



QUALITY CONTROL
TEMPLATE FOR HOLLOW
METAL DOORS AND
FRAMES MANUFACTURERS



This document was developed by representative members of the Hollow Metal Manufacturers Association Division (HMMA) of the National Association of Architectural Metal Manufacturers (NAAMM) to provide information and guidance on the development of a quality control program for hollow metal door and frame manufacturers. This document contains advisory information only and is published as an in-house document for the HMMA Division.

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FOREWORD

This document is intended as a guide for hollow metal manufacturers to develop or enhance their quality control program. The basics of a quality control program are outlined and these will need modification based on individual company's production flow.

The responsibility for quality control (QC) lies not only within a specific department (in larger organizations) but is the ultimate responsibility of each employee at each work station to include quality assurance as part of their task. Each company should have a minimum of one (1) person assigned to formulate inspection criteria, monitor, periodically review the QC program in addition to training employees on the importance of a quality control program and how to perform the quality checks.

Although this document has been developed around quality procedures on the production floor, the same quality control of check and balances should be inherent in the entire organization.

UL and their Follow-Up Service inspection program require that manufacturers provide a quality control system, which at a minimum the quality system must address the following elements to the extent necessary to maintain compliance with UL Requirements. Re: UL's document titled "UL Mark Surveillance Requirements."

1. *Product Assurance*
2. *Inspection and Testing*
3. *Documentation*
4. *Calibration*
5. *Material control such as procurement, verification and handling.*
6. *Nonconformance resolution and corrective action*
7. *Control of the UL Mark*
8. *Records*
9. *Other process necessary to assure compliance with UL requirements.*

The goal is to provide defect free products to the end user including:

1. Engineering and fabrication to customer specifications.
2. Proper labeling and packaging of products.
3. Correct quantities.
4. On-time shipments.
5. Delivery of product in an undamaged condition.

SCOPE

The basis of developing quality control is by checks and balances. Each operator needs to inspect the work of the station prior to and after performing their job assignment which includes inspecting their own work during and after completion. To accomplish these checks will require:

1. Proper training and involvement of all manufacturing employees.
2. Insure that all employees provide highest quality workmanship and perform inspections to ensure a quality product.
3. Employees should not knowingly produce or pass on to the next station defective product.

INSPECTION OF MATERIAL

The following list of manufacturing processes and inspection procedures are shown as a guideline. Not all manufacturers will follow the same production flow. Each individual company will need to develop documentation of such, and evaluate their individual manufacturing processes for their own Company specific processes and procedures. The intent is that each station is required to:

1. Inspect work performed by the station before them.
2. Perform their required task.
3. Inspect their own work.

MANUFACTURING TOLERANCES

The tolerance of manufactured products shall be in accordance with *ANSI/NAAMM HMMA 841, "Tolerances and Clearances for Commercial Hollow Metal Doors and Frames"*, included as Appendix "C" of this document. Manufacturing tolerances are also listed at individual sections within this document.

MEASURING EQUIPMENT, INSPECTION AND DOCUMENTATION

All measuring equipment such as; tape rulers and calipers (verniers and micrometers) used in the fabrication of hollow metal products must be inspected to ensure accuracy. In addition to the listed inspections below, all equipment must to be visually inspected each time they are used.

1. Appendix "A" - Tape Ruler Verification. Weekly or upon evidence of improper performance.
2. Appendix "B" - Verification / Calibration of measuring devices; Calipers, (verniers and micrometers).

Note: Underwriters Laboratory Inc. now requires companies with Follow-Up Services to maintain their own equipment. Please refer to UL Calibration Requirements: Equipment used for UL/C-UL/ULC Mark Follow-Up Services, which states calibration of measuring and test equipment must be conducted by an accredited calibration service provider annually.

MANUFACTURING PROCESSES

Shearing

All material shall be cut in accordance with work sheets. Door face sheets shall have all four (4) sides trimmed. Frame steel shall be squared at one side and the bottom prior to cutting any pieces.

Inspection of cut pieces for accuracy:

Small quantities – Inspect every piece.

Large quantities [six (6) or more], inspect 1st piece and spot check thereafter.

Acceptable Tolerance:

A. All parts; +/- 1/32 in., 0.031 in, (0.79 mm).

Punch Press

Material shall be punched in accordance with work sheets.

Inspection of punched pieces for accuracy:

Small quantities – Inspect every piece.

Large quantities [six (6) or more], inspect 1st piece and spot check thereafter.

Acceptable Tolerance:

A. Hardware cut out; Template dimension + 1/64 in., 0.015 in., (0.4 mm), - 0

B. Hardware location; +/- 1/32 in., 0.031 in., (0.8 mm)

C. Between hinge centerlines; +/- 1/64 in., 0.015 in., (0.4 mm)

Forming

Material shall be formed in accordance with work sheet.

Inspection of formed pieces for accuracy:

Small quantities – Inspect every piece.

Large quantities [six (6) or more], inspect 1st piece and spot check thereafter.

Acceptable Door Tolerance:

A. Width and Height; +/- 3/64 in. 0.046 in., (1.2 mm)

B. Thickness: +/- 1/16 in., 0.062 in., (1.5 mm)

Acceptable Frame Tolerance, cross sectional profile:

A. Face, Stop, Rabbet; +/- 1/32 in. 0.031 in., (0.8 mm)

B. Depth/Width; +/- 1/16 in., 0.062 in., (1.5 mm)

C. Throat; +/- 3/32 in., 0.093 in., (2.4 mm)

Mitered Joints

Mitered joints; either lazer cut, punched or saw mitered. When lazer cut or punch mitered, inspection shall be conducted prior to and after forming. When saw mitered, inspection will be at time of mitering and at next fabrication process.

Inspect for correct angle of miter, jamb opening height, and correct hinge locations from top of mitered rabbet.

Acceptable Tolerance:

A. Hinge location; +/- 1/32 in., 0.031 in., (0.8 mm)

Spot Welders

Hardware reinforcing preparation shall be welded inside of frame or door.

Hinge reinforcements; Projection/Spot Weld in three (3) places at each end.
Lock /Strike reinforcements; Projection/Spot Weld minimum two (2) welds per end.

Inspect for quality of welded marks, mortise depth, and alignment of screw holes.

Acceptable Tolerance:

A. Mortise depth; +/- 1/64 in., 0.015 in. , (.04 mm)

Welding of components such as closer reinforcement, floor clips, anchors, door core material and reinforcements for surface hardware shall be in accordance with project specifications.

Anchor spacing shall be to suit specific project requirements and or fire rating requirements.

Apply fire rating label on hinge edge of frame and door(s) prepared for mortised hinges or in header of frame and top of door(s) prepared for continuous hinges.

Inspect for quality of weld marks, correct label, quantity of welds, and location of anchors.

Spot Weld Twist Test

Determines two factors; (1) the size of the weld nugget and (2) the connectivity of the material. Used to verify the settings of a spot welder. Using two pieces of material representative of the material to be spot welded; overlap on one end and provide one weld in specimen. Rotate (twist) the two specimens until separation. Inspect for complete fusion and amount of nugget pull.

Drilling and Tapping

Verify that all material has been properly punched, drilled and tapped for all required mortised hardware with appropriate reinforcements, including silencer holes.

Existing wall anchors; Drill or punch jamb as specified and countersink hole to proper depth. Locate approximately 6 in. from top and bottom of frame and others equally spaced between.

Assembly

Frames shall be welded in accordance with project specifications as stated on work sheets. During assembly, the welder shall inspect for quality and accuracy.

Every representative sample shall be checked for:

- A. Squareness.
- B. Jamb opening size (width & height).
- C. Top hinge Location.
- D. Swing hand.
- E. Mark number.
- F. Label requirements.

Acceptable Tolerance:

- A. Jamb Depth/Width; +/- 1/16 in., 0.062 in., (1.5 mm)
- B. Hinge Locations; +/- 1/32 in., 0.031 in., (0.8 mm)
- C. Between Hinge Centerlines; +/- 1/64 in., 0.015 in., (0.4 mm)

Doors – Doors shall be constructed in accordance with shop sheets. During assembly, the door shall be inspected for quality and accuracy.

Every representative sample shall be checked for:

- A. Width & Height.
- B. Top Hinge Location.
- C. Swing Hand.
- D. Mark Number.
- E. Label Requirement.

At random, inspect for:

- A. Squariness; +/- 1/16 in., 0.062 in., (1.5 mm)
- B. Surface Flatness; +/- 1/8 in., 0.125 in., (3.1 mm)
- C. Perimeter Flatness; +/- 1/16 in., 0.062 in., (1.5 mm)
- D. Twist; +/- 1/16 in., 0.062 in., (1.5 mm)

Removable Glass Stops

Where required, frame and door products shall be provided with removable stops for glazing or infill panels. Inspect for correct quantity of pieces, length, and hole spacing.

Acceptable Tolerance:

- A. Width and Length; +/- 1/32 in., 0.031 in., (0.8 mm)

Finishing

After fabrication, tool marks and surface imperfections shall be filled and sanded as required to make face sheets, vertical edges and weld joints free from irregularities and dressed smooth.

Dressed smooth is defined as having a surface roughness < 1 mil. Respectively, when surface roughness is < = 1 mil., a prime coat of 1.5 mils or greater and a finish coat of paint will hide the grind marks. Finish coat of paint to have a maximum gloss rating of 20% reflectance, measured using a 60 degree gloss meter

Link to testing equipment: www.ktagage.com

Shipping

The employee in charge of loading, known as the shipper, shall check overall quality of product, quantity of material and required labels, including any loose items.

The shipper shall record on the "Bill of Lading", arrival and departure time of all brokerage trucks. After loading, the shipper shall confirm the quantities of material loaded.

CALIBRATION / VERIFICATION

Scope:

This scope applies to the verification or calibration of measuring devices; Calipers; (verniers and micrometers) used in production operations and the quality assurance (QA) program. These instructions define the process for the calibration or verification. These devices are to be tested semi-annually.

Process:

As required or upon evidence of improper performance, all measuring devices shall be calibrated or verified.

Testing Instructions, Verification:

Definition: **Verification** - Checking the measuring device and returning it to service with no adjustments made.

Inspect device for damage or wear, clean all mating surfaces and check function of device for smooth operation. Measure four (4) gauge blocks with device before adjusting to determine a pre-adjustment reading. Select one gauge block from the lower part of range, two from center of range, and one from top part of range. Log dimensional readings on attached log.

If device measures within the tolerance range of +/-0.002 in., re-measure the gauge blocks. If it still measures within range, mark device as verified and return to service. Log each dimensional reading on attached log.

If the device measures outside tolerance range, determine if and what corrective action is required. Check for damage or wear. Determine if device is serviceable, clean, repair as required and re-inspect. If still out of range and cannot be re-adjusted, remove from service.

Testing Instructions, Calibrated:

Definition: **Calibration** - The act of adjusting the out of tolerance measuring device to bring it back into acceptable tolerance range.

Devices:

Dial Caliper shall be calibrated in accordance with ISO 10012 (Latest Rev.), following procedure NEM-8.0 Rev. 1.

Micrometer shall be calibrated in accordance with ISO 10012 and ARME B89.1.13 (Latest Rev.), following procedure NEM-7.0 Rev.-2.

Establish a system to record the verification of measuring devices, sample below.

VERIFICATION LOG

ID Number: _____

Equipment Description: _____

Model Number: _____ Gage Serial Number: _____

Manufacturer: _____

Purchase Date: _____ Purchased From: _____

Issue Date: _____ Issued To: _____

Calibration Date: _____ Frequency: _____

Next Due Date: _____

Condition as Received: _____

Range: _____ Tolerance: - _____ + _____

Linearity: _____

Temperature: _____

Relative Humidity: _____

Barometric Pressure: _____

Action Taken: _____

Remarks: _____

Calibrated/Inspected by: _____

Equipment used to certify: _____ Date: _____

Storage Location: _____

Current Location: _____

Notes:

STANDARDS							
U.O.M.	(-) Tolerance (+)			Readings		OK/OUT	
	Minimum	Nominal	Maximum	Before	After		
	0		0			0	
	0		0			0	
	0		0			0	
	0		0			0	
	0		0			0	
	0		0			0	
	0		0			0	
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METAL DOORS & FRAMES



ANSI/NAAMM HMMA 841-07
June 12, 2007

TOLERANCES AND
CLEARANCES FOR
COMMERCIAL
HOLLOW METAL
DOORS AND FRAMES

ANSI/NAAMM HMMA 841-07
June 12, 2007



METAL DOORS & FRAMES



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This standard was developed by representative members of the Hollow Metal Manufacturers Association Division (HMMA) of the National Association of Architectural Metal Manufacturers (NAAMM) to provide their opinion and guidance on the manufacturing tolerances including installation and operating clearances of hollow metal frames and doors. This standard contains advisory information only and is published as a public service by NAAMM and its HMMA Division. NAAMM and its HMMA Division disclaim all liability of any kind for the use, application, or adaptation of material published in this standard.

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FOREWORD

Accurate fabrication and installation are essential to the performance of doors and frame product. The requirements for manufacturing and installation are given in the following Sections. The manufacturer is responsible for producing doors and frame product that comply with these Sections. However, it is important to recognize that proper installation is not the responsibility of the hollow metal manufacturer. For this reason, the requirements for installation should be included in the Section of the specifications where installation work is specified. It shall be the responsibility of the general contractor, using experienced installers, to perform the work outlined below. For additional information regarding installation see NAAMM HMMA 840, "Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames".

Hollow metal doors are undersized to fit the door opening in the frame. Final clearances and relationship between door and frame product depend on the setting of the frame and the hanging and adjustment of the door and hardware. Recommended clearances must be met to ensure functional operation.

Operating clearances for Commercial Security, Detention Security, and Sound Control doors and frames depend upon the requirements of specified hardware. See ANSI/NAAMM HMMA 862, Guide Specifications for Commercial Security Hollow Metal Doors and Frames, ANSI/NAAMM HMMA 863, Guide Specifications for Detention Security Hollow Metal Doors and Frames, and ANSI/NAAMM HMMA 865, Guide Specifications for Swinging Sound Control Hollow Metal Doors and Frames. Operation of sound control doors and frames is dependent on the clearances of individual manufacturer's design.

The values stated in inch-pound units are to be regarded as the standard. Corresponding metric values are included in the parenthesis for reference purposes only.

1. REFERENCED DOCUMENTS

Note: The publications listed in this section form a part of this standard to the extent referenced. The publications are referenced in the text by basic designation only. When a more recent standard is available, the specifier shall verify its applicability to this standard prior to its inclusion.

- A. ANSI A250.11 Recommended Erection Instructions for Steel Frames
- B. ANSI/NFPA 80 -2007, Standard for Fire Doors and Fire Windows
- C. NAAMM HMMA-810 TN01-03 Technical Note, "Defining Undercuts."
- D. NAAMM HMMA-840-99 Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames

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2. MANUFACTURING TOLERANCES

- A. Manufacturing tolerances shall be maintained within the following limits:
 - 1. Frame product for singles or pairs of doors (See Figure 1)
 - a. Width, measured between rabbets at the head:
 nominal opening width + 1/16 in. (+1.5 mm), - 1/32 in. (- 0.8 mm)
 - b. Height (total length of jamb rabbet):
 nominal opening height + 1/16 in. (+1.5 mm), - 1/32 in. (- 0.8 mm)
 - 2. Frame for glazing materials or panels, height and width of each opening ± 1/16 in. (1.5 mm)
 - 3. Surface flatness of factory assembled frame product (measured in any direction with straight edge placed on face of frame product)..... Max. 1/8 in (3.1 mm)
 - 4. Cross sectional profile dimensions (See Figure 2)
 - a. Face± 1/32 in. (0.8 mm)
 - b. Stop± 1/32 in. (0.8 mm)
 - c. Rabbet for door/glass/panel.....± 1/32 in. (0.8 mm)
 - d. Depth± 1/16 in. (1.5 mm)
 - e. Throat± 3/32 in. (2.4 mm)

Frames overlapping walls (except slip-on construction) to have throat dimension 1/8 in. (3.1 mm) greater than dimensioned wall thickness to accommodate irregularities in wall construction.

5. Doors; Tolerances for actual hollow metal door sizes are as follows (See Figure 3):
 - a. Width.....± 3/64 in. (1.2 mm)
 - b. Height.....± 3/64 in. (1.2 mm)
 - c. Thickness.....± 1/16 in. (1.5 mm)
 - d. Perimeter flatness.....1/16 in. (1.5 mm) maximum
 - e. Surface flatness1/8 in. (3.1 mm) maximum
 - f. Twist.....1/16 in. (1.5 mm) maximum
 - g. Squareness.....1/16 in. (1.5 mm) maximum
6. Hardware (See figure 1 & 3):
 - a. Cutouts.....Template dimensions + 1/64 in. (0.4 mm), - 0
 - b. Location± 1/32 in. (0.8 mm)
 - c. Between hinge centerlines.....± 1/64 in. (0.4 mm)
 - d. Face cutout for hinge+ 1/16 in. (1.5 mm), -0
 - e. Mortise depth of reinforcement.....± 1/64 in. (0.4 mm)

These tolerances provide a reasonable guideline for manufacturing of hollow metal products. However, it should be noted that the cumulative effect of manufacturing tolerances at or near their maximum levels could have an effect on operating clearances. Tolerance buildup occurs when several tolerances are at or near their maximums. Care should be taken to keep each of these tolerances as close to zero as possible.

3. INSTALLATION TOLERANCES

- A. The installer shall perform the following:
 1. Prior to installation, the area of floor on which the frame is to be installed, and within the path of door swing, shall be checked for flatness and levelness. Permissible tolerance is +/- 1/16" (1.5 mm) . If the floor exceeds this, it is the general contractor's responsibility to correct the area that is out of tolerance before the frame is installed.
 2. During the setting of the frame check and correct as necessary for opening width, opening height, squareness, alignment, twist and plumbness. Permissible frame product installation tolerances shall be maintained within the following limits: (see Figure 4)
 - a. Opening widthmeasured from rabbet to rabbet at top, middle and bottom of frame; + 1/16 in. (1.5 mm), - 1/32 in. (0.8 mm)
 - b. Opening heightmeasured vertically between the frame head rabbet and top of floor or bottom of frame minus jamb extension at each jamb and across the head; ± 3/64 in. (1.2 mm)
 - c. Squarenessmeasured at rabbet on a line from jamb, perpendicular to frame head; not to exceed 1/16 in. (1.5 mm)
 - d. Alignmentmeasured at jambs on a horizontal line parallel to the plane of the face; not to exceed 1/16 in. (1.5 mm)
 - e. Twistmeasured at opposite face corners of jambs on parallel lines perpendicular to the plane of the door rabbet; not to exceed 1/16 in. (1.5 mm)
 - f. Plumbnessmeasured at jambs on a perpendicular line from the head to the floor; not to exceed 1/16 in. (1.5 mm)

Prior to installation, doors and frame shall be checked for correct size, swing, fire rating and opening number.

Brace, level and square frame as specified in HMMA 840 and ANSI A250.11

Hardware shall be applied in accordance with hardware manufacturers' templates and instructions.

These tolerances provide a reasonable guideline for proper installation of hollow metal frame product. However, it should be noted that the cumulative effect of the installation tolerances at or near their maximum levels could result in sufficient misalignment to prevent the door from functioning properly. Installers should be careful not to create a tolerance buildup. Tolerance buildup occurs when several tolerances are at or near their maximums. Care should be taken to keep each of these tolerances as close to zero as possible.

3. Proper door edge clearances shall be maintained in accordance with Section 4 except for special conditions otherwise noted. Where necessary, steel hinge shims, furnished by the installer, shall be used to maintain clearances.

Installers and end users must be aware of thermal bow which can affect edge clearances. Thermal bow is a temporary condition that occurs when opposing sides of a door are exposed to extreme temperature differences. The effects of thermal bow depend upon the color of the door, door construction, ambient temperatures on each side of door (extreme hot or cold climates), and direct sunlight. An example of a door susceptible to this condition would be an exterior door on the southern side of a building exposed to direct sunlight. A door exposed to direct sunlight may bow and appear to be warped during part of the day and then straighten as the direct sun passes over it. The effects of thermal bow can be reduced by painting the exposed surface of the door a lighter color.

4. OPERATING CLEARANCES

- A. Edge clearance for swinging hollow metal doors and as specified in ANSI/NFPA 80, shall be provided for the functional operation of the assembly and shall not exceed the following (for all door heights):
 1. Between doors and frame at head and jambs1/8 in. (3.1 mm) ± 1/16 in. (1.5 mm)
 2. Between meeting edges of pairs of doors.....1/8 in. (3.1 mm) ± 1/16 in. (1.5 mm)
- B. Floor clearance for fire rated swinging hollow metal doors shall not exceed 3/4" (19.0 mm). Floor clearance shall be provided for the functional operation of all swinging hollow metal doors and shall not be less than 1/8" (3.1 mm)

The Architect must define the distance from the top of the floor/finished floor to top of floor covering so appropriate undercuts can be provided. Floor/Finish Floor is defined as the top of the concrete or structural slab. HMMA uses the term 'top of floor covering' to describe the NFPA term 'nominal surface of floor covering'. Please refer to HMMA-810 TN01-03 Tech Note, "Defining Undercuts."

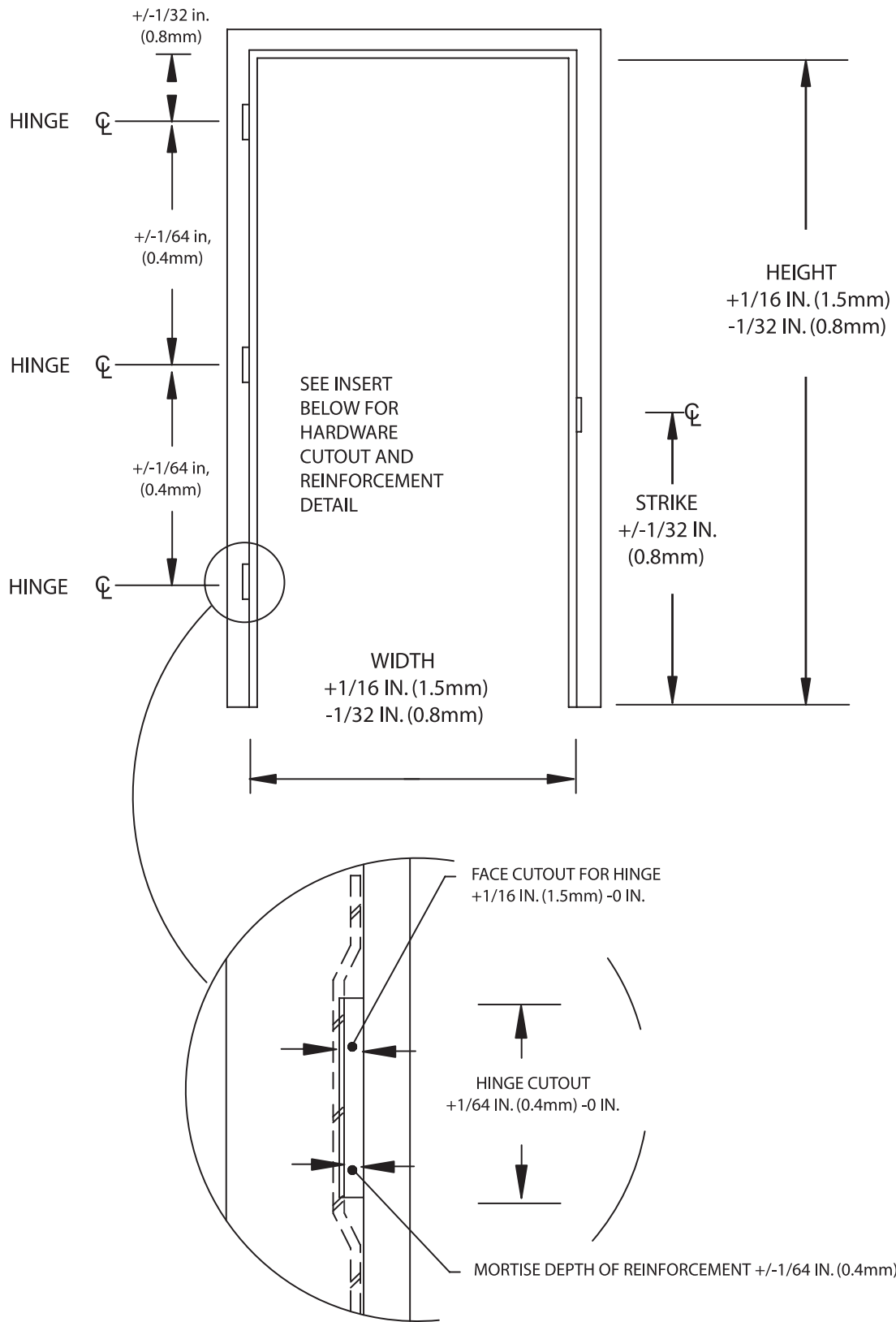


FIGURE 1
FRAME TOLERANCES

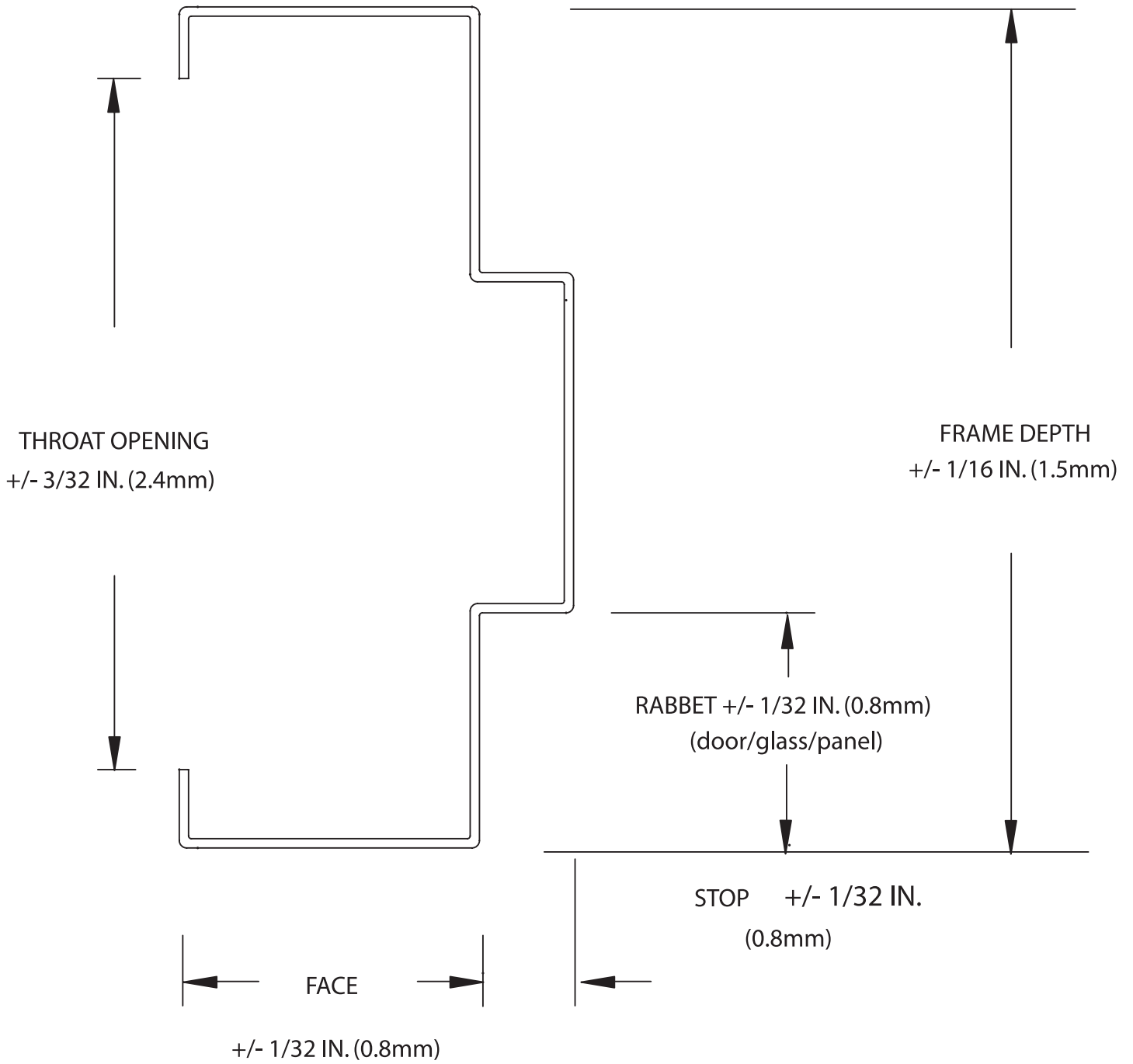


FIGURE 2
CROSS SECTION PROFILE TOLERANCES

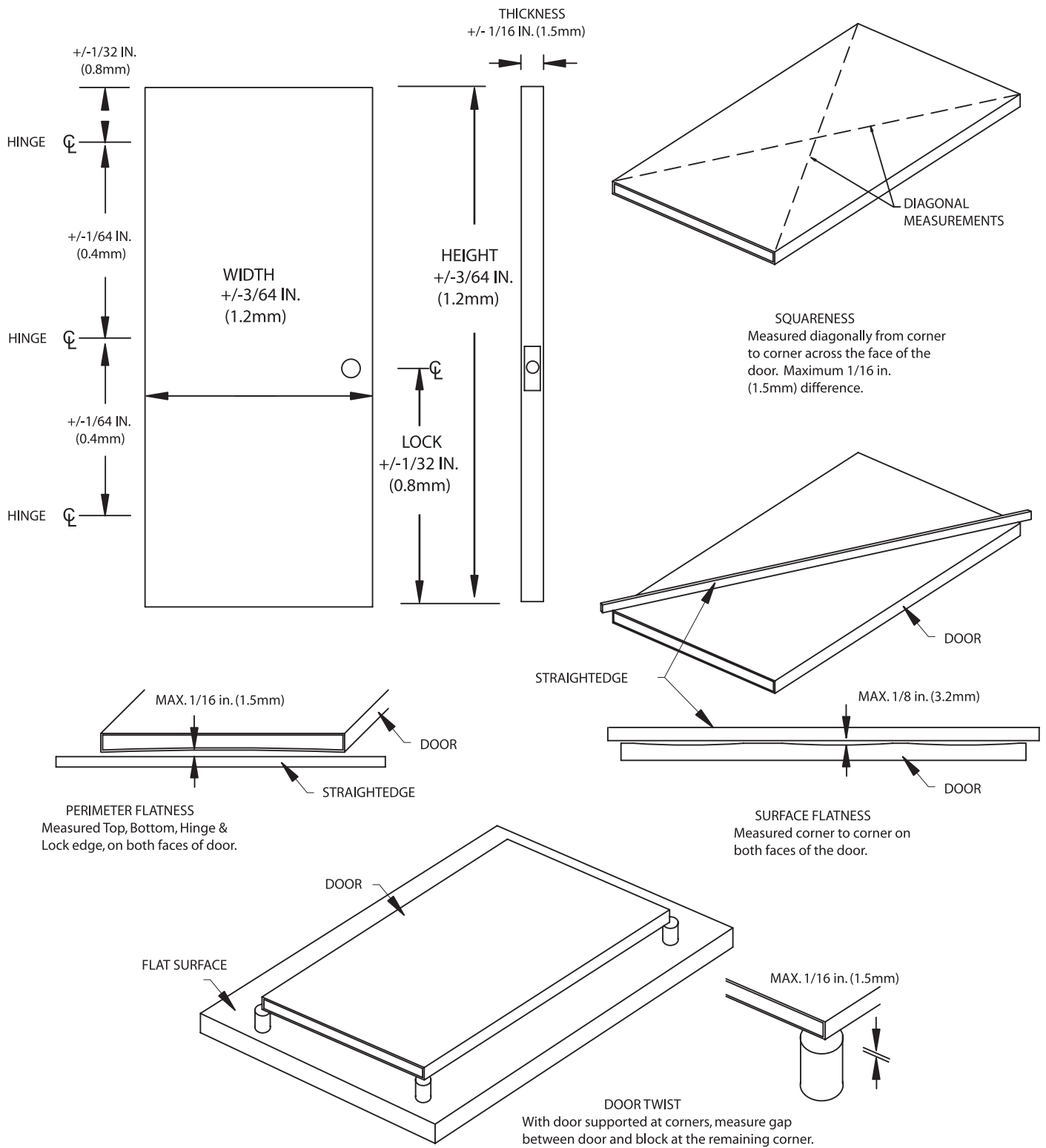


FIGURE 3
DOOR TOLERANCES

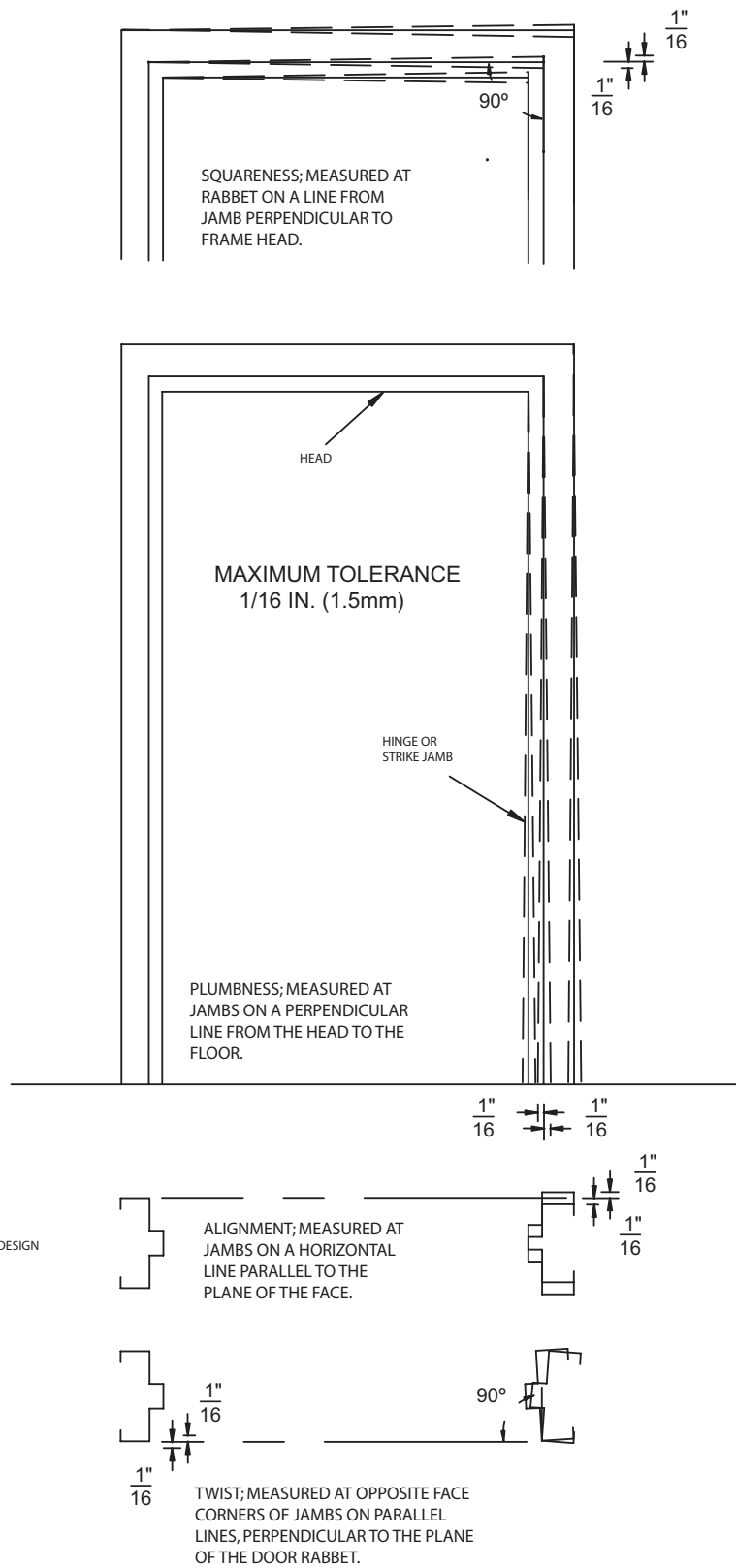


FIGURE 4
FRAME INSTALLATION TOLERANCES

RECOMMENDED GUIDE SPECIFICATIONS FOR HMMA HOLLOW METAL DOORS AND FRAMES

HMMA 860 — Hollow Metal Door and Frames

ANSI/NAAMM

HMMA 861 — Commercial Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 862 — Commercial Security Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 863 — Detention Security Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 865 — Swinging Sound Control Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 866 — Stainless Steel Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 867 — Commercial Laminated Core Hollow Metal Doors and Frames

RECOMMENDED GUIDE SPECIFICATIONS FOR HOLLOW METAL DOORS AND FRAMES

HMMA 860 - Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 861 - Commercial Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 862 - Commercial Security Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 863 - Detention Security Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 865 - Sound Control Hollow Metal Door and Frame Assemblies

ANSI/NAAMM

HMMA 866 - Stainless Steel Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 867 - Commercial Laminated Core Hollow Metal Doors and Frames

RELATED HMMA DOCUMENTS

HMMA 800 - Introduction to Hollow Metal

ANSI/NAAMM

HMMA 801 - Glossary of Terms for Hollow Metal Doors and Frames

HMMA 802 - Manufacturing of Hollow Metal Doors and Frames

HMMA 803 - Steel Tables

HMMA 804 – Quality Control Manual

HMMA 810 - Hollow Metal Doors

HMMA 820 - Hollow Metal Frames

HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames

HMMA 831 - Recommended Hardware Locations for Hollow Metal Doors and Frames

HMMA 840 - Installation and Storage of Hollow Metal Doors and Frames

ANSI/NAAMM

HMMA 841 - Tolerances and Clearances for Commercial Hollow Metal Doors and Frames

HMMA 850 - Fire-Rated Hollow Metal Doors and Frames

HMMA 890 - Technical Summary

HMMA 810-TN01 - Defining Undercuts

HMMA 820-TN01 - Grouting Hollow Metal Frames

HMMA 820-TN02 - Continuously Welded Frames

HMMA 820-TN03 - Guidelines for Glazing Hollow Metal Transoms, Sidelights and Windows

HMMA 840-TN01 - Painting Hollow Metal Products

HMMA 840-TN02 - Maintenance of Installed Hollow Metal Products