Wood Stud Wall Construction**

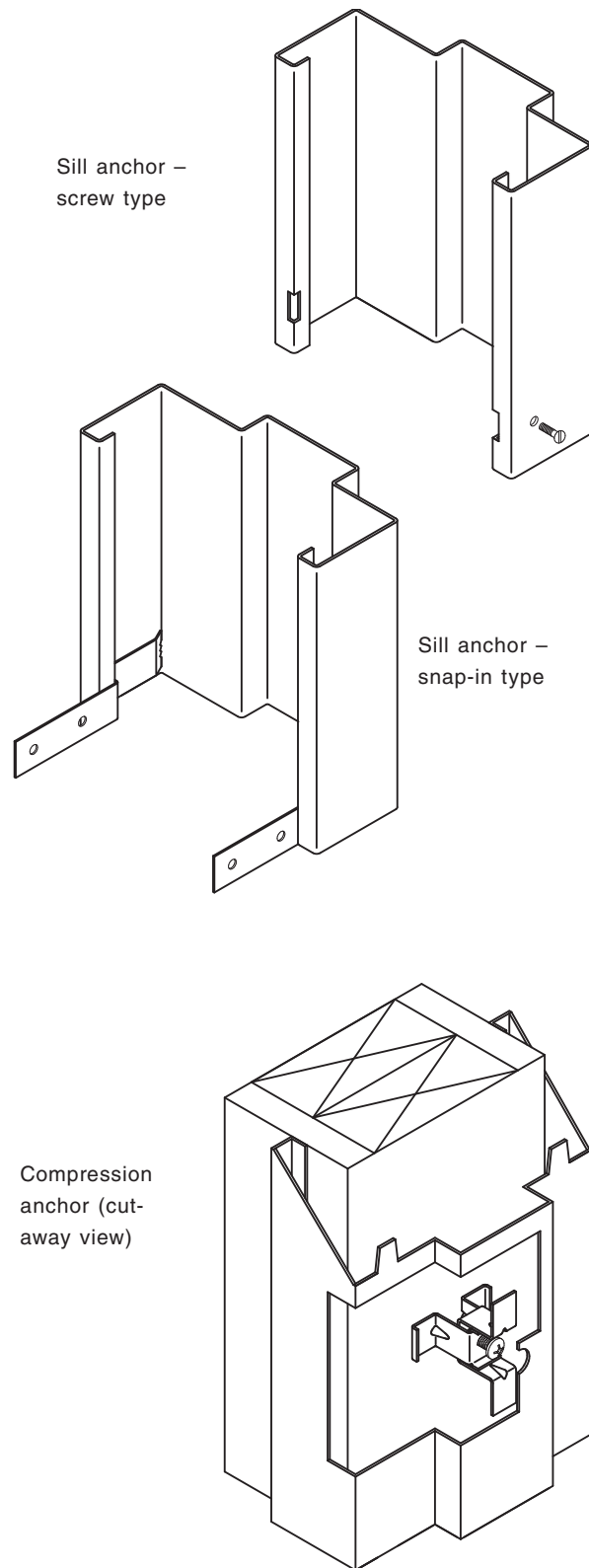
**12.1** Historically, frames installed in fire-rated stud walls required frames to wrap around the wall and drywall must extend at least  $\frac{1}{2}$ " (12.7 mm) into frame throat. Fire testing has confirmed that fire door frames will perform satisfactorily to the acceptance criteria of UL 10C under positive pressure when butted to new or existing stud and drywall construction (see Figure 34 and Figure 35).

**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



**Figure 33 – Fasten base anchors to wall stud**

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 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.

**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 34 and Figure 35) 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.

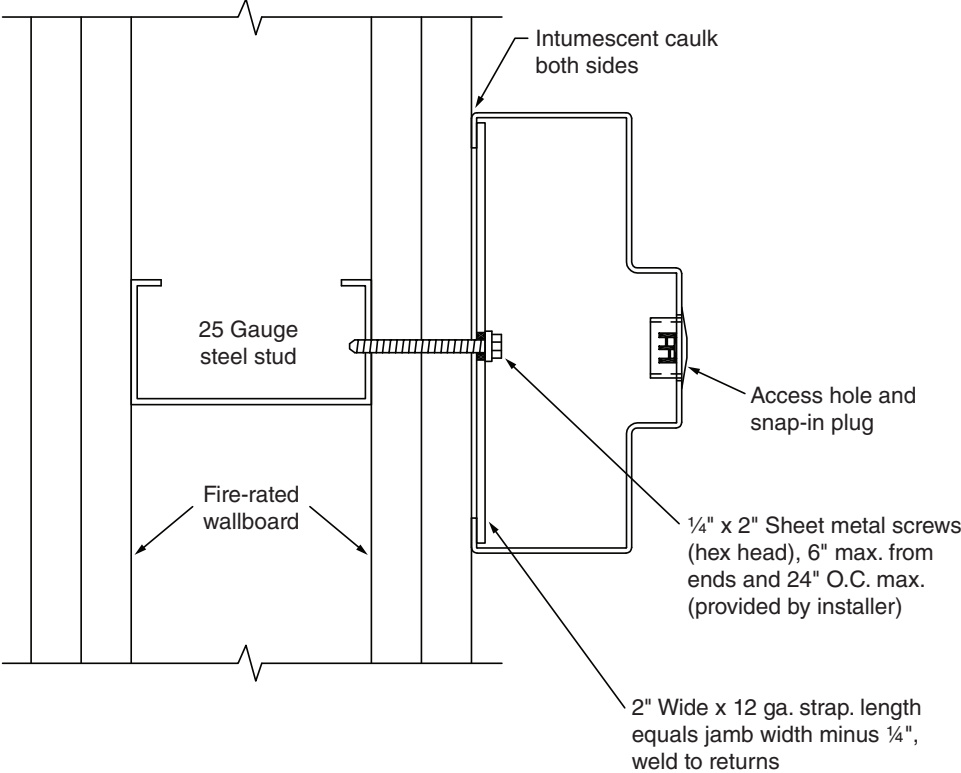


Figure 34 – Hole plug mount

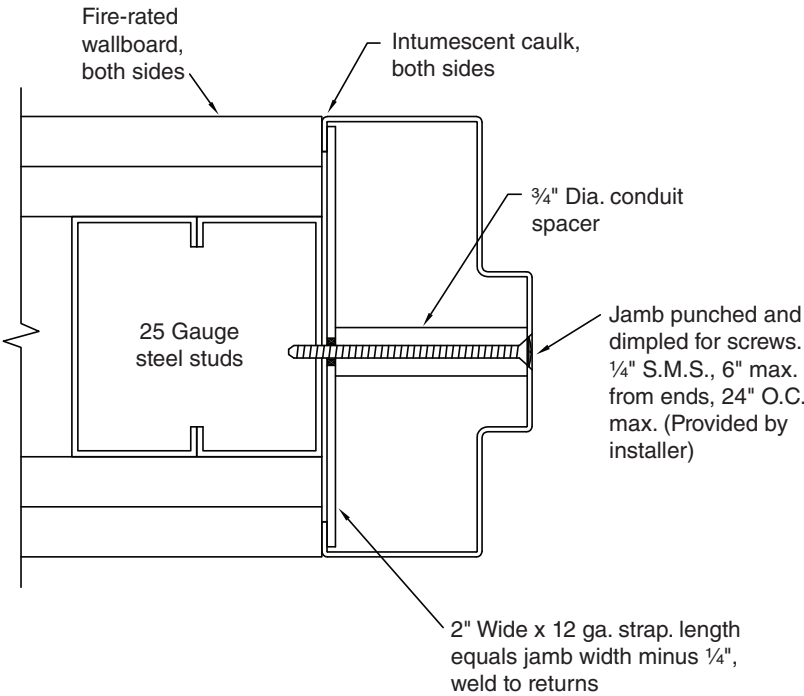


Figure 35 – Countersink mount

## Annex A (informative)

### Manufacturing Tolerances for Standard Steel Doors and Frames

#### A1 Introduction

It is the intent of this annex 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*. See also SDI 112, *Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames*. The two most commonly used are designations A40 and A60. Minimum requirements for these designations are:

A40= 0.40 oz/ft<sup>2</sup> total both sides.

A60= 0.60 oz/ft<sup>2</sup> total both sides.

For reference, 1 oz/ft<sup>2</sup> = 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.

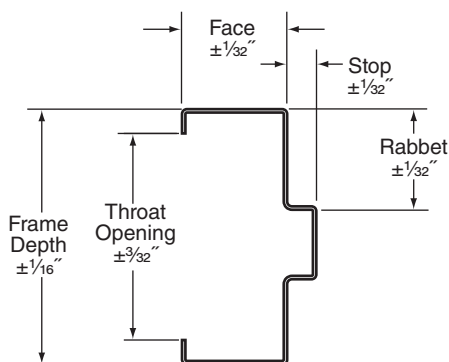


Figure A – Profile Tolerances

### A4.2 Frame Opening & Vertical Locations

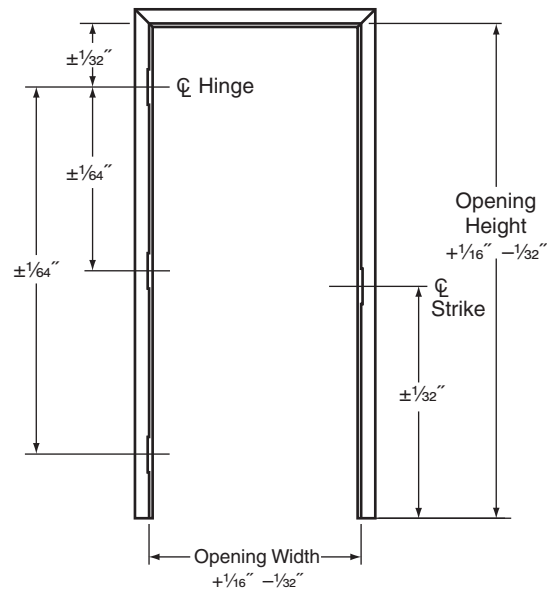


Figure B – Opening Tolerances

### 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.

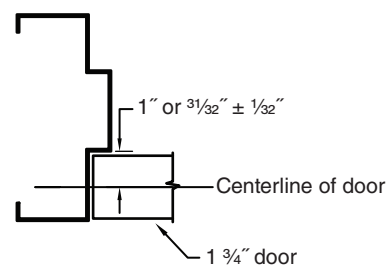


Figure C – Horizontal Alignment

#### A4.5 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).

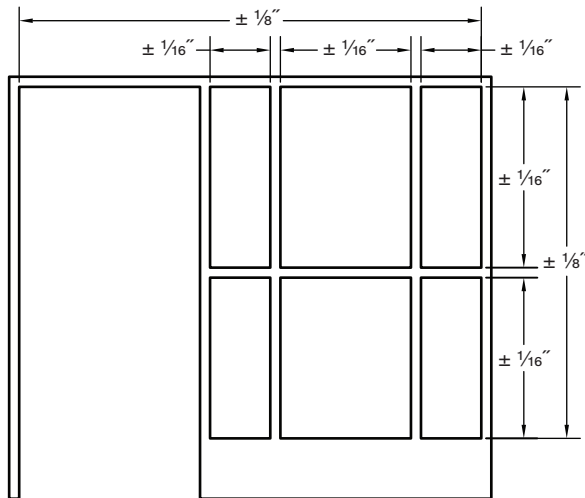


Figure D – Frames with Lights or Panels

### A5 Door Tolerances

#### A5.1 Door Size, Thickness, and Vertical Locations (see Figure E)

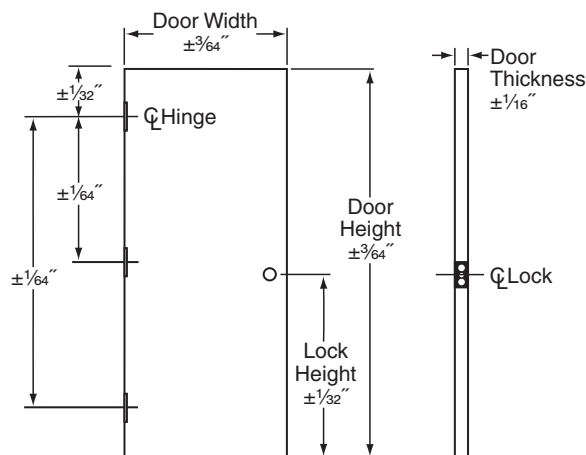


Figure E – Doors

#### 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.

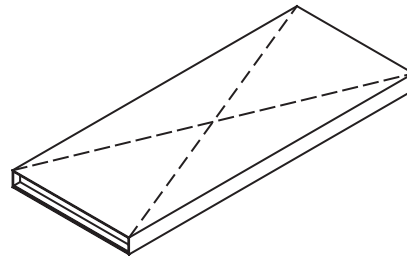


Figure F – Squareness

#### A5.3 Door Perimeter Flatness

When a 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.

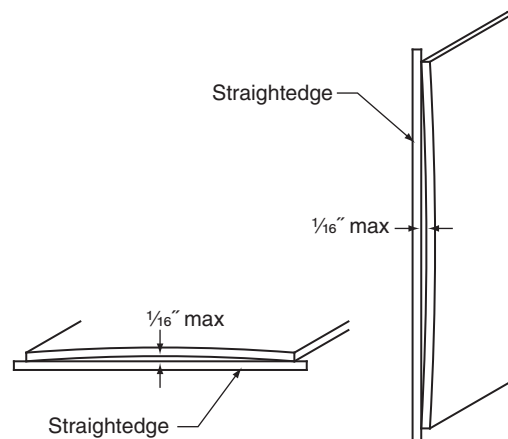


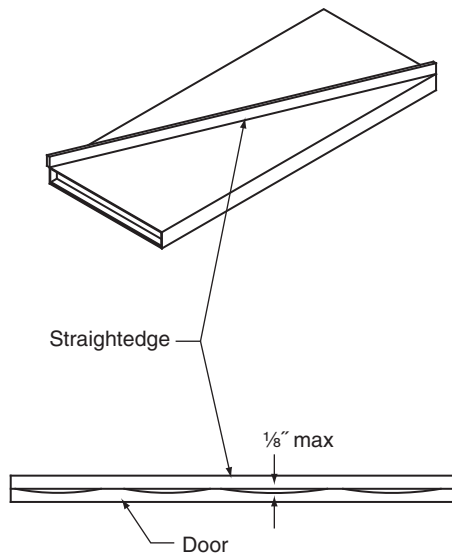
Figure G – Flatness

#### A5.4 Door Face Bow or Crown

When a 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  $\pm 1/16$ " 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**

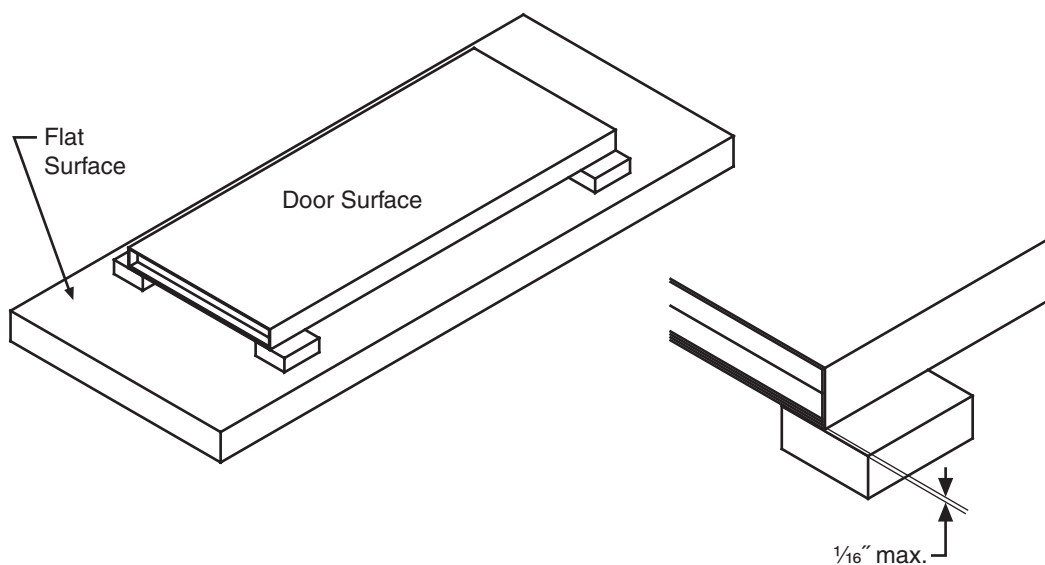
Tolerances for horizontal alignment of door and rabbet are as noted in Paragraphs 4.4.

#### **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  $\pm 1/64$ ".

##### **A6.3.1 Cutout Depth at Frame or Door Faces**

In order to allow for field adjustment, usually accomplished by shimming, hardware cutouts



**Figure I – Door Twist**

(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  $\frac{1}{16}$ ". 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. 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 strike jamb.

**A7.1.2** Figure K shows how to relocate the pivot point away from the strike jamb.

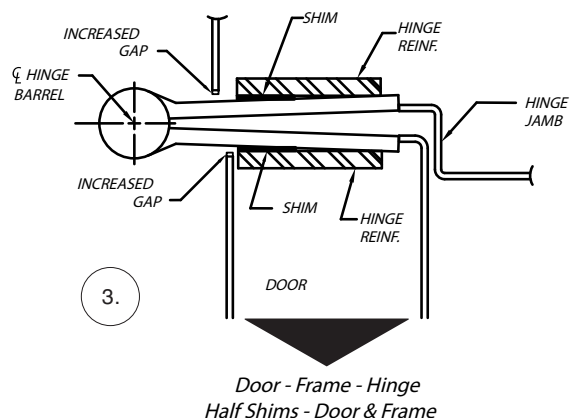
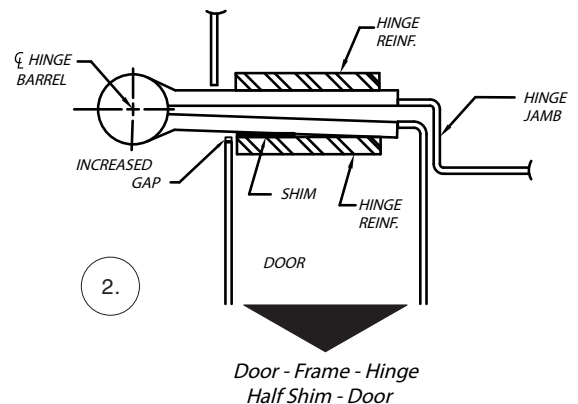
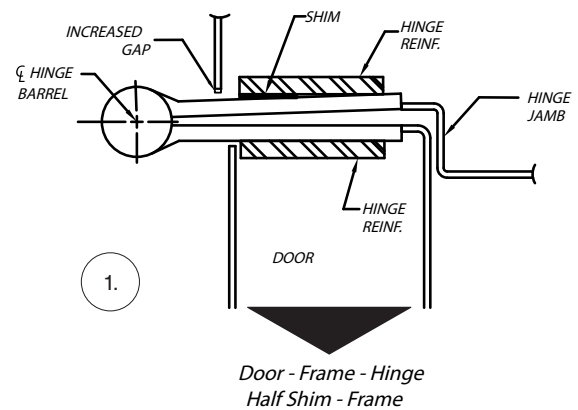
### A7.2 Frame Installation Tolerances

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.

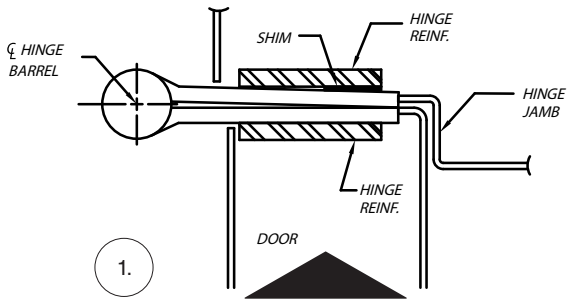
### A7.3 Troubleshooting

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

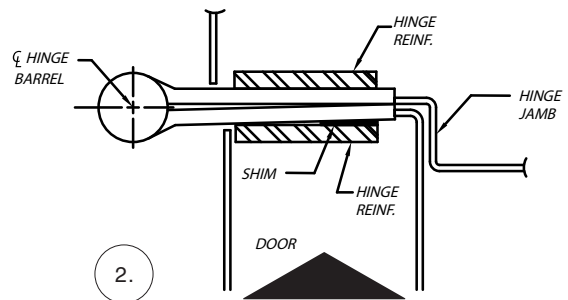


This method will move door toward Strike jamb. It will leave a small gap between Hinge and frame face. It will also help if hinge bind is occurring.

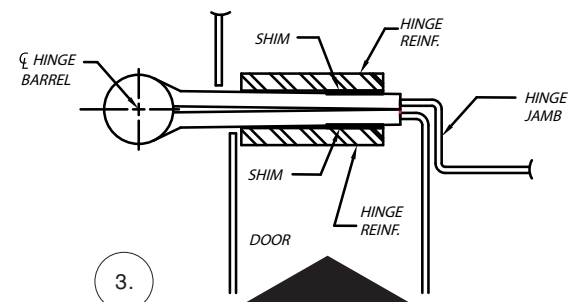
**Figure J – Hinge Bind**



Door - Frame - Hinge  
Half Shim - Frame



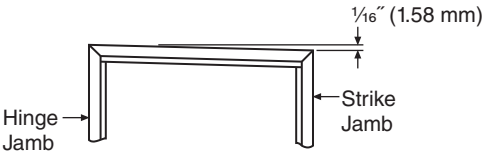
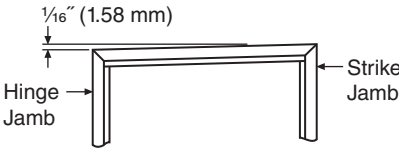
Door - Frame - Hinge  
Half Shim - Door



Door - Frame - Hinge  
Half Shims - Door & Frame

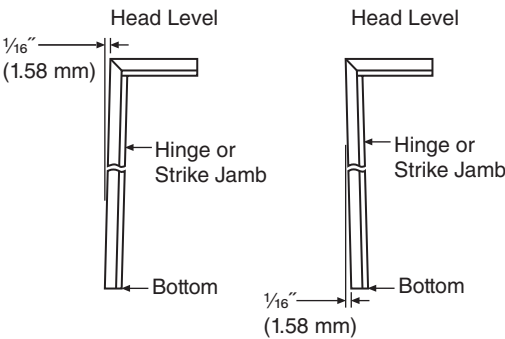
This method will pull door toward Hinge jamb. It may create hinge bind.

**Figure K – Hinge Bind**

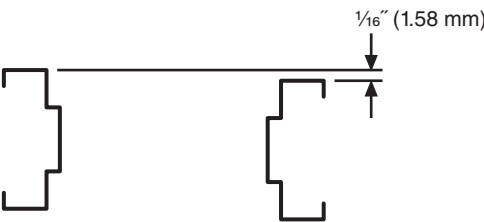


Maximum 1/16" allowable tolerance on total opening.

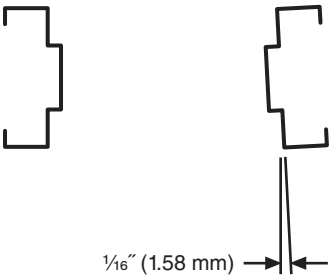
**Figure L – Squareness**



**Figure M – Plumbness**



**Figure N – Alignment**



**Figure O – Twist**

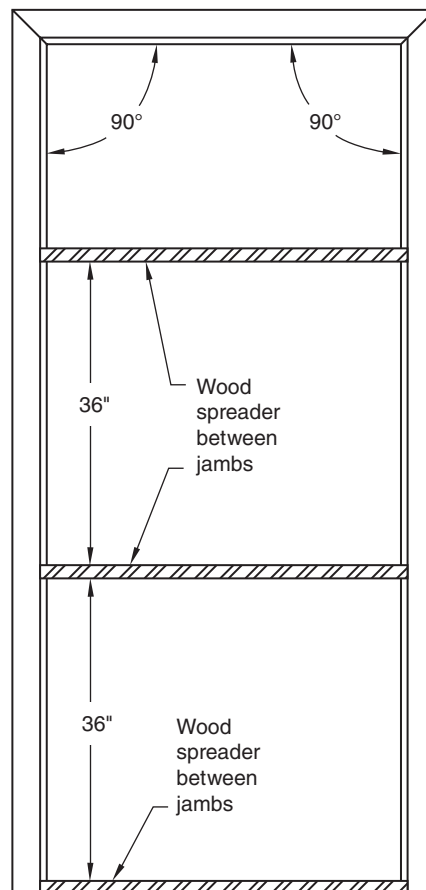
## Annex B (informative)

### For Installation

The installation instructions contained in ANSI/SDI 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 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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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*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)*



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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)**

Secretariat

**Steel Door Institute**

Approved February 25, 2014

**American National Standards Institute, Inc.**



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ANSI A250.13-2014

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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:

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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 Institute of Architects .....	Joseph Berchenko
Architectural Testing .....	Dan Johnson
Builders Hardware Manufacturers Association .....	Mike Tierney
Canadian Steel Door Manufacturers Association .....	Bud Bulley
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Therma-Tru .....	Steve Jasperson
Underwriters Laboratories LLC.....	Luke Woods
Vetrotech Saint-Gobain.....	Christian Mueller

## 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.

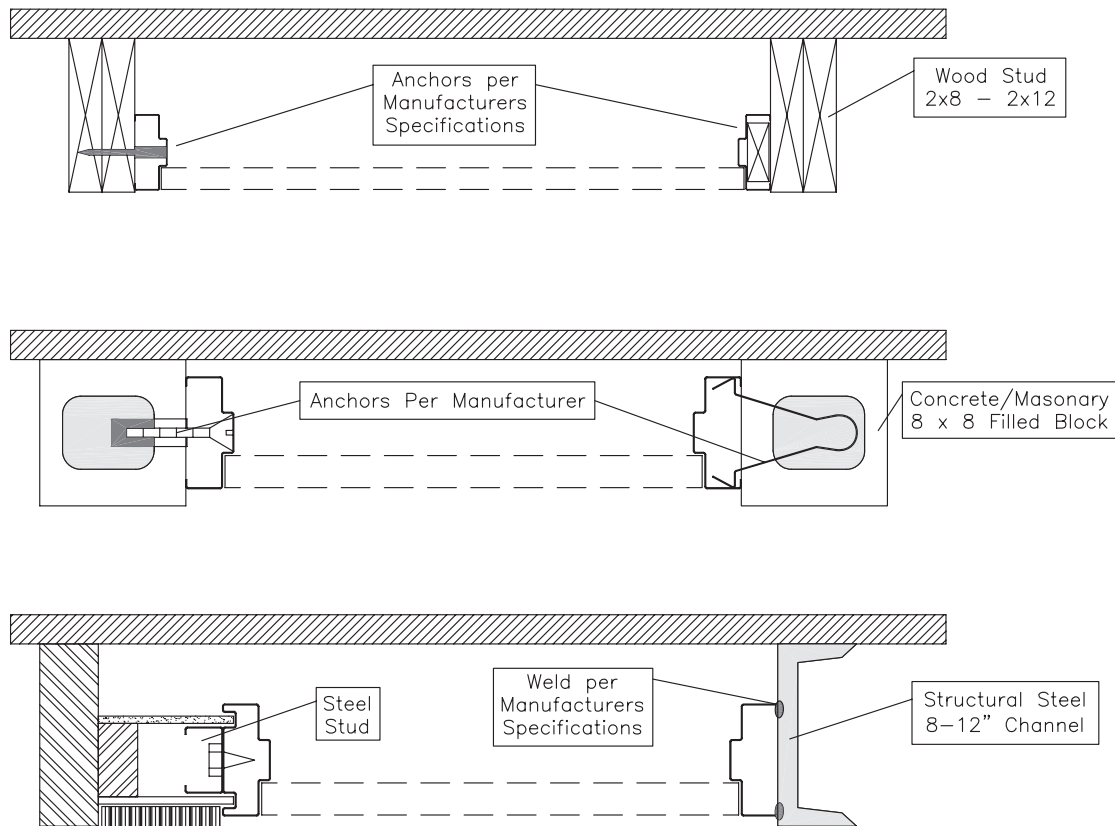
## 5.2 Test Procedure

### 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

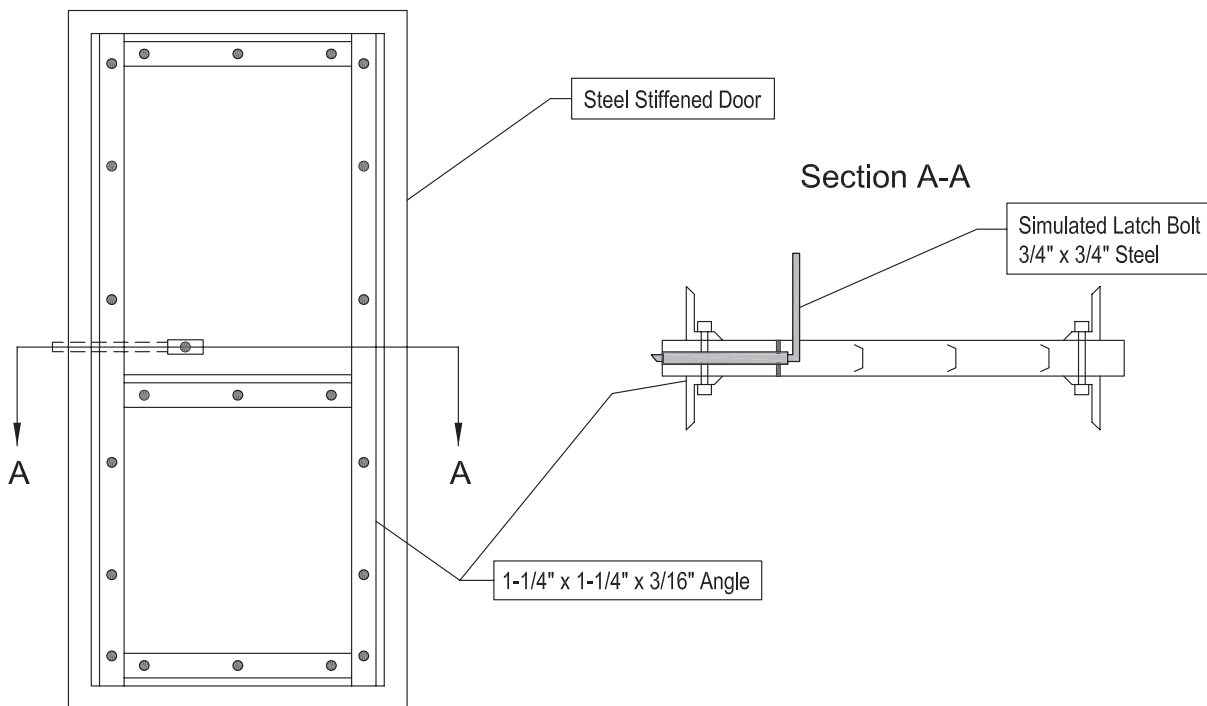
Six impacts in accordance with Figure 4.

**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

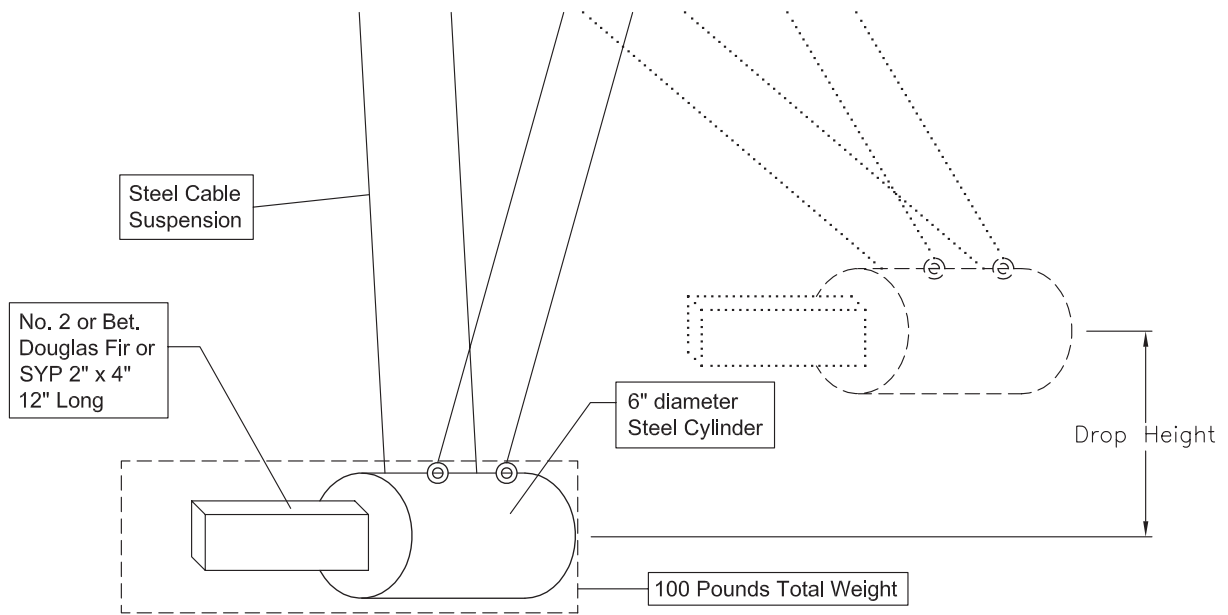
**5.3.1** Upon completion of the impact tests specified in 5.2, the same assembly shall be subjected to the pressure cycling test specified in ASTM E1886.

**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.

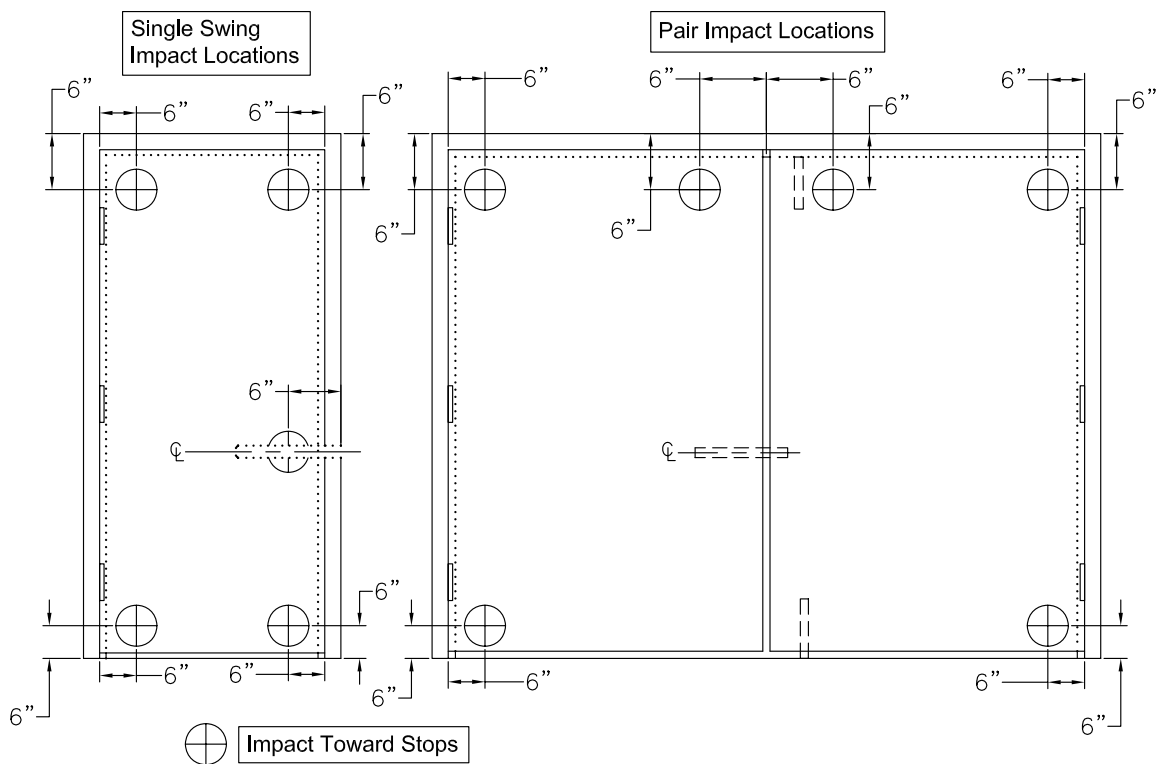


**Figure 2 – Door Reinforcement for Frame Tests**





**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.

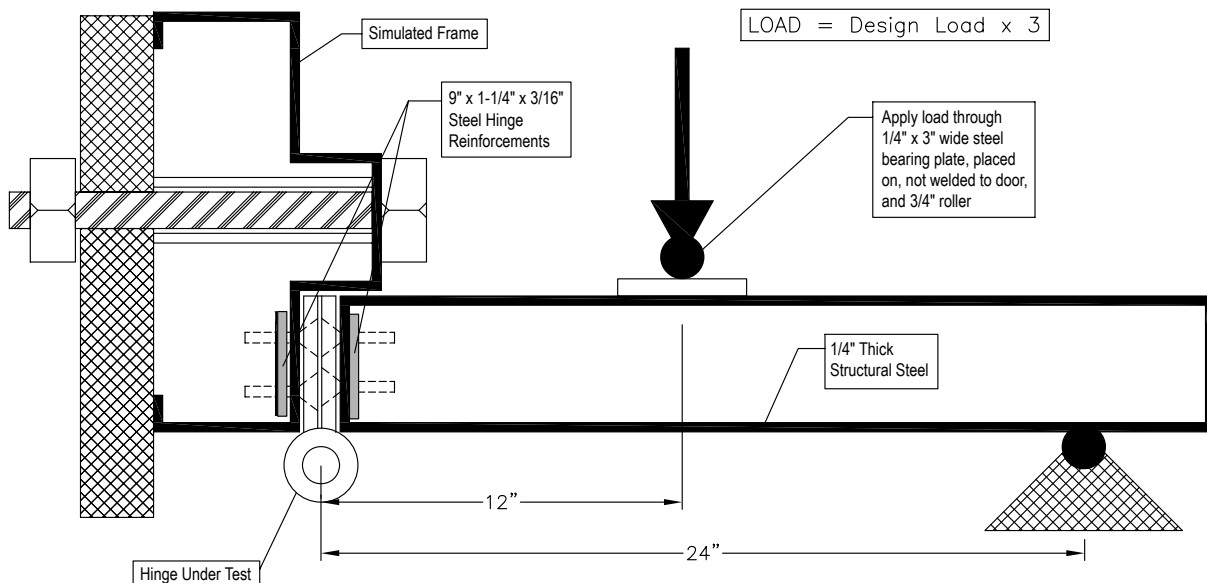
**NOTE:** Impact energy specified delivers approximately twice the energy to the hinge as occurs in a typical door assembly test using a 9 pound 2 x 4 missile at 50 feet-per-second.

#### 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.

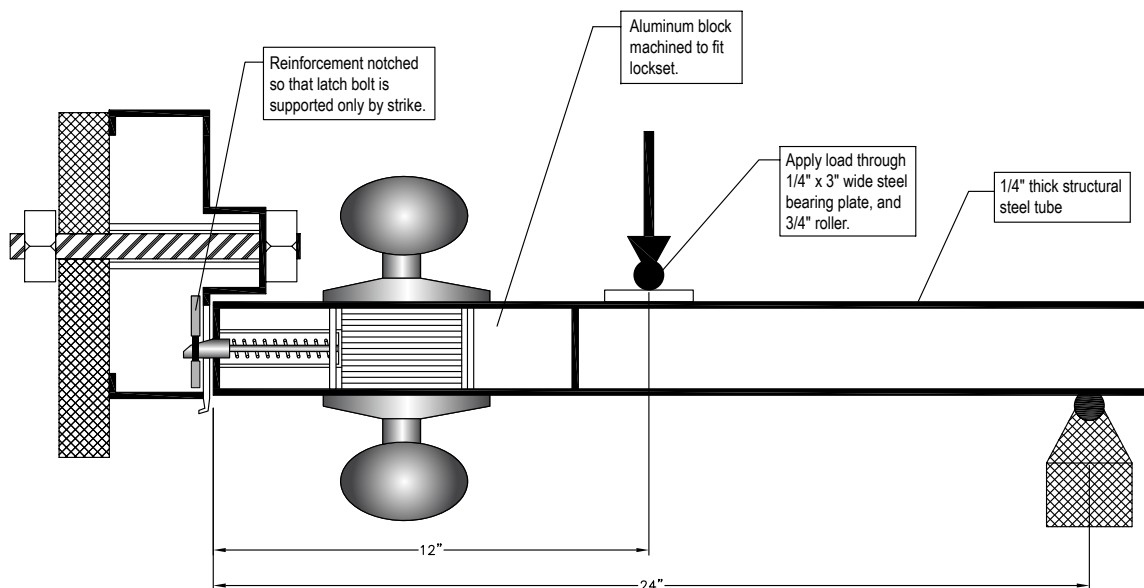


Figure 6 – Lockset Test Fixture

### 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.

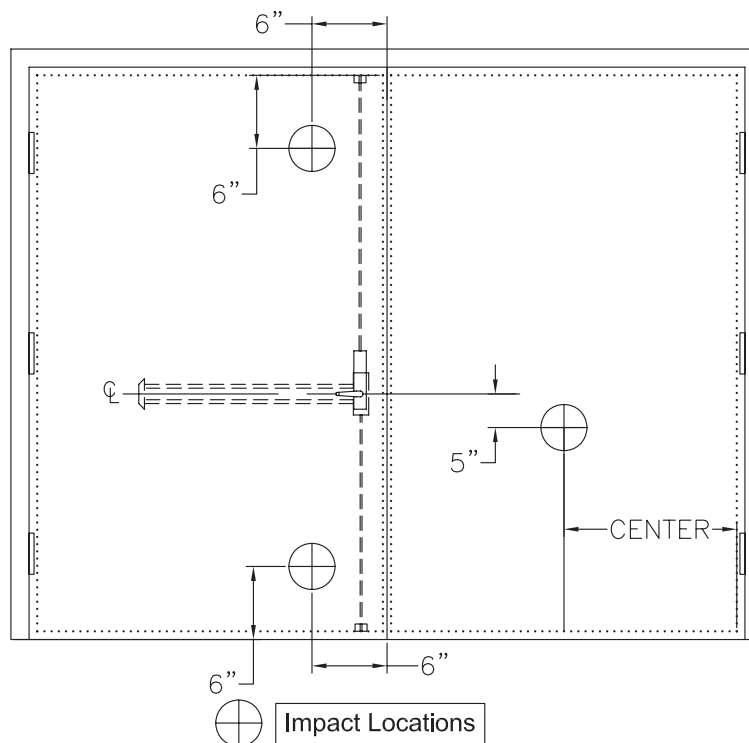
**7.3.2.2** When other hardware is being evaluated simultaneously with bolts (surface or flush type) to increase the overall rating, then a fourth impact is to be made at the centerline of the other hardware and 6 inches from the meeting door edge.

**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

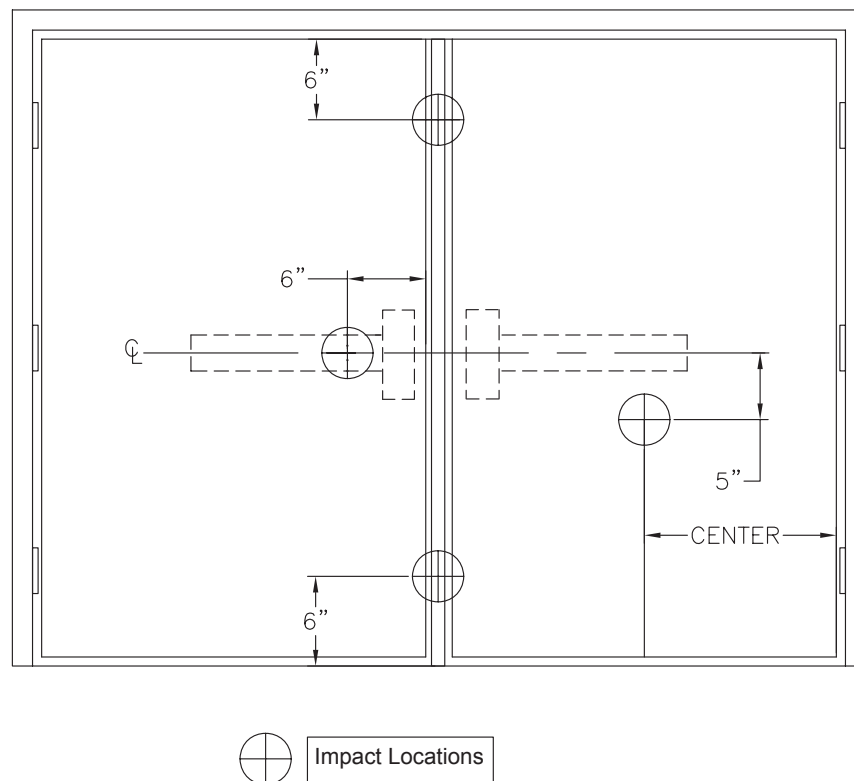


Figure 8 – Impact Locations for Center Mullion Test

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- <sup>5</sup> / <sub>16</sub>	in	± <sup>1</sup> / <sub>8</sub>	1024	mm	±3
1- <sup>1</sup> / <sub>4</sub>	in	± <sup>1</sup> / <sub>8</sub>	1024	mm	±3
<sup>3</sup> / <sub>16</sub>	in	± <sup>1</sup> / <sub>32</sub>	4.8	mm	±1
16	in	±1	406	mm	±25
6	in	±1	152	mm	±25
3	in	± <sup>1</sup> / <sub>8</sub>	76	mm	±3
15	lbf	±0.5	67	N	±2
1	in	± <sup>1</sup> / <sub>16</sub>	25	mm	±2
350	ft-lb	±3.5	475	N-M	±5
100	lb	±1	45.4	Kg	±0.5
12	in	± <sup>1</sup> / <sub>8</sub>	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)

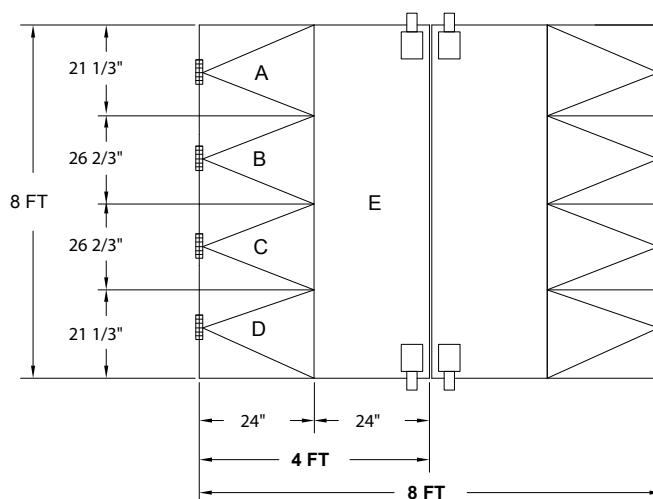
Frame: 14 ga. Pressed steel with  $\frac{5}{8}$  inch stops

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.**

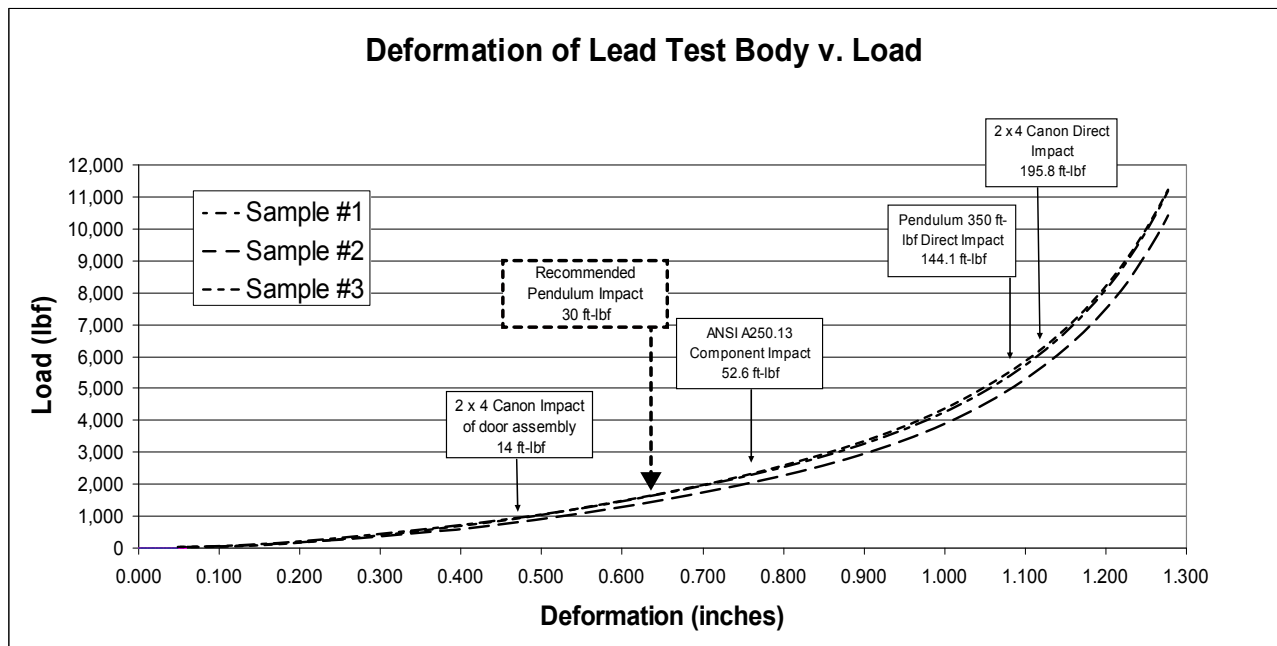


Chart 2 shows the relationship between the deformation and work for the specific test body used. The relationship is approximated mathematically as:

$$\text{Work} = 120 \times D^3 \text{ (ft-lbf)}$$

Where: D is the deformation in the test body in inches.

The  $R^2$  correlation coefficient is 0.99.

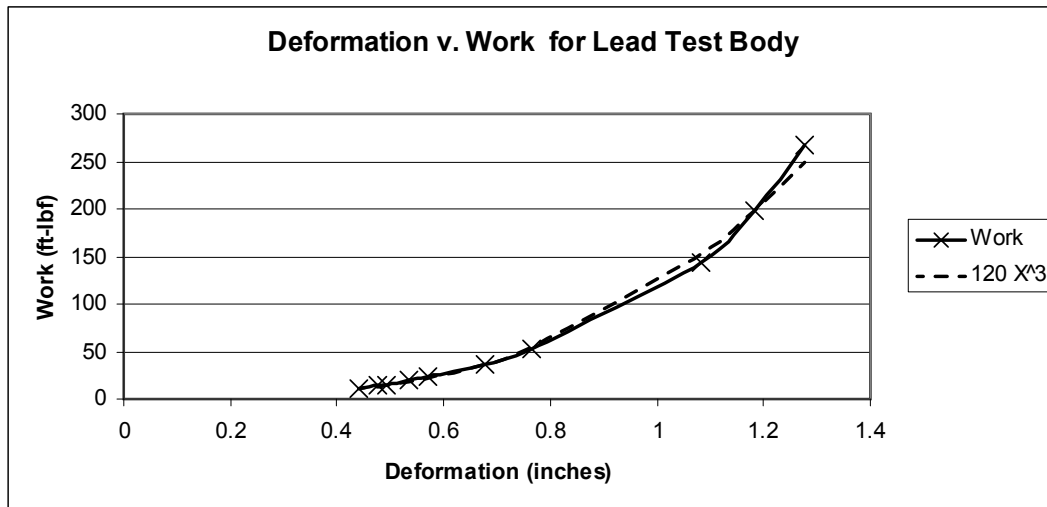


Table 1. shows the results of phase I through III of this experiment.

**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 1/4" 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.

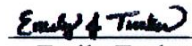
A nearly identical test is specified in ANSI A250.13 for leaf hinges and these results should apply equally to the hinge component test.

Tests Conducted By:

Reported By:

  
Jim Turgeson

  
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Rick Curkeet, PE

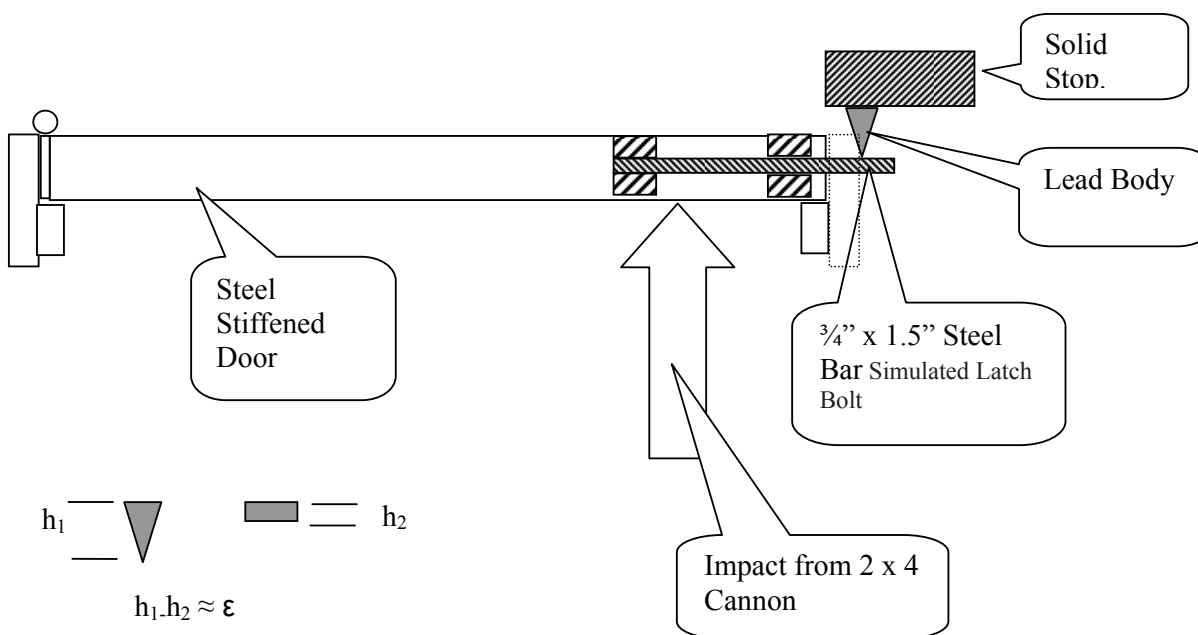
## Appendix I Experimental Design

### 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.



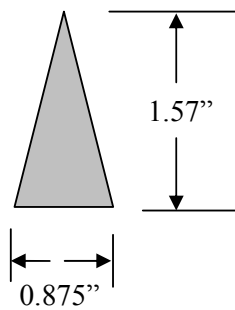
First phase is to run a series of tests using a door and the set-up as shown above to establish the effect of the standard test energy as transmitted to the test body.

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
- SDI-136** Guideline for Specifying Windstorm Products

### 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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*Hardware Preparation  
in Steel Doors and Steel Frames*

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Approved July 28, 2023





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American National Standard  
**Hardware Preparation in Steel Doors and Steel Frames**

Secretariat  
**Steel Door Institute**

Approved July 28, 2023  
**American National Standards Institute, Inc.**

# American National Standard

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Consensus is established when, in the judgement of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

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ANSI/SDI A250.14-2023

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## **Foreword** (This Foreword is not part of American National Standard A250.14-2023)

This Standard was first published by the Door and Hardware Institute in a series of individual standards for wood and steel doors, and designated as A115. In 2001, the Builders Hardware Manufacturers Association reactivated the Joint Door and Hardware Standards Committee for the purpose of updating and promulgating the ANSI A115 standards for steel doors and frames. The development of the BHMA standard - ANSI/BHMA A156.115 Hardware Preparation in Steel Doors and Steel Frames - was a joint effort by members of the Steel Door Institute, Window and Door Manufacturers Association, Door and Hardware Institute, Hollow Metal Manufacturers Association, Builders Hardware Manufacturers Association and the Canadian Steel Door Manufacturers Association. The effort was chaired by SDI Technical Committee member Allan Ashachik.

On March 24, 2020 BHMA forfeited the maintenance of ANSI/BHMA A156.115 to SDI's Accredited Standards Committee A250 via Project Initiation Notification (PINS) form submitted to and approved by ANSI. It has since been revised and published by SDI in 2023 and is now designated as ANSI A250.14. 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:

A250 Accredited Standards Committee  
Builders Hardware Manufacturers Association  
Canadian Steel Door Manufacturers Association  
Cedar Valley Associates  
D.H. Pace Company  
Door Control Services  
ESTM Technical Services, LLC  
HMMA/Division of NAAMM  
Intertek  
MasterSpec  
Ray and Associates  
Steel Door Institute  
UL Solutions  
Vetrotech/Saint-Gobain

The Technical Committee of the Steel Door Institute, which developed this standard, had the following personnel at the time of approval:

Craig Ordmandy, *Chairman*  
J. Jeffery Wherry, *Manager*

<i>Organization Represented</i>	<i>Name of Representative</i>
Allegion.....	Tim Weller
Builders Hardware Institute.....	Michael Tierney
Canadian Steel Door Manufacturers Association .....	Mike van Geyn
Ceco Door Products .....	Dwayne Charlton
Cedar Valley Associates .....	Stan Horsfall
Curries Company.....	David Bill
Deansteel .....	Claus Heide
De La Fontaine Industries, Inc.....	René Bouchard
DCI .....	Henry Ray
D.H. Pace.....	Jerry Rice
Door Control Services .....	Craig Ordmandy
ESTM Technical Services, LLC .....	Michael Kolovich
Hollow Metal Xpress (HMX).....	Adam Matusz
HMMA/Division of NAAMM.....	Russell Tauscher
Intertek.....	Justin Hendricks
MasterSpec .....	Rick Howard
Mesker Door.....	Mike Mehaffy
MPI .....	David McConnell
Pioneer Industries .....	Kamal Sheikh
Premier Steel Doors & Frames .....	Joey Meggs
Ray and Associates .....	Ron Ray
Republic Doors and Frames .....	Marilyn Latham
Steel Door Institute .....	J. Jeffery Wherry
Stiles Custom Metal.....	Steve Stiles
UL Solutions .....	Michael Nicasio
Vetrotech/Saint-Gobain.....	Kevin Norcross

## American National Standard

## Hardware Preparation in Steel Doors and Steel Frames

**1. Scope and Purpose**

**1.1** This standard covers all significant dimensional attributes for mounting common hardware products in steel doors and frames. All dimensions shall be as shown on the accompanying drawings.

**1.2** This standard was developed to show only the most commonly used preparations for door hardware, and provide targets for standardization. Where multiple configurations are in common usage, separate drawings are provided. For other configurations, it is recognized that these standards may be used in part, or with exceptions, while still providing some degree of basic guidance and standardization.

**2. General Requirements**

**2.1** Preparations covered by this standard are intended for use in doors 1-3/4 inches and 1-3/8 inches in thickness unless otherwise specified.

**2.2** The center line of the lock in the door shall be located in reference to the center line of its strike.

**2.3** Location of operable parts in accessible openings shall be between 34 and 48 inches unless otherwise specified. Consult local building codes and Authority Having Jurisdiction for exceptions.

**2.4** Door Edge - Doors shall be furnished with a beveled lock edge unless otherwise specified.

**2.5** Door Reinforcement - Doors shall be reinforced to support the requirements of the hardware application.

**2.6** Tolerances for preparations are shown on individual drawings.

**3. Definitions**

**3.1 Bored Locks** Bored lock is used herein to designate locks having cylindrical shaped bodies which are mounted in holes bored in the door.

**3.2 Dead-latch** A spring-bolt latch in which the bolt is deadlocked against end pressure but may be retracted by either the knob or key.

**3.3 Door Edge** The vertical surfaces of a door to which hinges, locking or latching hardware is attached.

**3.4 Beveled Edged** A vertical door edge having a 1/8" in 2" slope from a plane perpendicular to the pull-side face of the door.

**3.5 Door Face** Surface of the door exposed to view when the door is closed.

**3.6 Face Cut Out** A piercing of the door face for hardware, lites, louvers or accessories.

**3.7 Flush Bolt** A locking device for the inactive leaf of a pair of doors that latches and unlatches either automatically or manually

**3.8 Frame** Frame is that portion of an opening which gives a finished appearance to a cutout in a wall and provides a square and plumb opening on which to hang a door.

**3.9 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.

**3.10 Head** Horizontal frame member atop of opening or top of transom frame.

**3.11 Hinge Face** That face of the door viewed when observing the hinge knuckles on the door and frame.



**3.12 Interconnected Lock** A mechanically interconnected locking mechanism having a separate latch bolt or dead locking latch bolt and dead bolt designed for installation in round bored openings in the edge and face of a door.

**3.13 Junction Box** A metal cover provided to allow for the connection or termination of electrified hardware component wiring.

**3.14 Lock Backset** The horizontal distance from the door edge centerline measured at the door thickness, to the centerline of the lock hub or cylinder.

**3.15 Lock Case** The main body of a mortise lock containing the working mechanism which operates the latch bolt and deadbolt.

**3.16 Lock Front** A plate fastened to the edge of a door through which the bolt(s) pass.

**3.17 Strike** A mortised or surface mounted plate fastened to the door frame into which the bolts project.

**3.18 Lock Support** Component inside the door used to keep the hardware in alignment.

**3.19 Mortise Lock** A lock or latch fitting into a mortised cavity prepared in the edge of a door. The bolts are operated by knobs, levers, turns, thumb pieces, paddles or cylinders engaging the mortise lock or latch through holes prepared in the faces of the door.

**3.20 Open Back Strike** A lock strike for use on pairs of doors permitting the inactive leaf to be opened or closed independently, eliminating the need for an astragal or coordinator.

**3.21 Preassembled Lock** A lock fitting into a notched cutout in a door.

**3.22 Reinforcement** Additional door material which provides structural support for hardware.

**3.23 Square Edged Doors** The lock and hinge edge of the door is 90 degrees to the face of the door. Also called Universal Edged Doors.

**3.24 Stop Face** That side of a door viewed when observing the stop side of a frame.

## 4. SDI Document Disclaimers

### 4.1 Tolerances

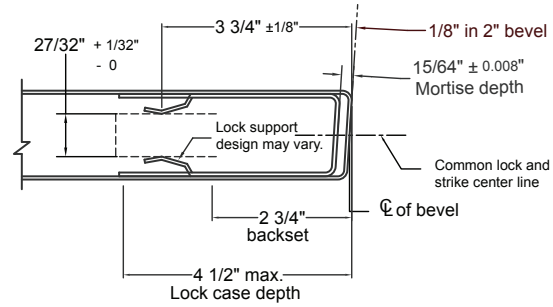
All values which do not carry specific tolerances or are not marked maximum or minimum shall have the following tolerances: Linear dimensions shall be  $\pm 1/16$  inches. Weight or force shall be  $\pm 2\%$ . Angles shall be  $\pm 2$  degrees. Where only minus tolerances are given, the dimensions are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

### 4.2 Gauge vs. Thickness

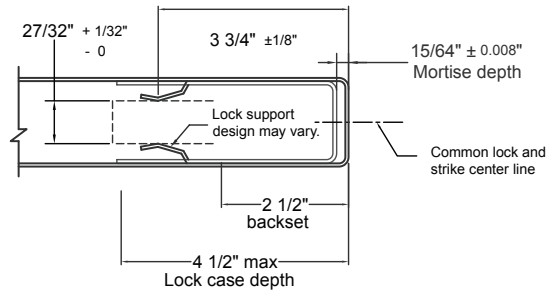
While the term 'gauge' is no longer common for defining material thickness it is still used to specify doors and frames for ordering purposes. The term 'thickness' is used when defining the actual dimension of an item, and the term 'gauge' is used in the context of specifying a particular door or frame.

### 4.3 Drawing

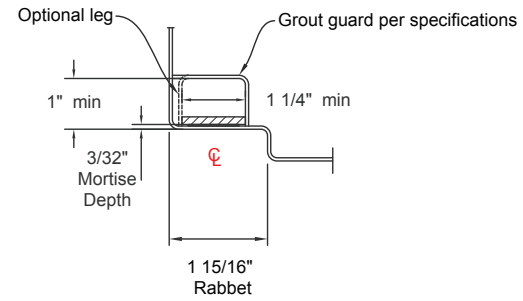
It is recommended that the individual manufacturer's specifications be reviewed to confirm compliance with these drawings.



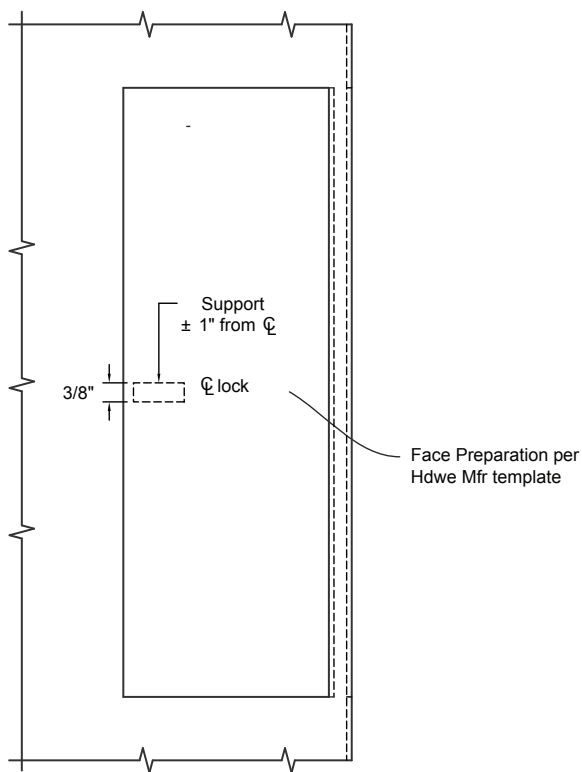
Beveled Edge - 1/8" in 2"



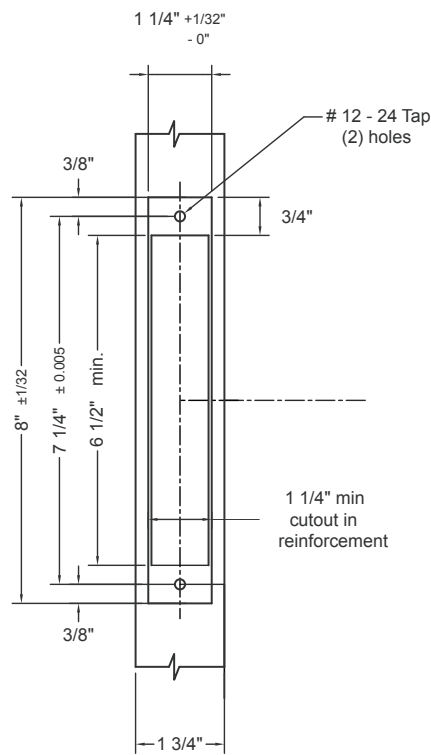
Square Edge



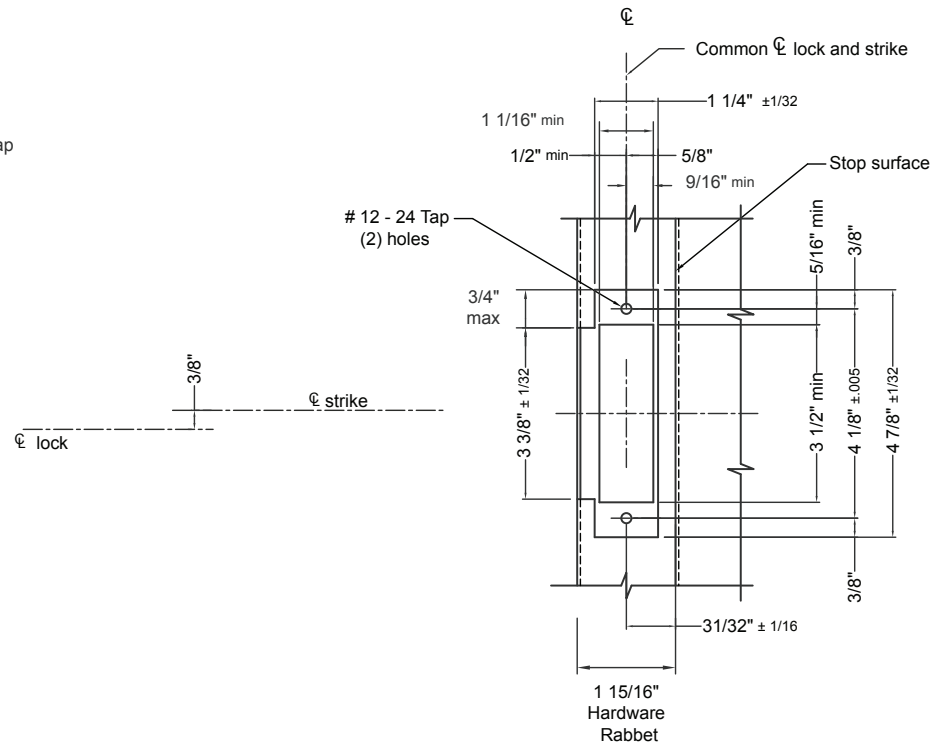
Frame Section



Door Face



Door Edge



Frame Rabbet

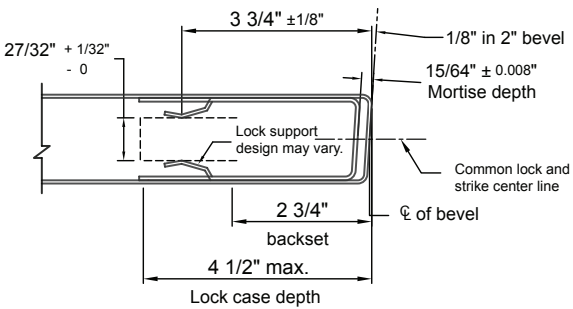
Preparation of 1-3/4" Steel Doors and Steel Frames for Mortise Locks



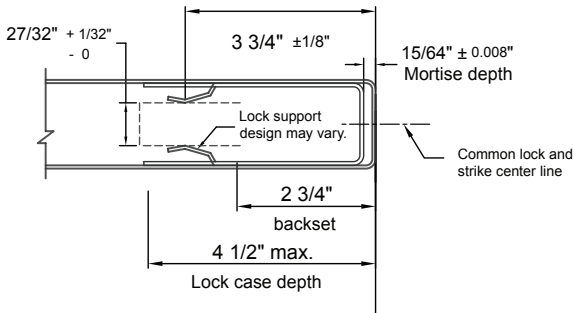
ANSI/SDI A115.001

Date:  
March 2022

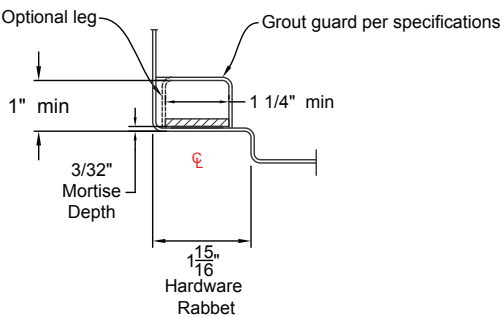
Rev A



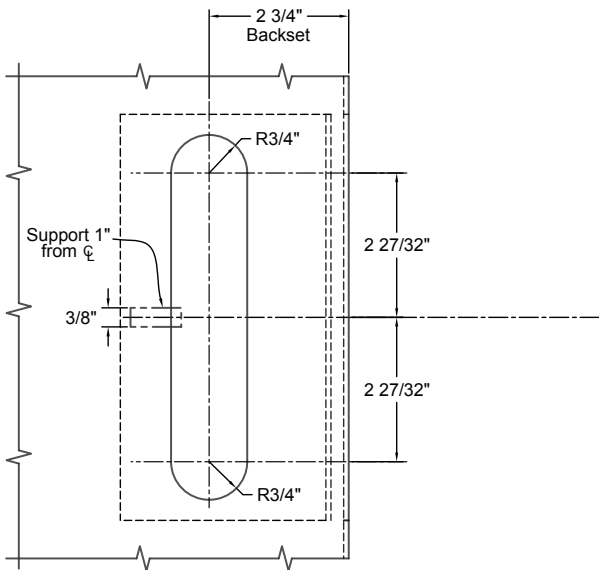
Beveled Edge - 1/8" in 2"



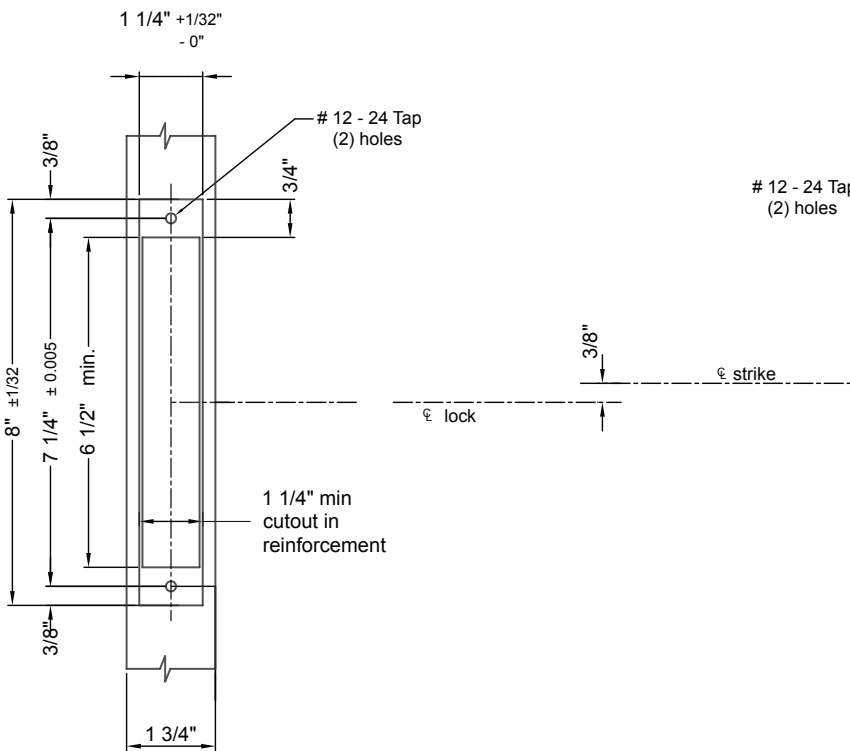
Square Edge



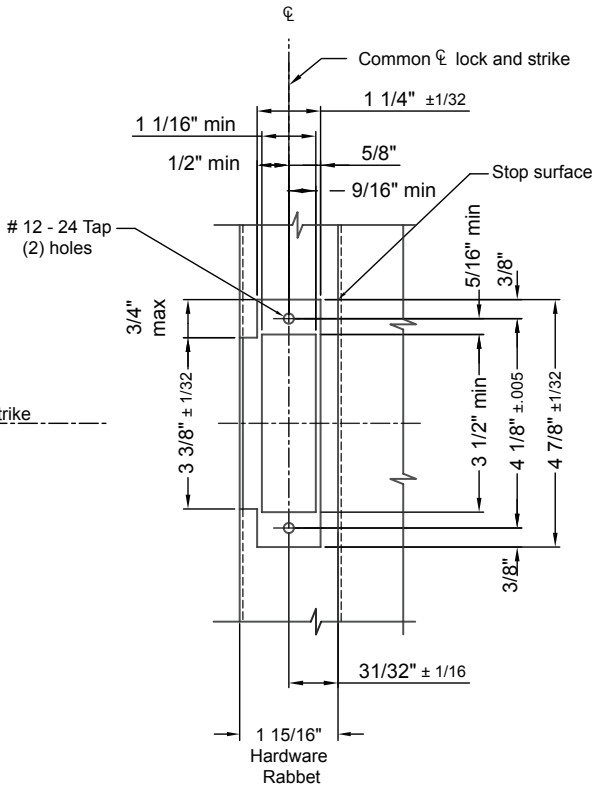
Frame Section



Door Face



Door Edge



Frame Rabbet

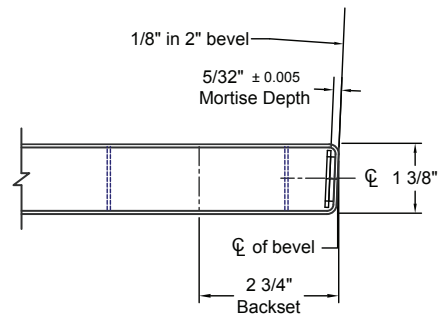
Preparation of 1-3/4" Steel Doors and Steel Frames for Mortise Locks with Escutcheon Trim



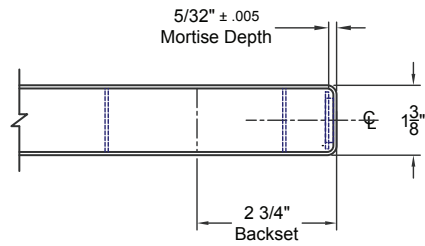
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Date: March 2022

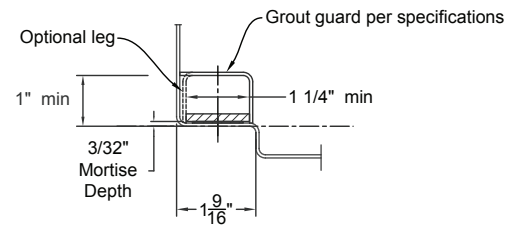
Rev A



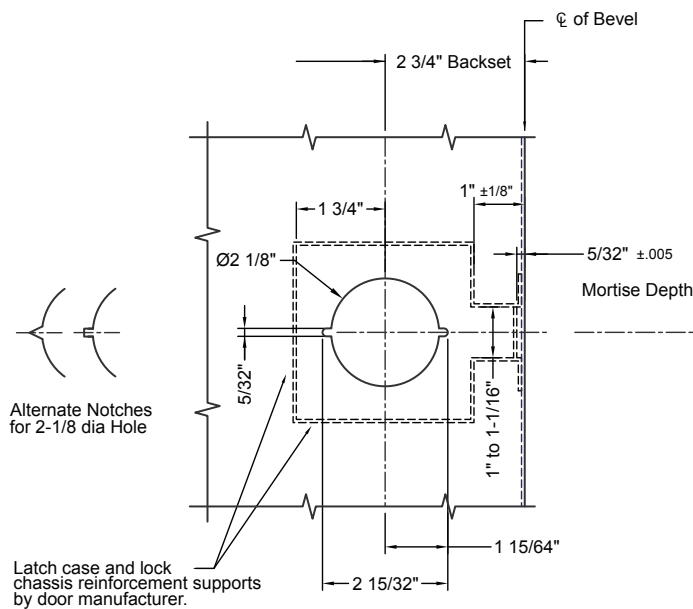
Beveled Edge



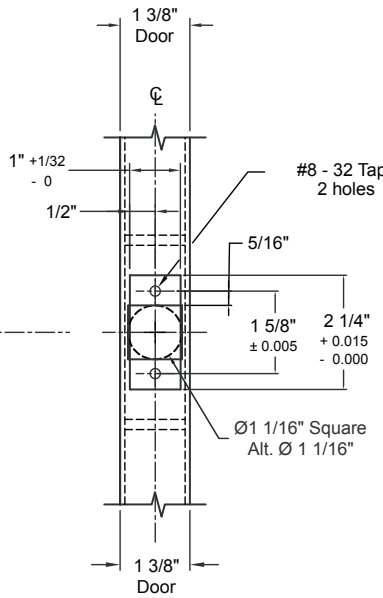
Square Edge



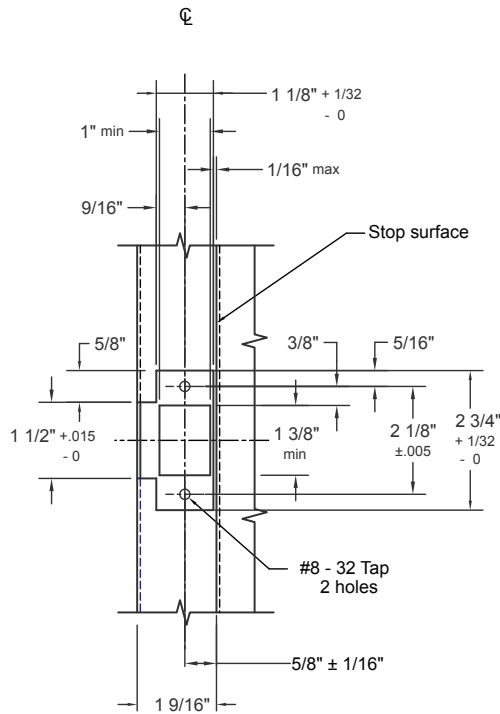
Frame Section



Door Face



Door Edge



Frame Rabbet

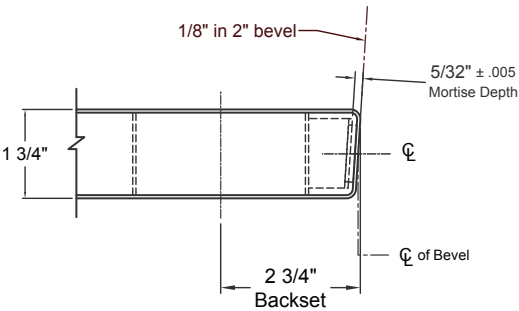
Preparation of 1-3/8" Steel Doors and Steel Frames for Mortise Locks



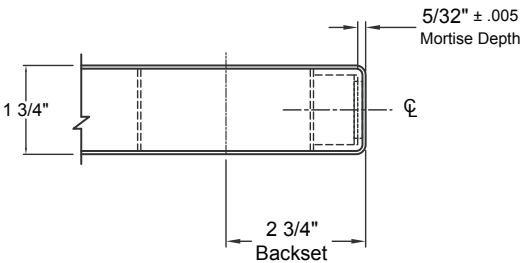
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Date:  
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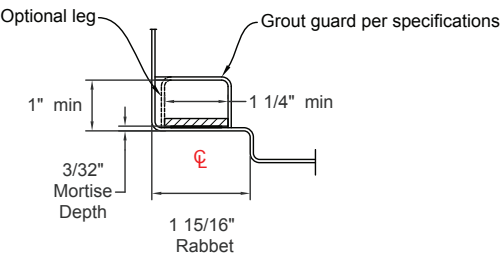
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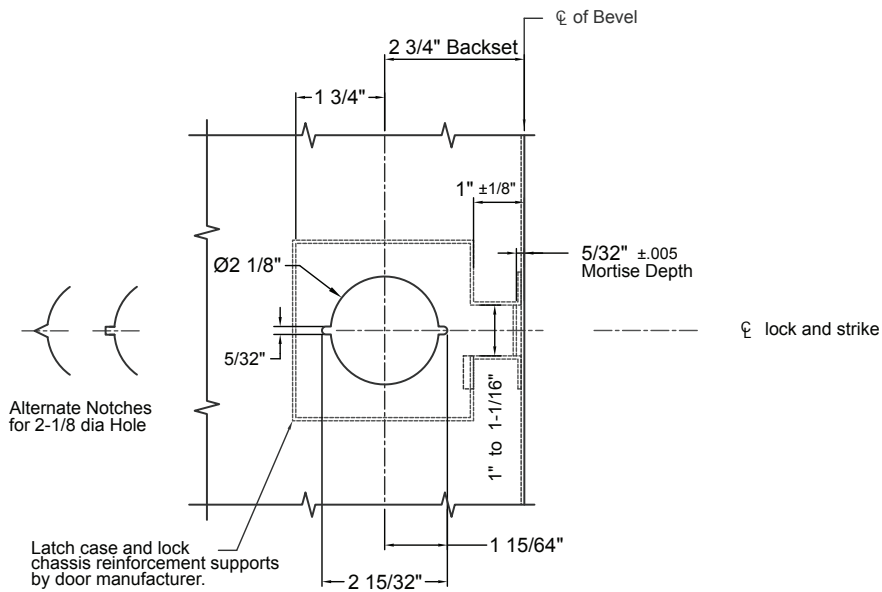
Beveled Edge



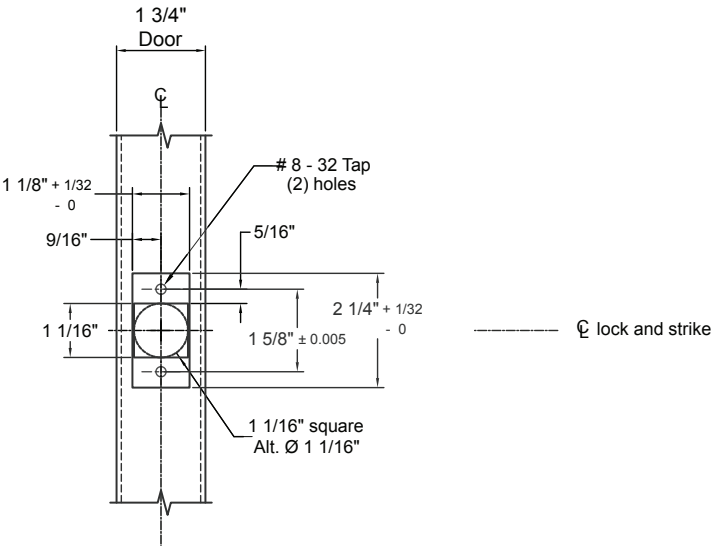
Square Edge



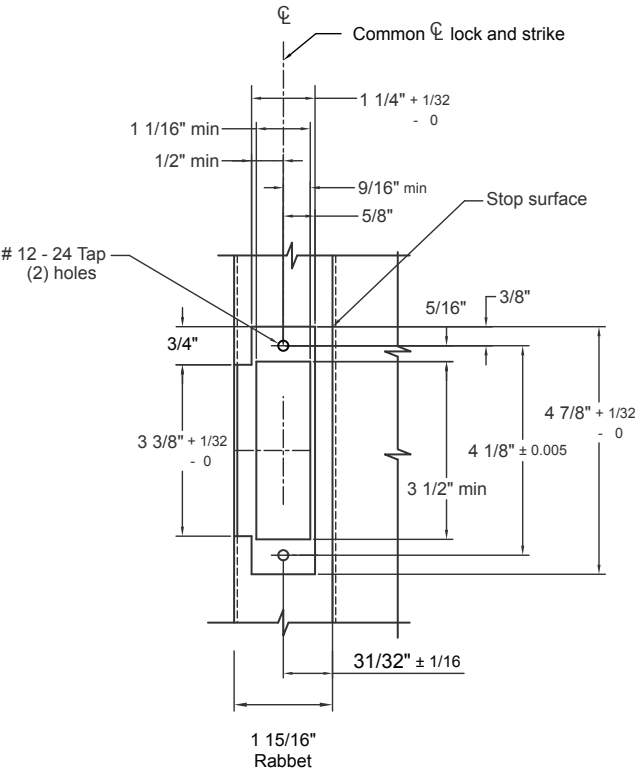
Metal Frame Section



Door Face



Door Edge



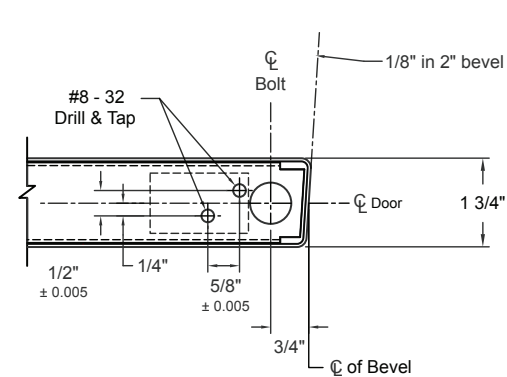
Frame Rabbet

Preparation of 1-3/4" Steel Doors and Steel Frames for Bored Locks

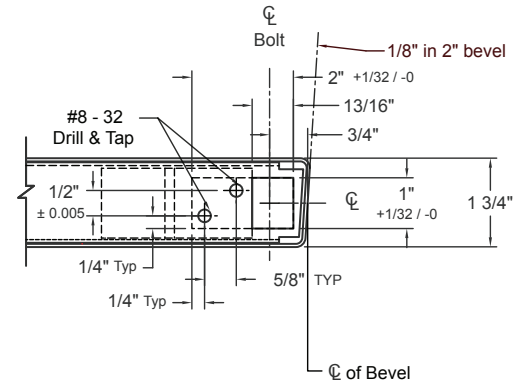


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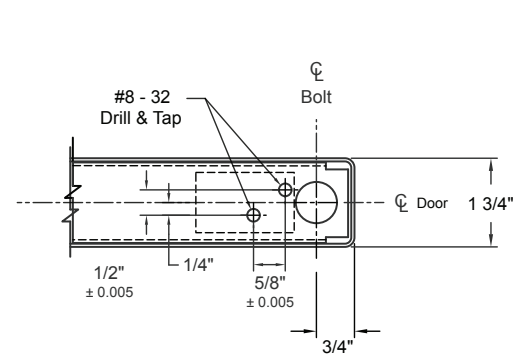
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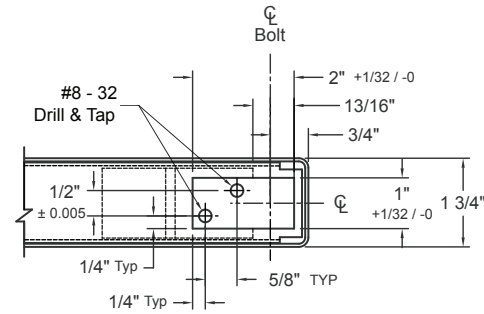
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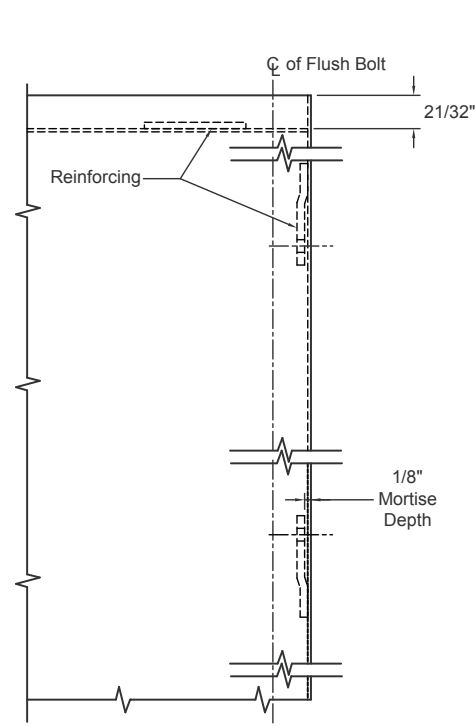
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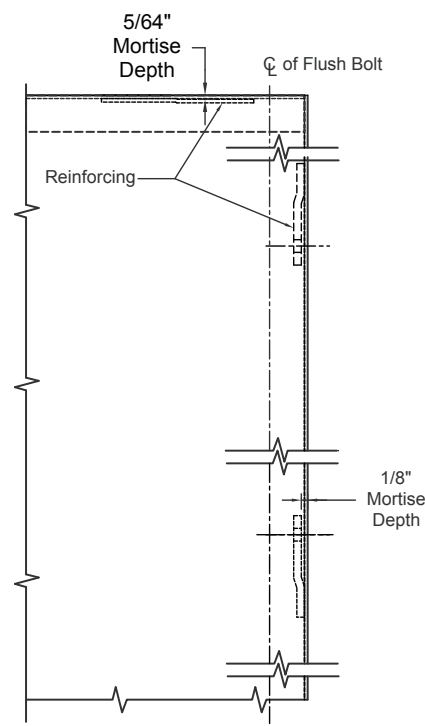
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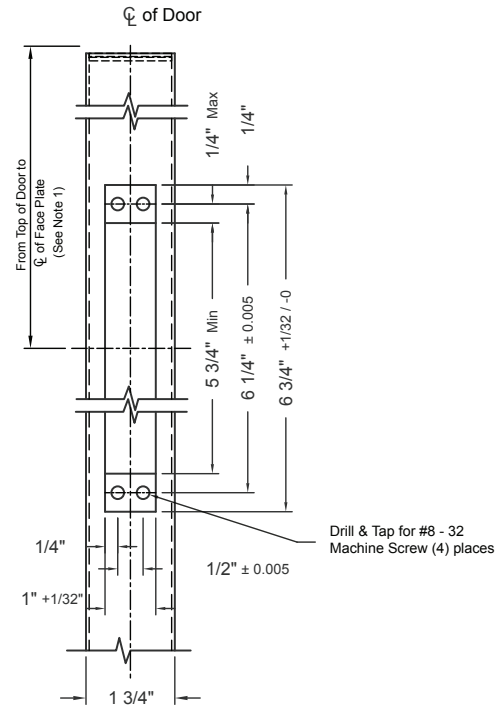
Square Edge



Recessed  
Top / Bottom



Flush  
Top / Bottom



Door Edge

NOTES:

1. For Doors 84" or less in Height, the Center of the Face Plate shall be 12" from the Top and Bottom Edges of the Door

For Doors Over 84" in Height, the Center of the Top Face Plate shall not be over 72" from the Floor

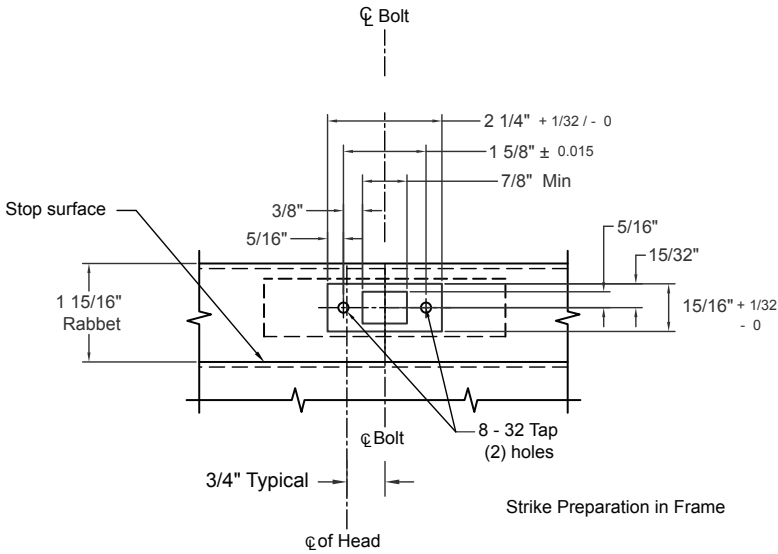
Preparation of 1-3/4" Steel Doors and Steel Frames for  
Manually Operated Lever Extension Flush Bolt



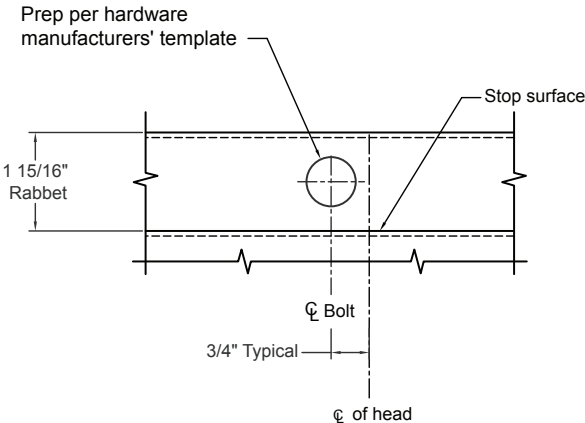
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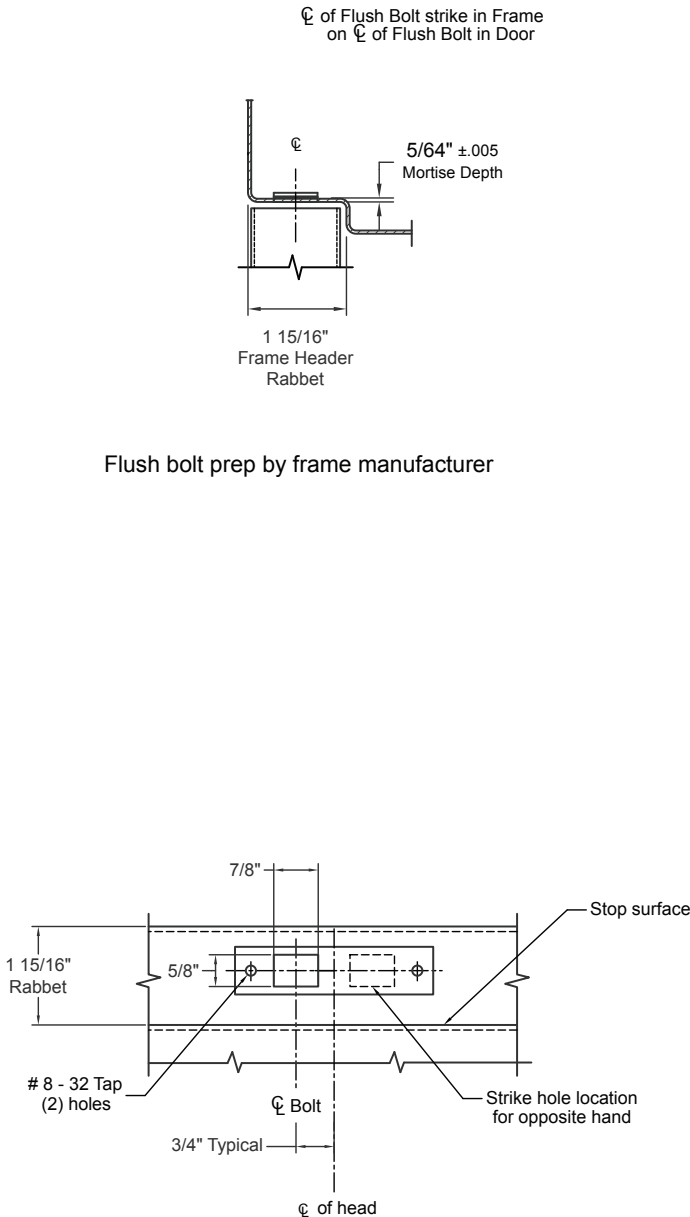
Rev A



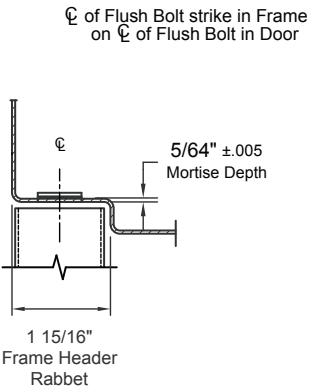
Frame Head Flushbolt Prep  
Head Detail



Frame Head Flushbolt Prep  
Optional Head Detail



Frame Head Flushbolt Prep  
Optional Head Detail  
Reversible Hand Strike



Flush bolt prep by frame manufacturer

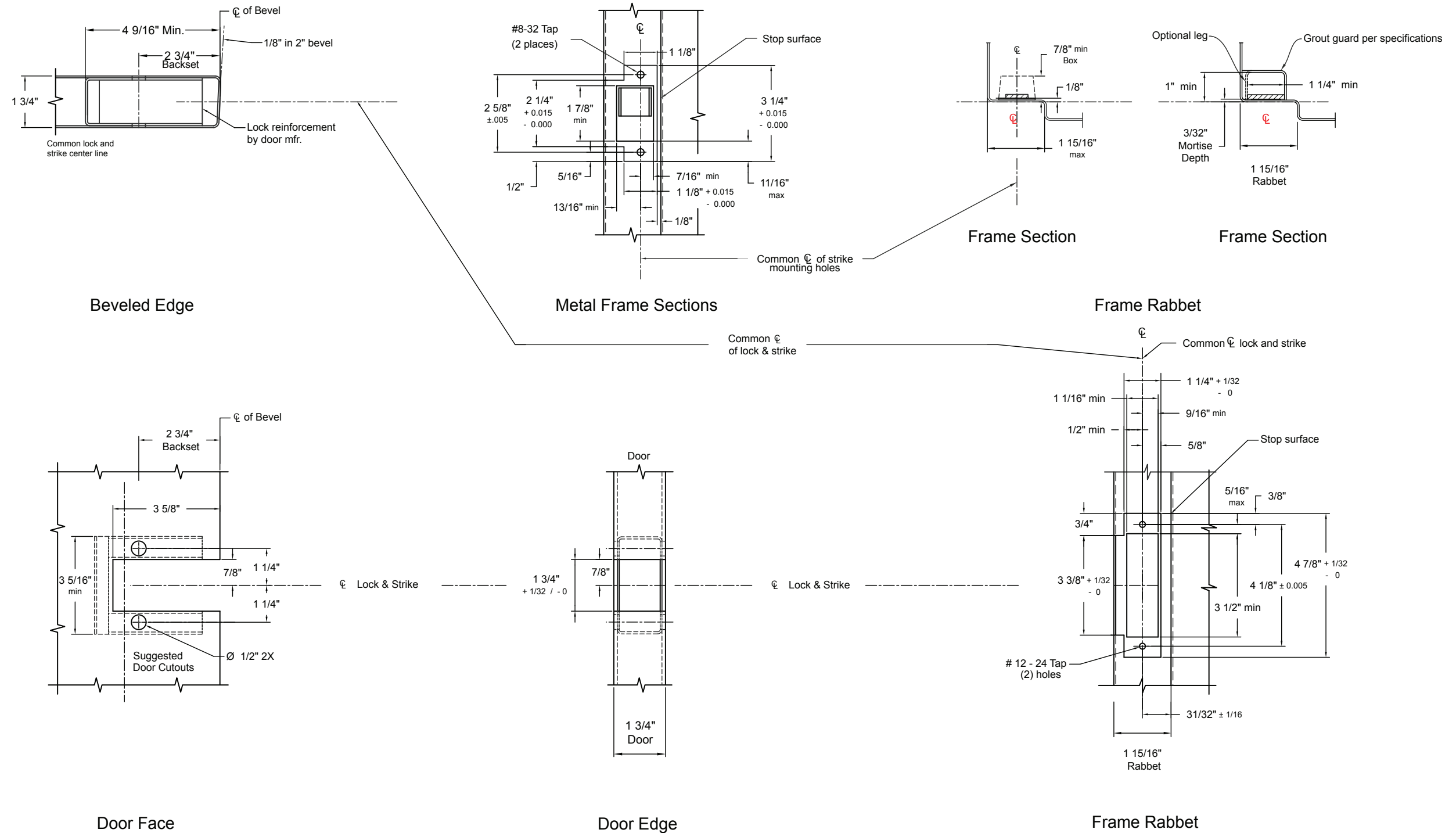
Preparation of 1-3/4" Steel Doors and Steel Frames for Manually Operated Lever Extension Flush Bolt Strike



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March 2022

Rev A



Preparation of 1-3/4" Steel Doors and Steel Frames for Preassembled Door Locks

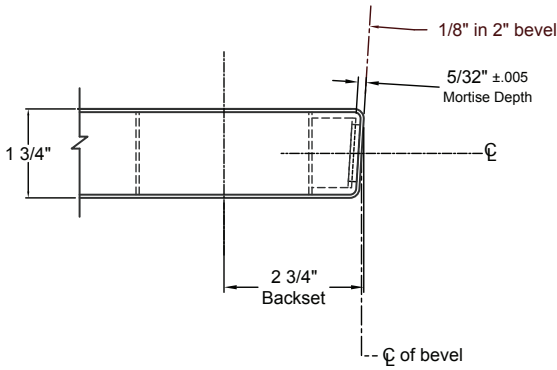


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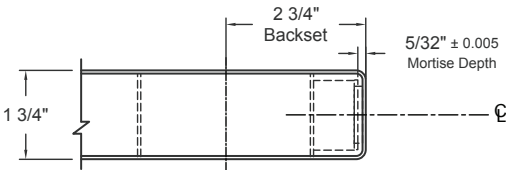
Date: March 2022

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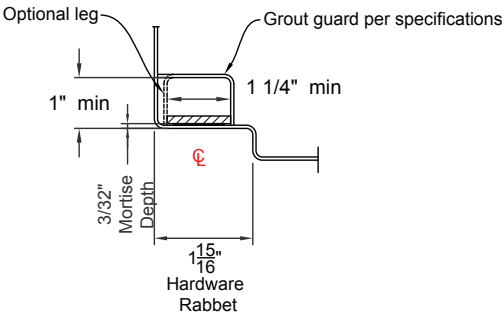




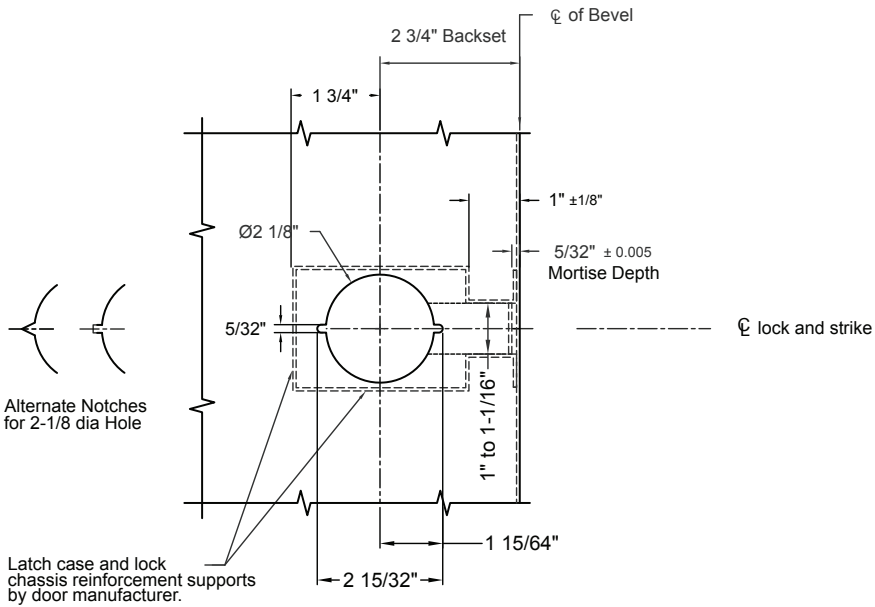
Beveled Edge - 1/8" in 2"



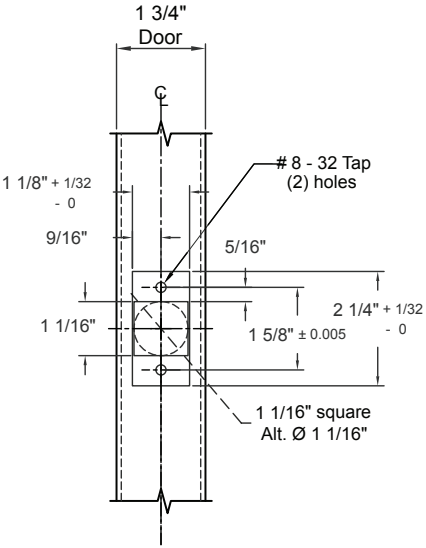
Square Edge



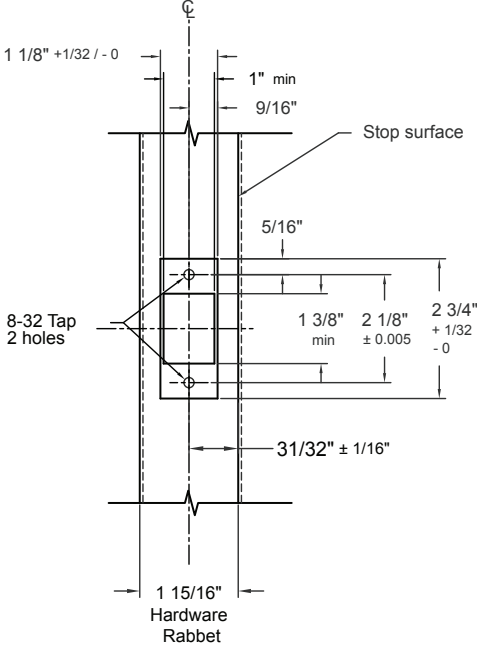
Frame Section



Door Face



Door Edge



Frame Rabbet

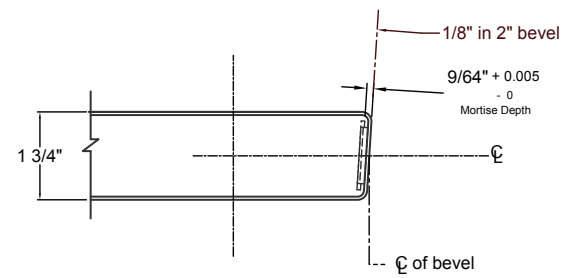
Preparation of 1-3/4" Steel Doors and Steel Frames for Bored Deadlatches



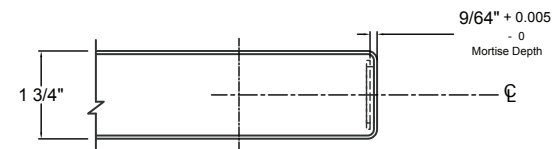
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Date: March 2022

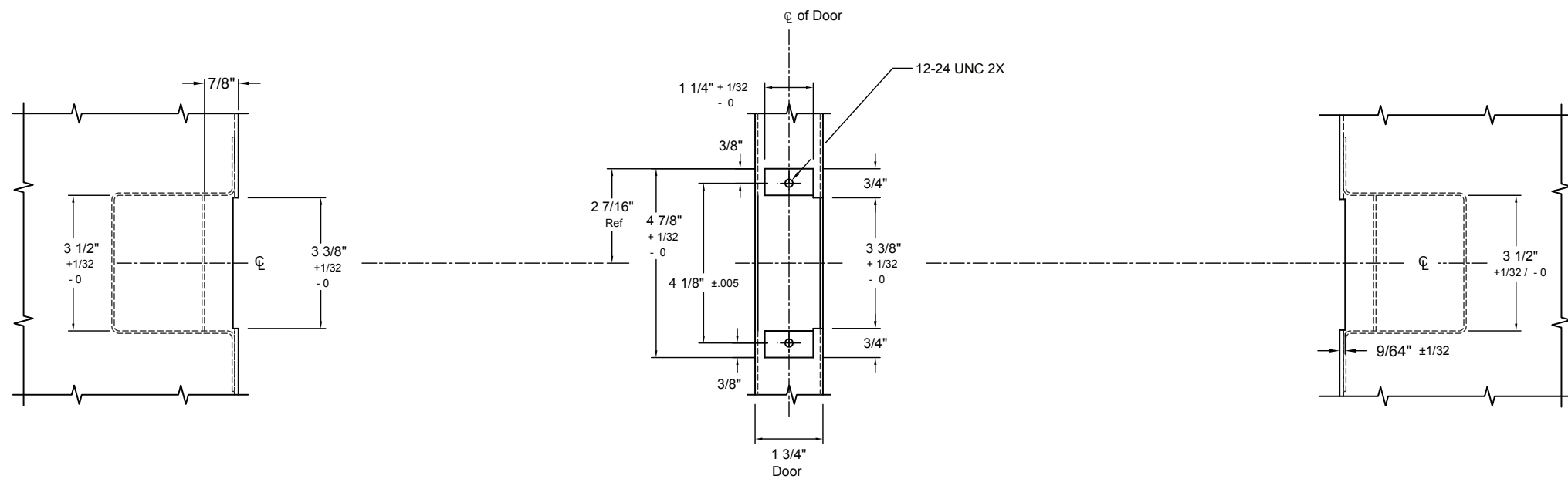
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Beveled Edge



Square Edge



Door Face

Door Edge

Door Face

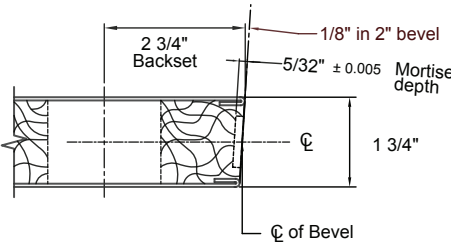
### Preparation of 1-3/4" Steel Doors for Open Back Strikes



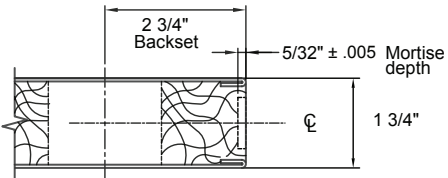
ANSI/SDI A115.009

Date: March 2022

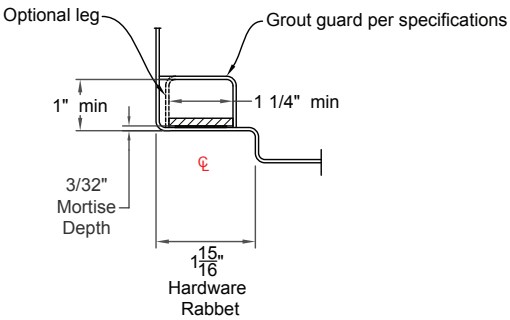
Rev A



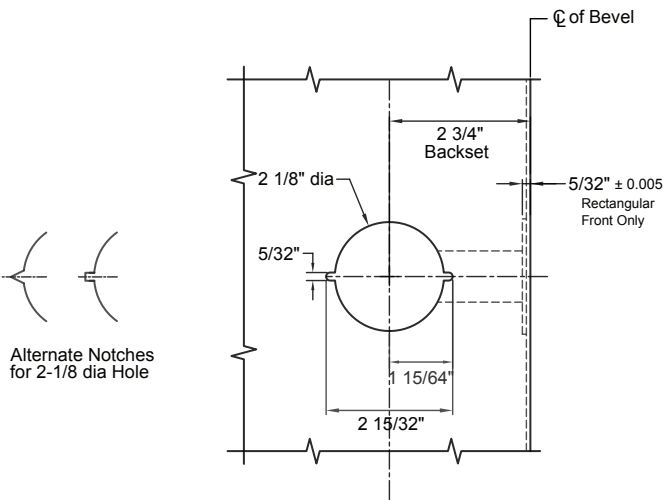
Beveled Edge



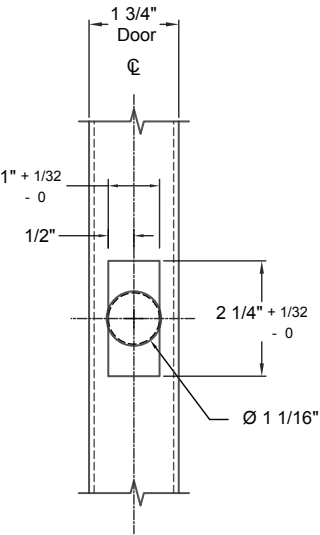
Square Edge



Frame Section

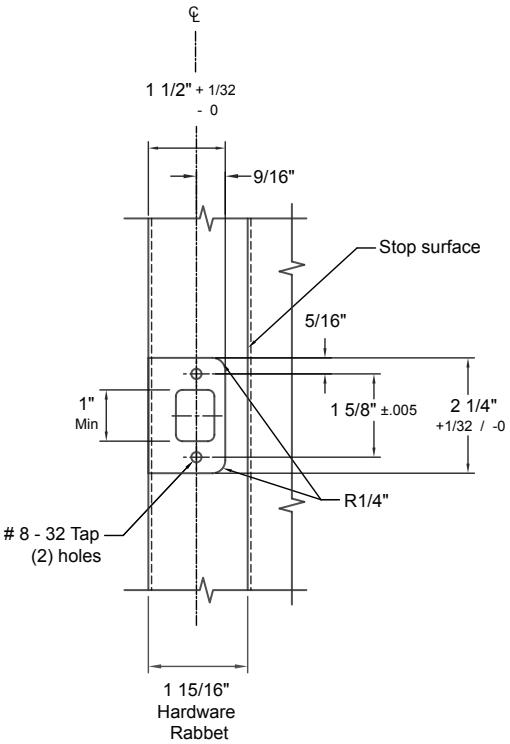


Door Face

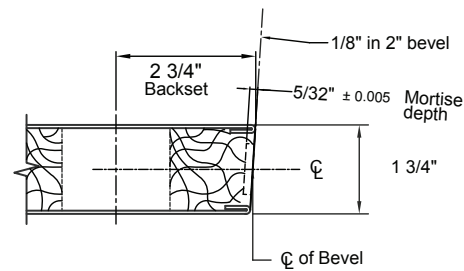


Door Edge

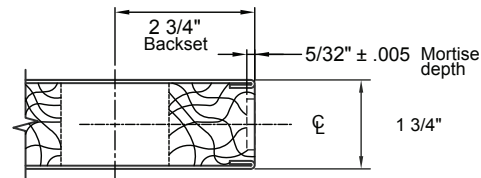
- NOTES:
- 1. A 1" DIAMETER DRIVE IN BOLT IS AN ACCEPTABLE ALTERNATE TO THE STANDARD.
  - 2. A 1/4" RADIUS CORNER LOCK FRONT IS AN ACCEPTABLE ALTERNATE TO THE STANDARD.



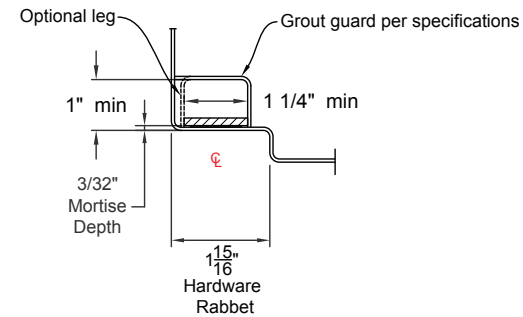
Frame Rabbet



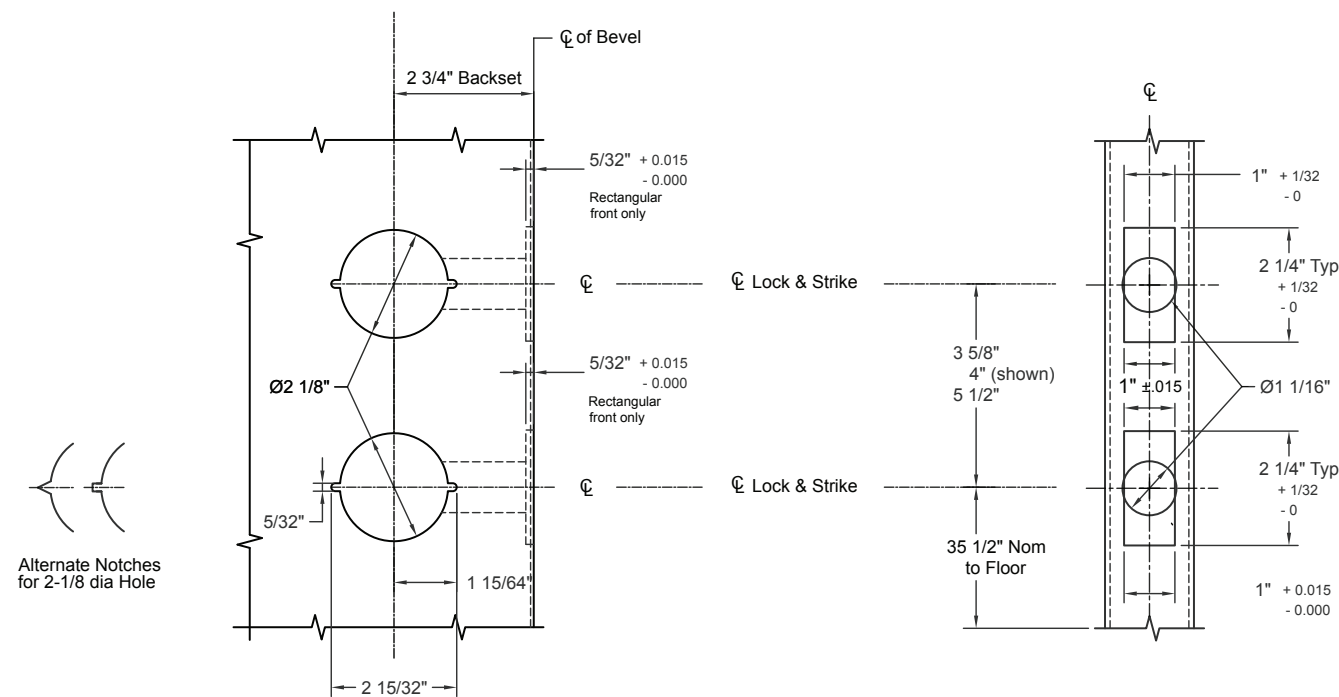
Beveled Edge



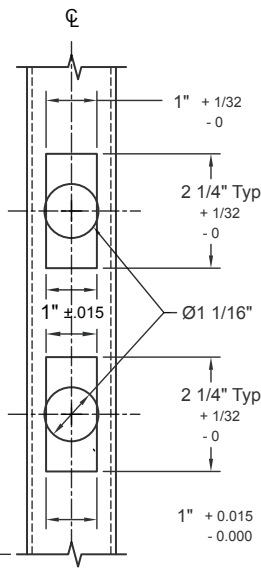
Square Edge



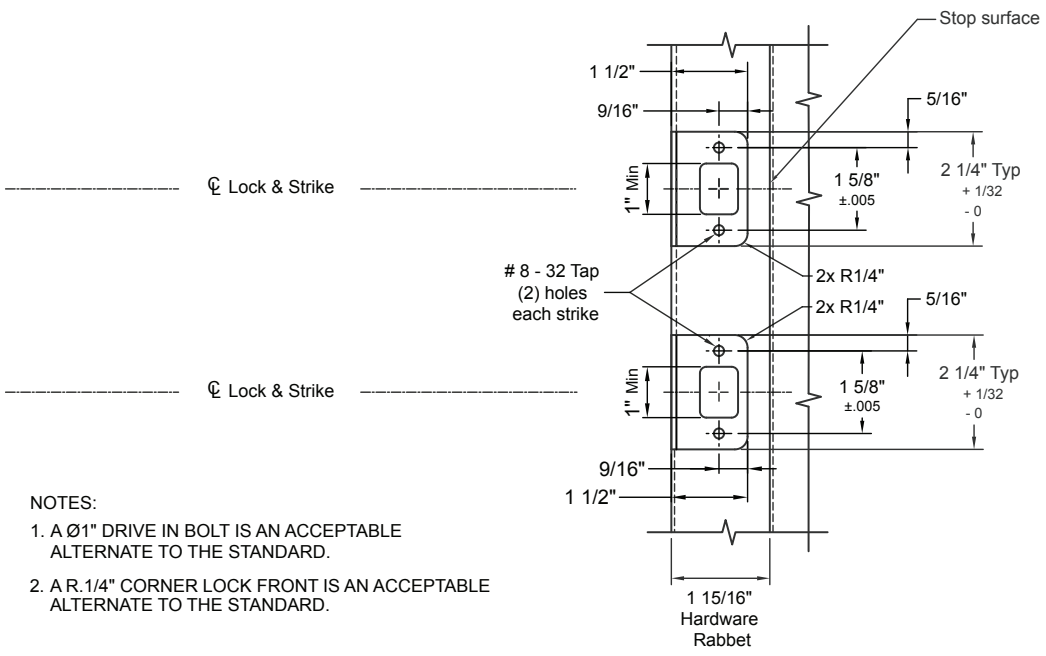
Frame Section



Door Face

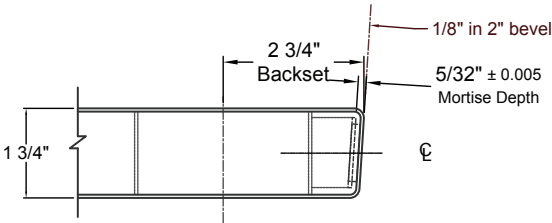


Door Edge

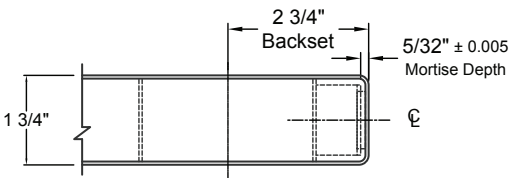


Frame Rabbet

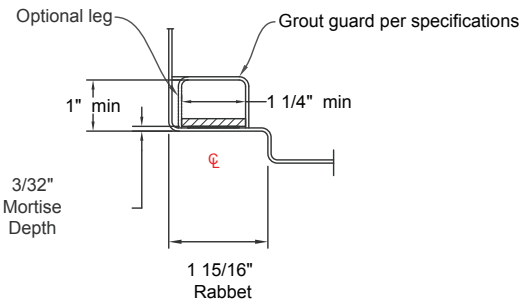
- NOTES:
1. A Ø1" DRIVE IN BOLT IS AN ACCEPTABLE ALTERNATE TO THE STANDARD.
  2. A R.1/4" CORNER LOCK FRONT IS AN ACCEPTABLE ALTERNATE TO THE STANDARD.



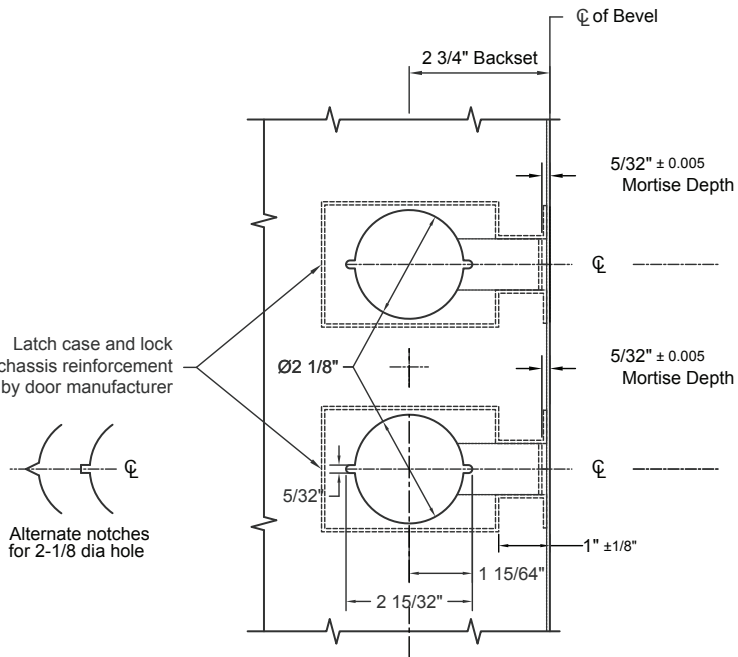
Beveled Edge Detail



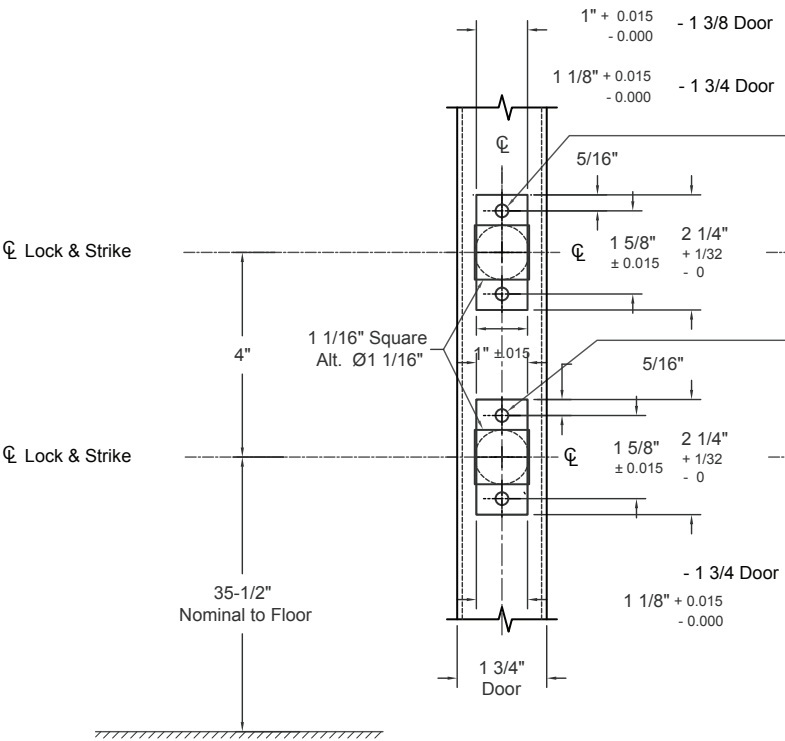
Square Edge Detail



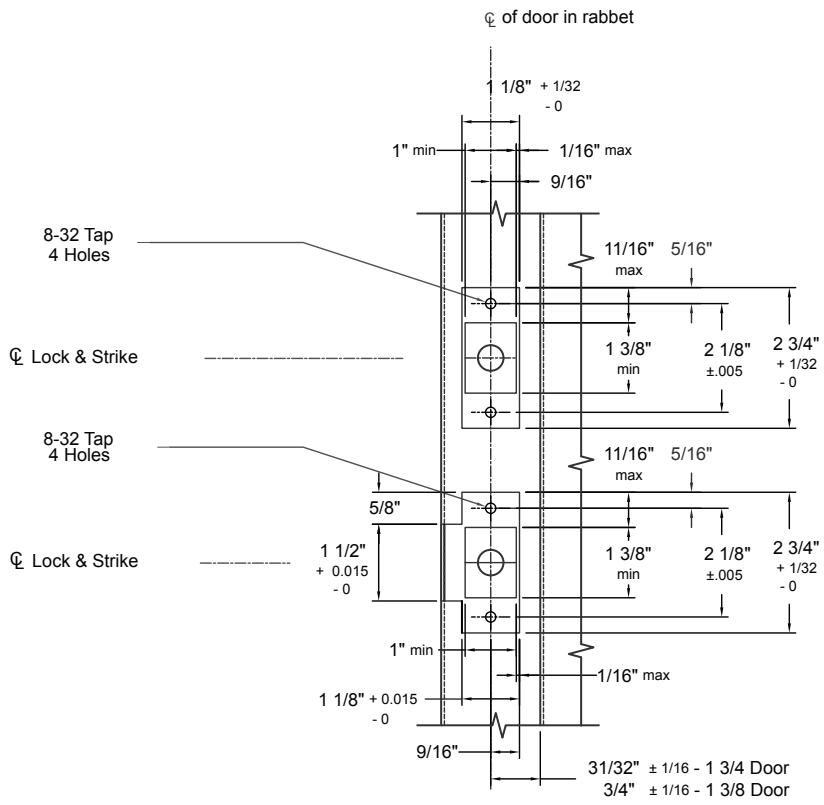
Frame Section



Door Face



Door Edge



Frame Rabbet

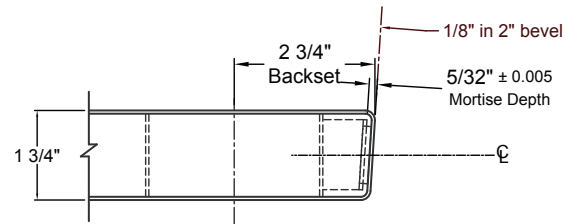
Preparation of 1-3/4" Steel Doors and Steel Frames for Double Locks with 4" Centerline Spacing of Combined or Interconnected Lock or Latch



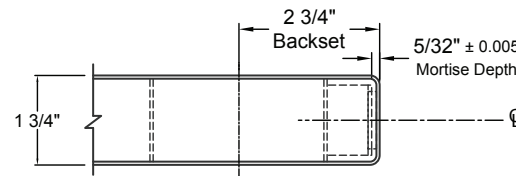
ANSI/SDI A115.012

Date: March 2022

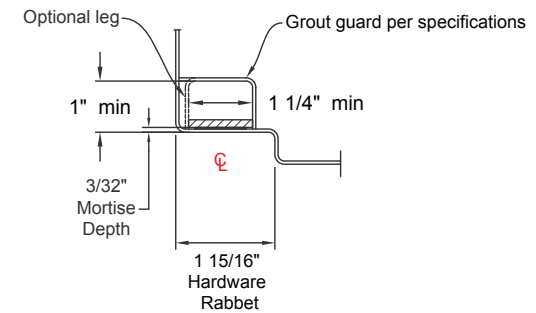
Rev A



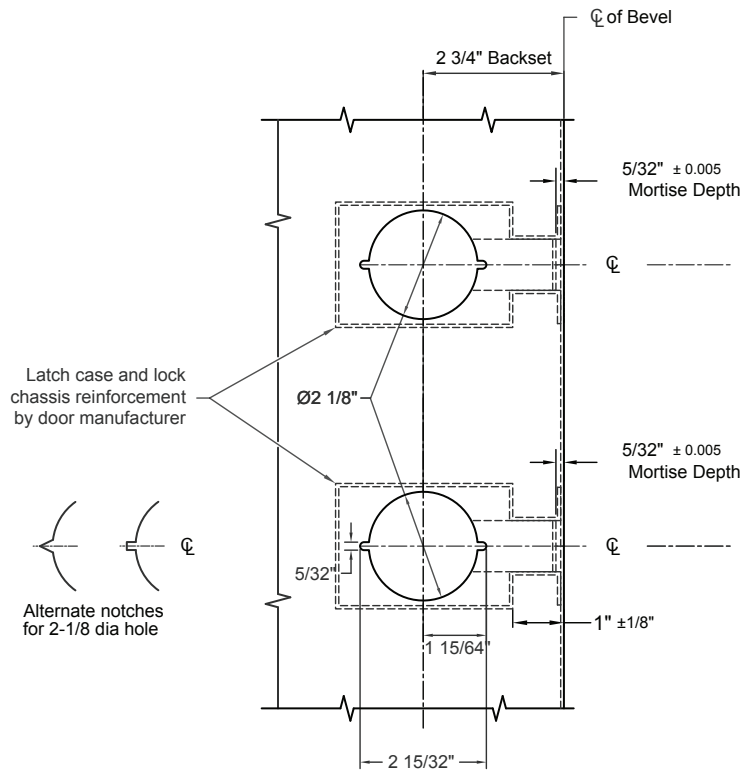
Beveled Edge Detail



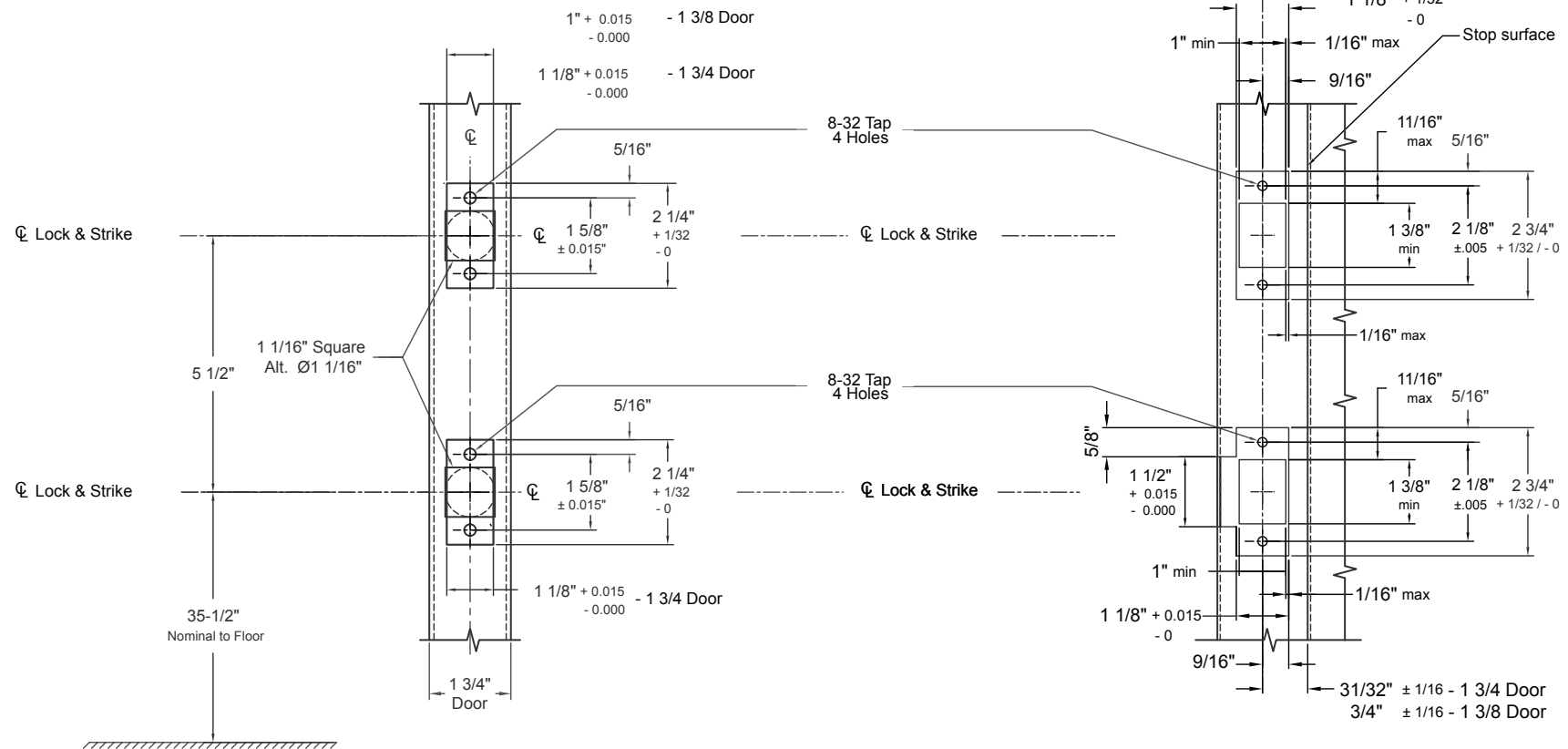
Square Edge Detail



Frame Section



Door Face



Door Edge

Frame Rabbet

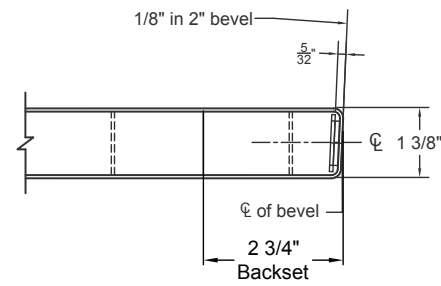
Preparation of 1-3/4" Steel Doors and Steel Frames for Double Locks with 5-1/2" Centerline Spacing of Combined or Interconnected Lock or Latch



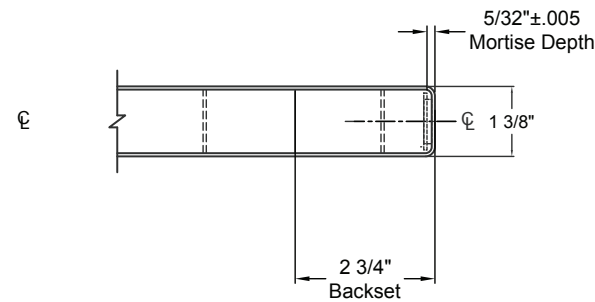
ANSI/SDI A115.013

Date: March 2022

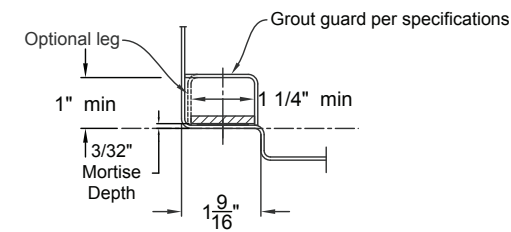
Rev A



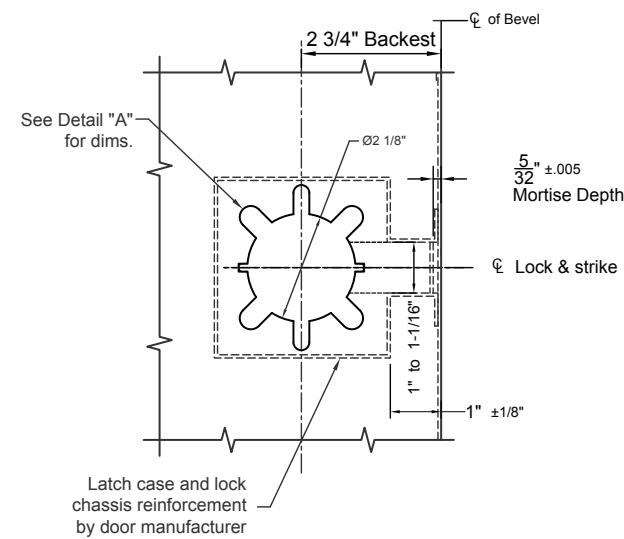
Beveled Edge



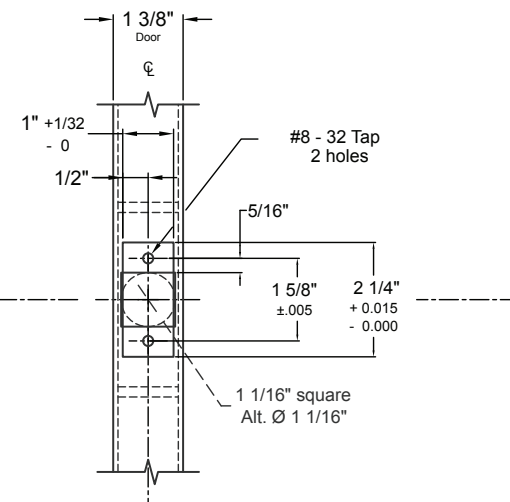
Square Edge



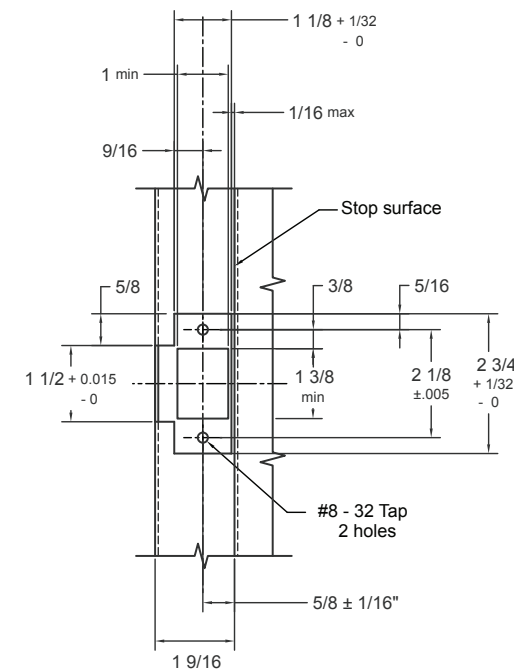
Frame Section



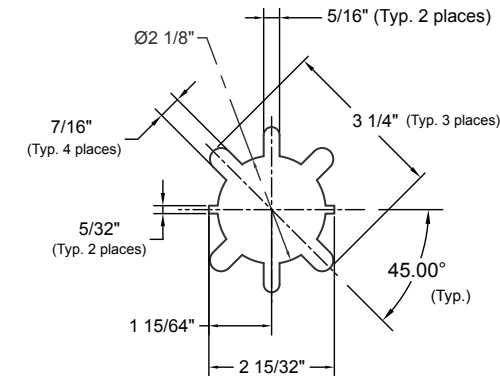
Door Face



Door Edge



Frame Rabbet



Detail A

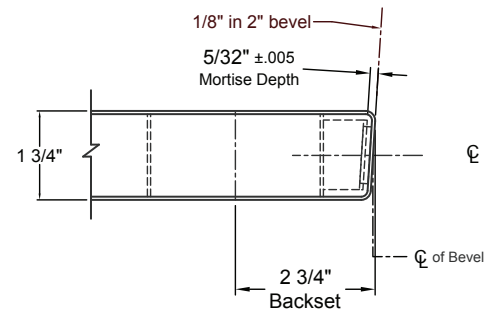
Preparation of 1-3/8" Steel Doors and Steel Frames for Bored Locks with Lever Handles



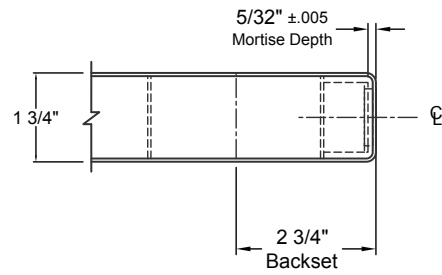
ANSI/SDI A115.014

Date: March 2022

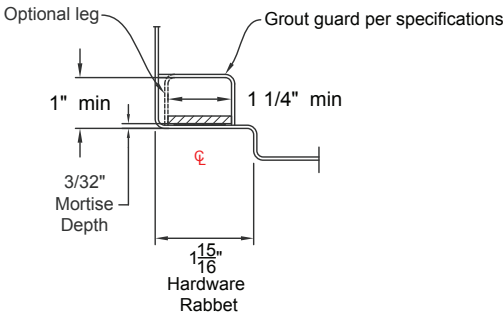
Rev A



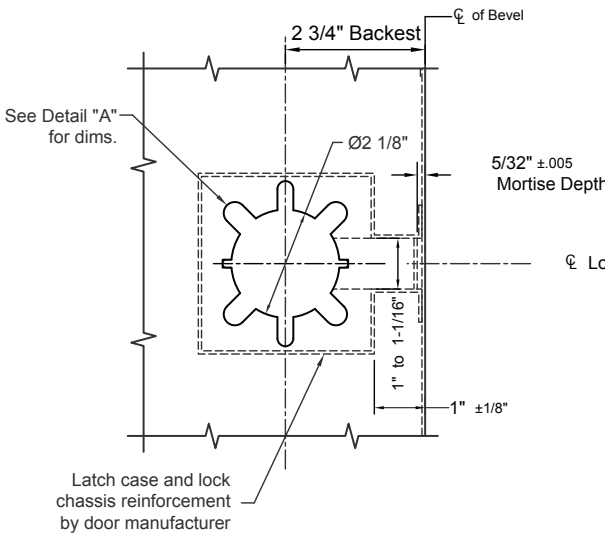
Beveled Edge



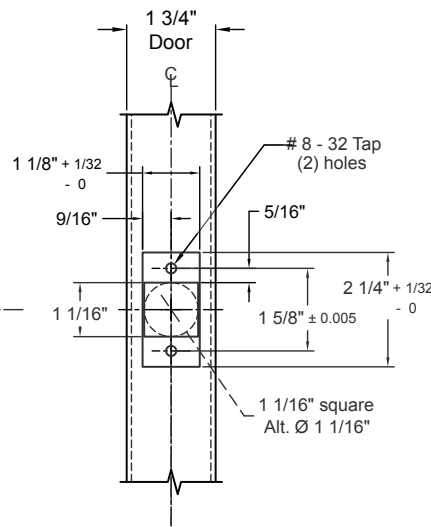
Square Edge



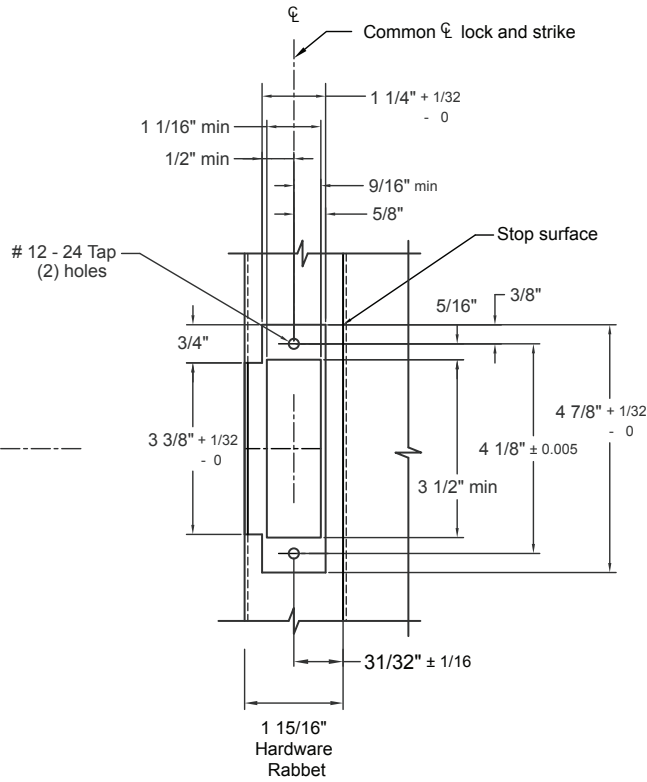
Frame Section



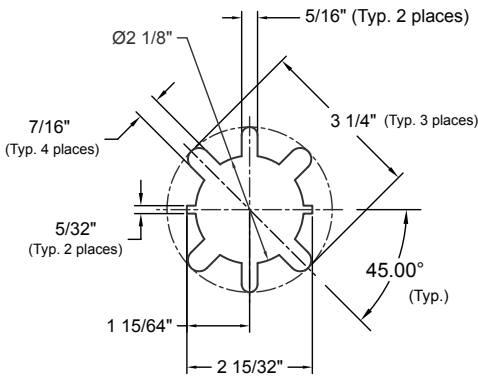
Door Face



Door Edge



Frame Rabbet



Detail A

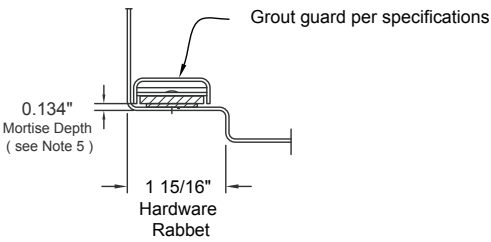
Preparation of 1-3/4" Steel Doors and Steel Frames for Bored Locks with Lever Handles



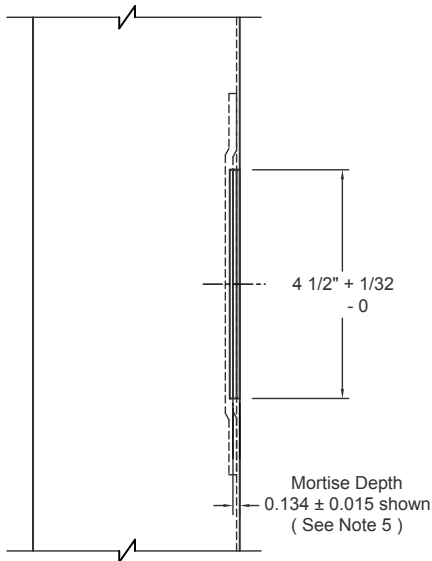
ANSI/SDI A115.015

Date: March 2022 Rev A

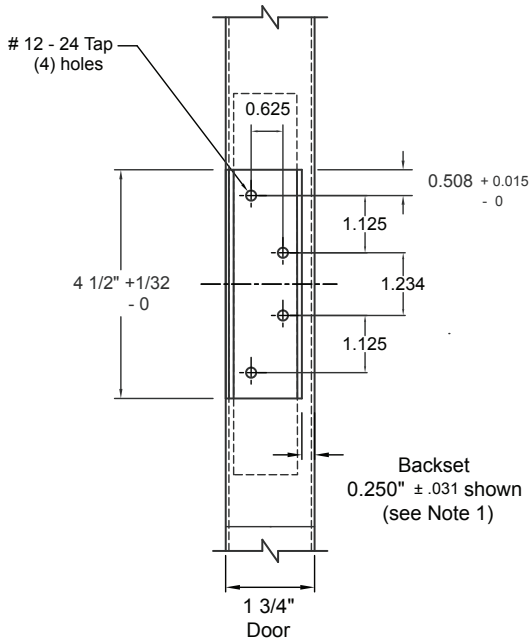




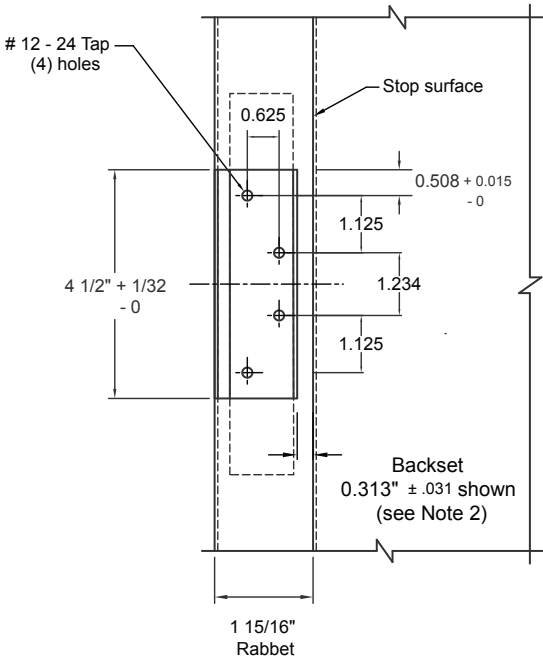
Frame Section



Door Face



Door Edge

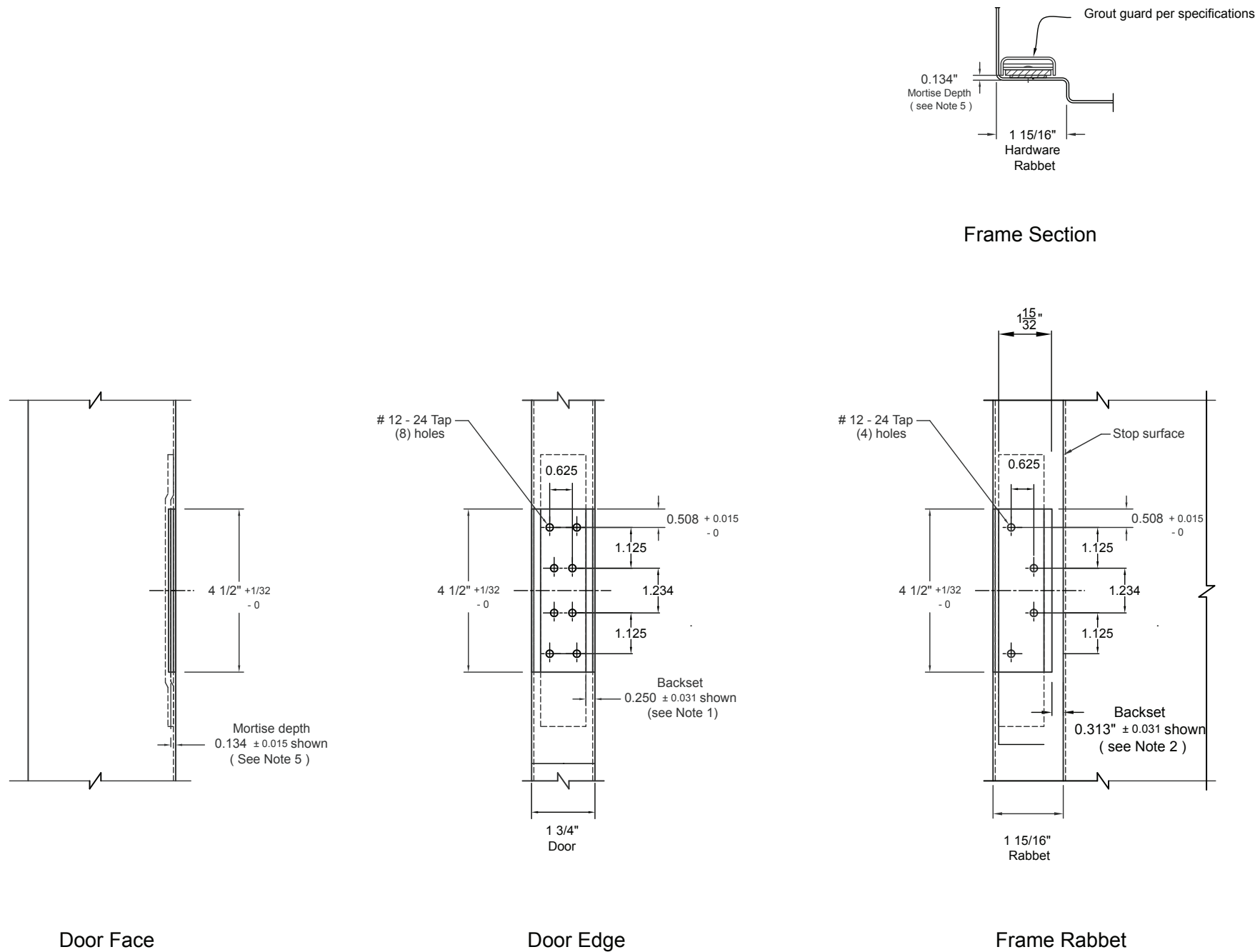


Frame Rabbet

- Note 1: The hinge backset on doors varies by manufacturer, from 3/16" to 1/4"
- Note 2: The hinge backset on frames varies by manufacturer, from 5/16" to 3/8".
- Note 3: Extra holes may be present in the reinforcement for tooling and weld fixturing
- Note 4: Manufacturers may offer a removable shim or embossed standoff which allows conversion of a standard weight preparation to a heavy weight butt hinge application.
- Note 5: Typical mortise depths are in accordance with ANSI/BHMA A 156.1 as follows:
- Standard weight butt hinge : 0.134
- Heavy weight butt hinge : 0.180"
- Note 6: Tolerance ±0.005" unless otherwise specified.

Notes





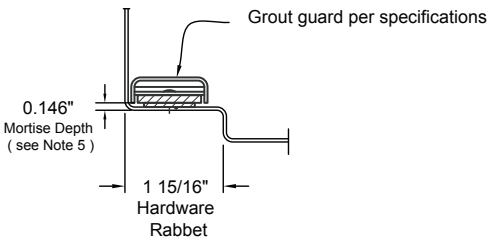
Preparation of 1-3/4" Non-Handed Steel Doors and Steel Frames for 4-1/2" Full Mortise Hinge



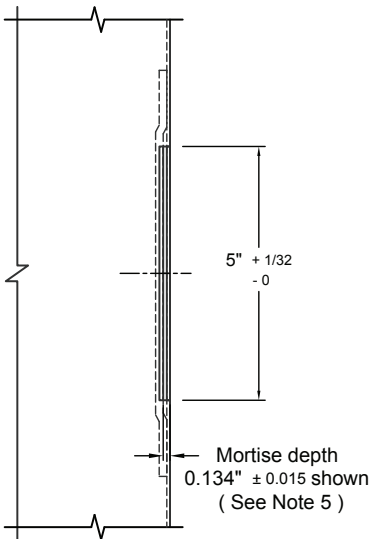
ANSI/SDI A115.017

Date:  
March 2022

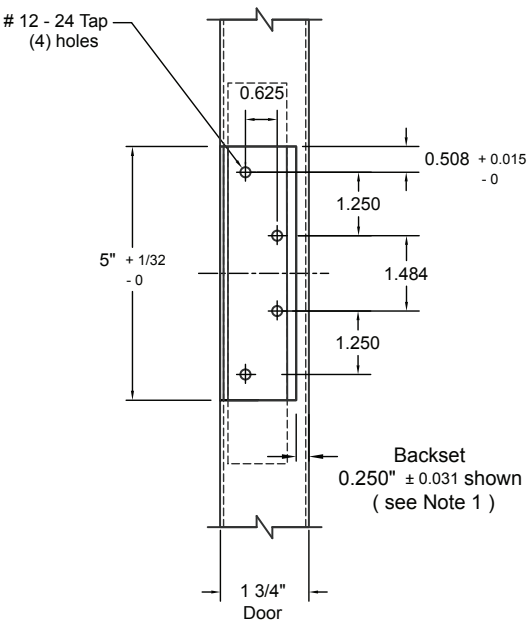
Rev A



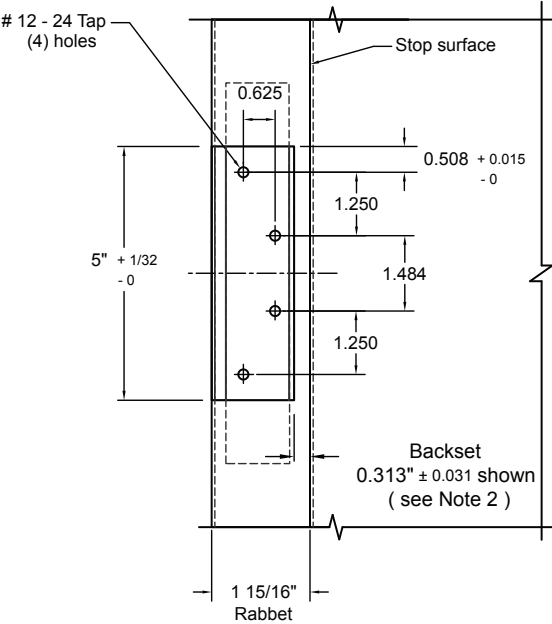
Frame Section



Door Face



Door Edge

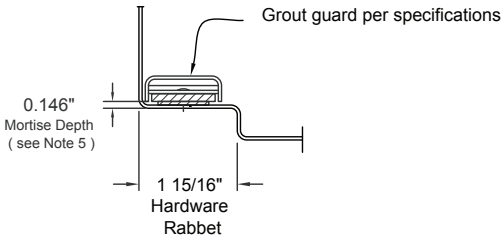


Frame Rabbet

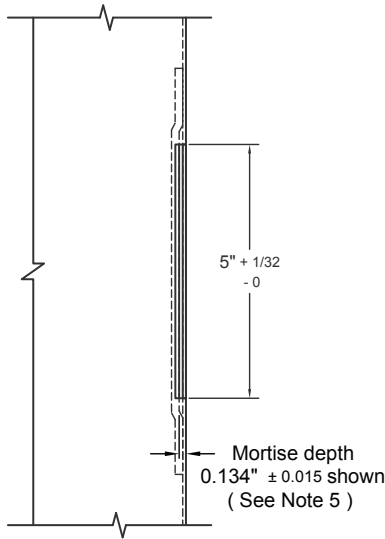
- Note 1: The hinge backset on doors varies by manufacturer, from 3/16" to 1/4"
- Note 2: The hinge backset on frames varies by manufacturer, from 5/16" to 3/8".
- Note 3: Extra holes may be present in the reinforcement for tooling and weld fixturing.
- Note 4: Manufacturers may offer a removable shim or embossed standoff which allows conversion of a standard weight preparation to a heavy weight butt hinge application.
- Note 5: Typical mortise depths are in accordance with ANSI/BHMA A 156.1 as follows:
- Standard weight butt hinge : 0.146"
- Heavy weight butt hinge : 0.190"
- Note 6: Tolerance ± 0.005" unless otherwise specified.

Notes

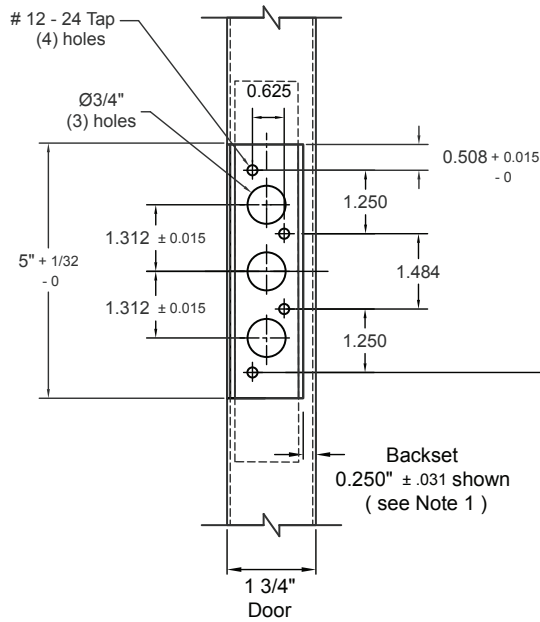




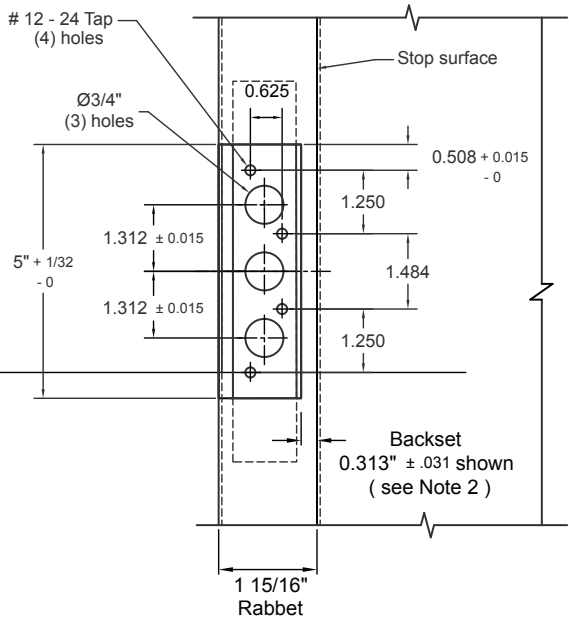
Frame Section



Door Face



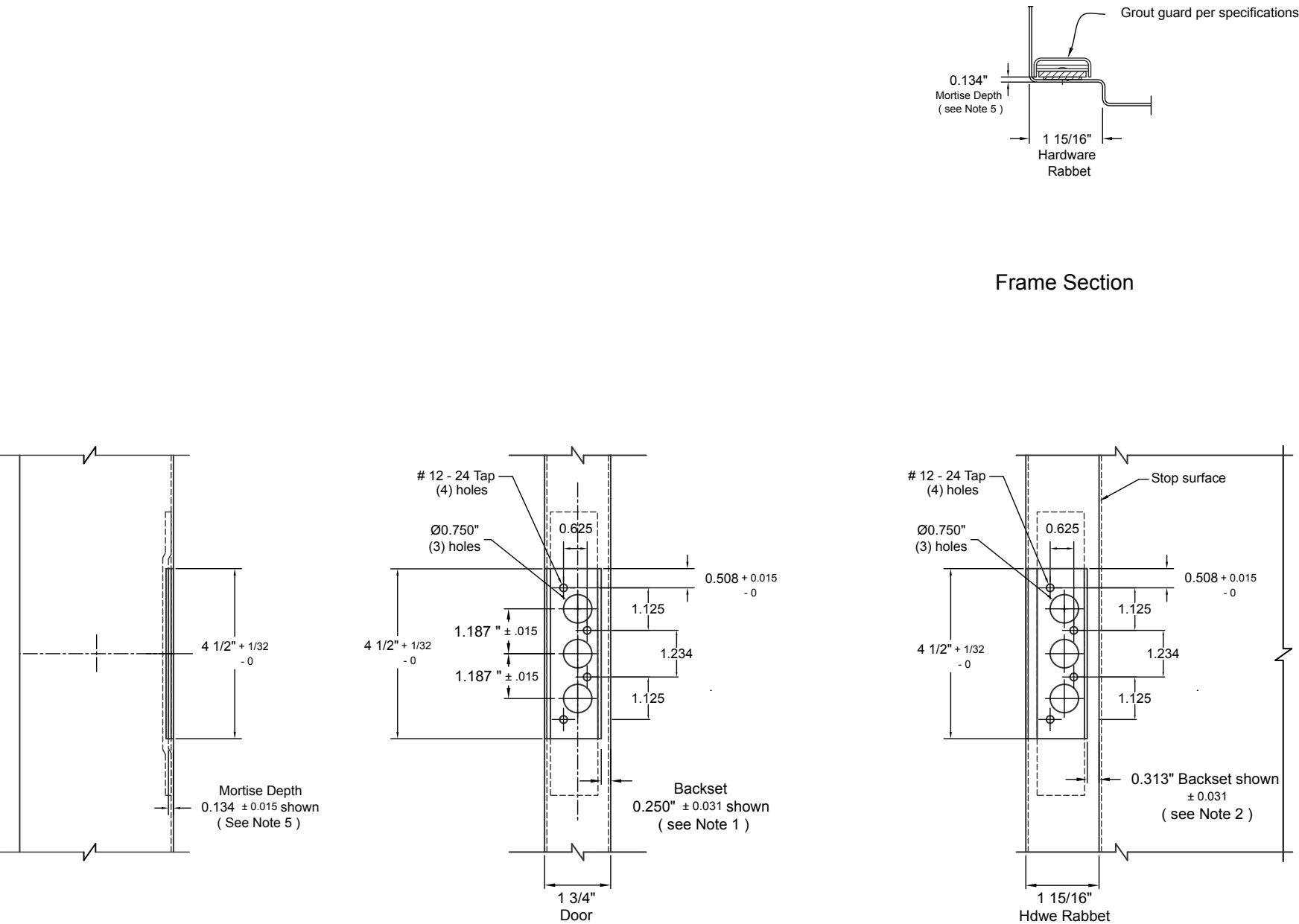
Door Edge



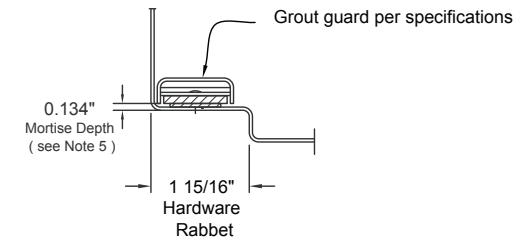
Frame Rabbet

- Note 1: The hinge backset on doors varies by manufacturer, from 3/16" to 1/4"
- Note 2: The hinge backset on frames varies by manufacturer, from 5/16" to 3/8".
- Note 3: Extra holes may be present in the reinforcement for tooling and weld fixturing.
- Note 4: Manufacturers may offer a removable shim or embossed standoff which allows conversion of a standard weight preparation to a heavy weight butt hinge application.
- Note 5: Typical mortise depths are in accordance with ANSI/BHMA A 156.1 as follows:
- |                              |        |
|------------------------------|--------|
| Standard weight butt hinge : | 0.146" |
| Heavy weight butt hinge :    | 0.190" |
- Note 6: Tolerance ± 0.005" unless otherwise specified.

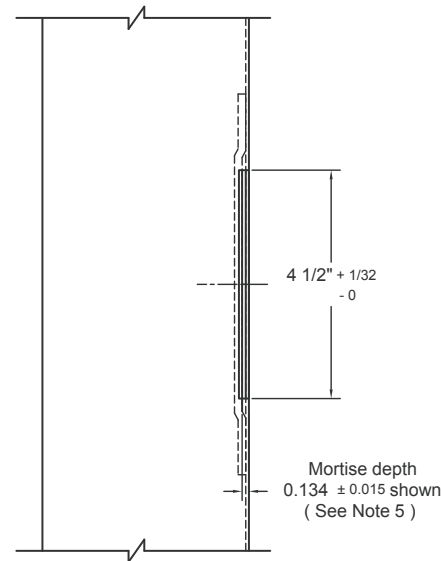
Notes



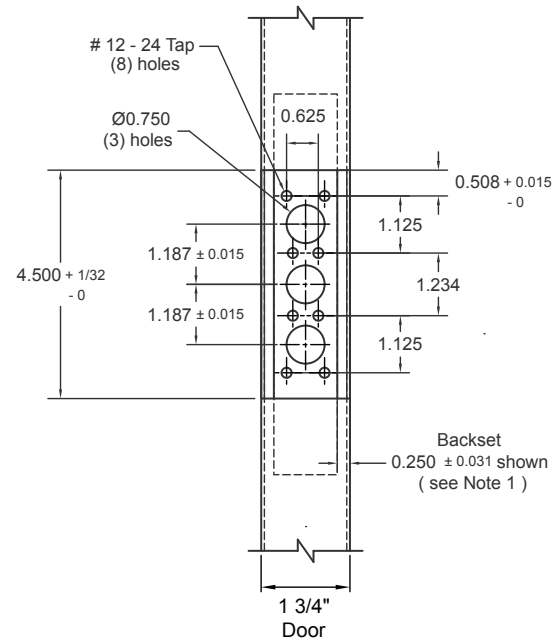
- Note 1: The hinge backset on doors varies by manufacturer, from 3/16" to 1/4"
- Note 2: The hinge backset on frames varies by manufacturer, from 5/16" to 3/8".
- Note 3: Extra holes may be present in the reinforcement for tooling and weld fixturing
- Note 4: Manufacturers may offer a removable shim or embossed standoff which allows conversion of a standard weight preparation to a heavy weight butt hinge application.
- Note 5: Typical mortise depths are in accordance with ANSI/BHMA A 156.1 as follows:
- Standard weight butt hinge : 0.134"
- Heavy weight butt hinge : 0.180"
- Note 6: Tolerance ± 0.005" unless otherwise specified.



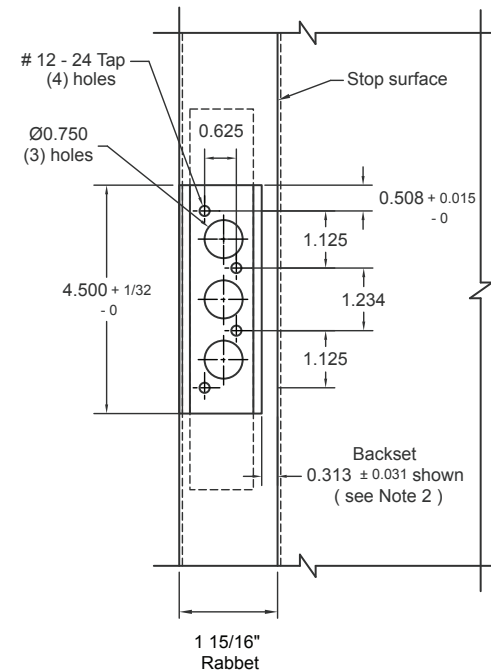
Frame Section



Door Face



Door Edge



Frame Rabbet

Note 1: The hinge backset on doors varies by manufacturer, from 3/16" to 1/4"

Note 2: The hinge backset on frames varies by manufacturer, from 5/16" to 3/8".

Note 3: Extra holes may be present in the reinforcement for tooling and weld fixturing

Note 4: A shim with a lip may be used to conceal the edge of the hinge leaf after the desired door handing is selected. Manufacturers may offer a removable shim or embossed standoff projection which allows conversion of a standard weight preparation to a heavyweight butt hinge application.

Note 5: Typical mortise depths are in accordance with ANSI/BHMA A 156.1 as follows:

Standard weight butt hinge : 0.134"

Heavy weight butt hinge : 0.180"

Note 6: Tolerance ± 0.005" unless otherwise specified.

## 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)
- ANSI/SDI A250.14** Hardware Preparation in Steel Doors and Steel 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 and Frames
- SDI-129** Hinge and Strike Spacing
- SDI-133** Guideline for Specifying Steel Doors & Frames for Blast Resistance
- SDI-136** Guideline for Specifying Windstorm Products

### 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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