

American National Standard

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



SPONSOR
Steel Door Institute

Approved October 7, 2003



American National Standard

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for Hardware Reinforcing
on Standard Steel Doors and Frames**

Secretariat
Steel Door Institute

Approved October 7, 2003
American National Standards Institute, Inc.

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Foreword (This Foreword is not part of American National Standard A250.6-2003)

The first edition of this standard was developed under the auspices of the Technical Committee of the Steel Door Institute and published in 1978 as SDI-107 *Hardware on Steel Doors (Reinforcement – Application)*. In 1994, the word “standard” was added to the document’s title and the decision was made to promulgate SDI-107 as an American National Standard. A250.6 was officially approved by the American National Standards Institute on October 22, 1997. Substantive changes between SDI-107 and the revised and redesignated A250.6-1997 *Hardware on Standard Steel Doors (Reinforcement – Application)* include the addition of metric equivalents, revised tap and drill sizes to eliminate those that are not recommended, and a better definition for “factory mortise.”

In 2001, the TC-1 Committee of the Accredited Standards Committee A250 initiated the 5-year review process, and changed the title of A250.6 to *Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames* to more accurately define the content of the standard. In addition, this revision includes the following substantive changes: Addition of Appendices A and B, both informative; discontinuation of the use of “gauge” in favor of decimal equivalents; addition of information relating to continuous hinges; redefinition of the scope to exclude “architecturally specified or specialized conditions.”

Suggestions for improvement gained in the use of this standard will be welcome, and should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, Ohio 44145-1967.

The organizations of the Accredited Standards Committee A250 that have approved this standard are as follows:

American Institute of Architects
American Iron and Steel Institute
Builders Hardware Manufacturers’ Association
Canadian Steel Door Manufacturers’ Association
Door and Hardware Institute
Factory Mutual Research Corporation
General Services Administration
Hollow Metal Manufacturers’ Association / Division of National Association
of Architectural Metal Manufacturers’ Association
Insulated Steel Door Institute
International Conference of Building Officials
Intertek Testing Services
Manufactured Housing Institute
National Association of Home Builders
Steel Door Institute
Underwriters Laboratories Inc.
Window and Door Manufacturers’ Association

The Accredited Standards Committee A250 TC-1 developed this standard had the following personnel at the time of approval:

Robert Berhinig, Chairman
 J. Jeffery Wherry, Secretary

<i>Organization Represented</i>	<i>Name of Representative</i>
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Underwriters Laboratories Inc.....	Daniel Kaiser
Window & Door Manufacturers' Association.....	Rick Perry

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/SDI-100 "Recommended Specifications for Standard Steel Doors and Frames" 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, 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

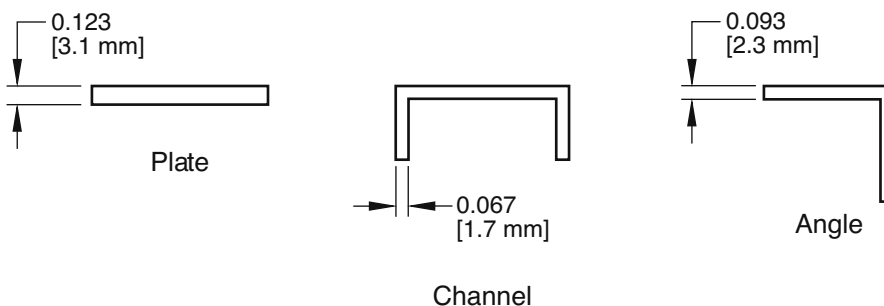


Figure 1 – Rigidity of angle or channel versus plate

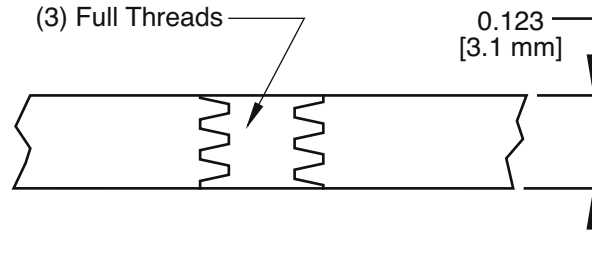


Figure 2 – Full #12-24 (nm) threads

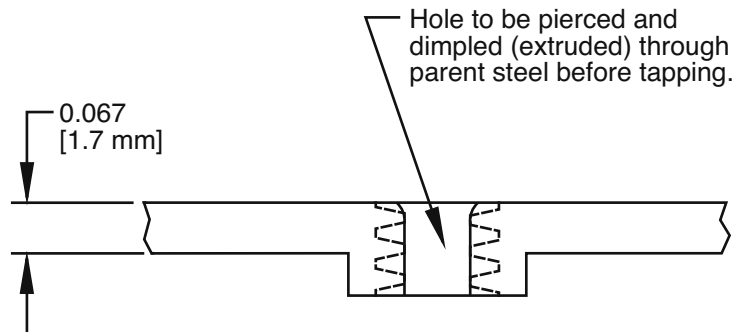


Figure 3 – Extrusion to create (3) full threads of #12-24 (nm)

based on HMMA 803 “Steel Tables.” Units without metric equivalents are indicated as (nm) (e.g. screws).

3 Reference documents

ANSI/SDI A250.8/SDI-100 “Recommended Specifications for Standard 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”

Machinery's Handbook

4 Recommended reinforcing thickness

The Manufacturer, based on individual construction methods and tooling capabilities, shall reinforce their product to insure performance in accordance with ANSI/SDI A250.4. This reinforcing shall include (unless noted

otherwise) reinforcing and tapped mounting holes for template hinges and ANSI defined locks as specified. Additional reinforcing for surface applied hardware shall be built into the door at the factory when specified.

As a guide to specification writers, table 1 shows the minimum thickness of steel to be used for hardware reinforcing as endorsed by ANSI/SDI A250.8.

5 Recommended application of hardware

5.1 Mortised hardware

Standardized and ANSI defined preparations are made at the factory to allow installation of mortise hardware such as hinges and locks. Holes shall be made to precise diameters and accurately tapped to insure maximum thread engagement and holding strength. Cutouts shall be pierced to surround the mortised hardware item to close tolerances on three or all four sides. The hardware shall be installed

using only the proper screws as furnished with or specifically recommended for each device.

NOTE: The installer must exercise caution upon initial insertion of screws to prevent cross threading, especially with the smaller diameter screws.

5.2 Field drilling and tapping

Doors and frames shall be prepared by the installer in the field for surface applied hardware, such as surface closers or holders, track type concealed closers or holders, pulls, exit device cases, or vertical rod latches. In addition,

some hardware such as anchor hinges, thrust pivots, pivot reinforced hinges or floor mounted pivots must be field prepared due to design variations or to provide adjustment that can only be provided at time of installation. The installer shall use a template provided with the device or the device itself to locate hole spacing.

5.2.1 A suitably sized punch shall be used to locate the drilling for pilot holes to prevent drill creeping, off-center holes and improper screw alignment.

Table 1 – Minimum hardware reinforcing thickness

Hardware Item	Door			Frame		
	inches	mm	MSG No. ⁽⁶⁾	inches	mm	MSG No. ⁽⁶⁾
Mortise Hinge 1-3/8" [34.9 mm] Door ⁽¹⁾	0.093	2.3	12	0.093	2.3	12
Mortise Hinge 1-3/4" [44.5 mm] Door ⁽¹⁾⁽²⁾	0.123	3.1	10	0.123	3.1	10
Mortise Lock or Deadbolt ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Bored Lock or Deadbolt ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Flush Bolt Front ⁽¹⁾	0.067	1.7	14	0.067	1.7	14
Surface Bolt ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Surface Applied Closer ⁽⁴⁾	0.067	1.7	14	0.067	1.7	14
Hold Open Arm ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Pull Plates and Bar ⁽³⁾	0.053	1.3	16	0.053	1.3	16
Surface Exit Device ⁽³⁾	0.067	1.7	14	0.067	1.7	14
Floor Checking Hinge	0.167	4.2	7	0.167	4.2	7
Pivot Hinge	0.167	4.2	7	0.167	4.2	7
Continuous Hinges ⁽⁵⁾	Not Required			Not Required		
Kick / Push Plate	Not Required			Not Required		

Note: The minimum steel thickness for each specific gage is derived from the published figures of Underwriters Laboratories, Inc.

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

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

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

⁽⁴⁾ Reinforcement shall occur on both sides.

⁽⁵⁾ Refer to section 6.

⁽⁶⁾ MSG No. to be used for reference purposes only.

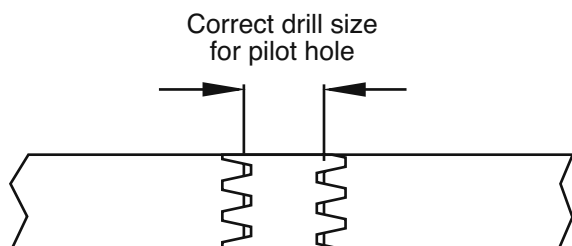


Figure 4 – Maintain a minimum of 65% of full thread

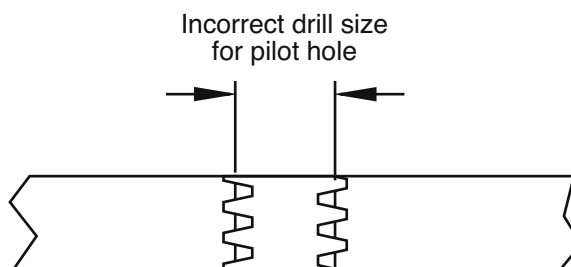


Figure 5 – Full thread shall not fall below 65%

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).

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

Table 2 – #10-24 thread (nm)

Drill Size	Drill Diameter	% Full Thread
#23	0.154"	66%
#24	0.152"	70%
#25	0.149"	75%
#26	0.147"	79%
#27	0.144"	85%
“Machinery’s Handbook” recommendation in BOLD		

Table 3 – #12-24 thread (nm)

Drill Size	Drill Diameter	% Full Thread
#15	0.180"	66%
#16	0.177"	70%
#17	0.173"	75%
“Machinery’s Handbook” recommendation in BOLD		

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

Size of Screw		No. of Threads per Inch	Tap Drills		Clearance Hole Drills			
No. or Diam.	Decimal Equiv.		Drill Size	Decimal Equiv.	Close Fit		Free Fit	
					Drill Size	Decimal Equiv.	Drill Size	Decimal Equiv.
0	.060	80	3/64	.0469	52	.0635	50	.0700
1	.073	64	53	.0595	48	.0760	46	.0810
		72	53	.0595				
2	.086	56	50	.0700	43	.0890	41	.0960
		64	50	.0700				
3	.099	48	47	.0785	37	.1040	35	.1100
		56	45	.0820				
4	.112	36*	44	.0860	32	.1160	30	.1285
		40	43	.0890				
		48	42	.0935				
5	.125	40	38	.1015	30	.1285	29	.1360
		44	37	.1040				
6	.138	32	36	.1065	27	.1440	25	.1495
		40	33	.1130				
8	.164	32	29	.1360	18	.1695	16	.1770
		36	29	.1360				
10	.190	24	25	.1495	9	.1960	7	.2010
		32	21	.1590				
12	.216	24	16	.1770	2	.2210	1	.2280
		28	14	.1820				
14	.242	20*	10	.1935	D	.2460	F	.2570
		24*	7	.2010				
1/4	.250	20	7	.2010	F	.2570	H	.2660
		28	3	.2130				
5/16	.3125	18	F	.2570	P	.3230	Q	.3320
		24	I	.2720				
3/8	.375	16	5/16	.3125	W	.3860	X	.3970
		24	Q	.3320				
7/16	.4375	14	U	.3680	29/64	.4531	15/32	.4687
		20	25/64	.3906				
1/2	.500	13	27/64	.4219	33/64	.5156	17/32	.5312
		20	29/64	.4531				

* Screws marked with asterisk (*) are not in the American Standard but are from the former ASME Standard.

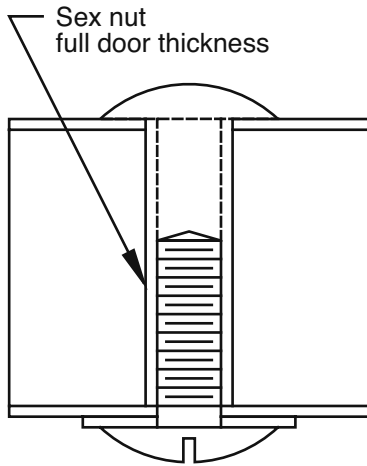


Figure 6 – Sex-bolted

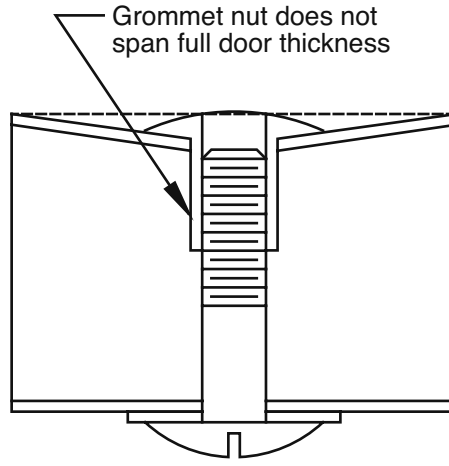


Figure 7 – Improper thru-bolting

to or greater than the thickness of the face sheets.

6 Continuous hinges

6.1 Standard preparation for continuous gear type or barrel type hinges shall not include any factory reinforcing, drilling and/or tapping in doors or frames. All mounting shall be prepared in the field by the hardware installer.

6.2 For continuous hinges that require reinforcing (either for fasteners, door weight, door size or frequency of use situations) reinforcing shall be indicated at the time of order.

6.2.1 Standard reinforcing shall be a 0.067" (1.7 mm) steel strip no less than 1-1/4" (31.7 mm) in width securely welded inside the hinge edge of doors and hinge jamb door rabbet of frames.

6.2.2 Optional reinforcing shall be a 0.067" (1.7 mm) steel strip no less than 1-1/4" (31.7 mm) in width securely welded inside the hinge jamb door side face of frames.

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

Appendix A

(informative)

Conclusion

It has been the experience of the Steel Door Institute that most failures of hardware attachments have been caused by improper field installation rather than insufficient reinforcement. It is quite obvious that it is easier to tap an oversize pilot hole than to tap one of correct size necessary for maximum strength. Oversized holes will not ensure adequate product performance.

Manufacturing tolerances and dimensions may not always be consistent on machine and sheet metal screws when compared with different sources of supply.

The material used for the manufacture of screws is also a factor in the overall performance of the attachment. Stainless steel, for example, is a stronger fastener than aluminum or plain carbon steel. On installations where vibration or unusual frequency of operation is a factor, the use of thread locking inserts, liquids on threads, or binding heads should be considered.

Standard steel doors and top grade 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"
- ANSI/SDI A250.7 “Nomenclature for Standard Steel Doors and Frames”
- SDI-117 “Manufacturing Tolerances for Standard Steel Doors and Frames”
- SDI-122 “Installation and Troubleshooting Guide for Standard Steel Doors and Frames”

AVAILABLE PUBLICATIONS

Specifications

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

Test Procedures

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

Construction Details

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

Miscellaneous Documents

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

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