Overview: Installation instructions

These installation instructions are only guidelines. Errors and Omissions statement from TECH DATA p.6 applies to this document. Applicable building codes, standards and accepted practices apply. Follow installation and ICC500 requirements. Align with the architect, project engineer and other contractors. The Authority Having Jurisdiction is the final authority in issues related to the installation and use of any building products. This doc is supported by typical installations found in our collaboration with the Steel Door Institute (SDI). Reference "Prep and Installation Videos" of SDI Videos *(referenced videos are not tornado specific).*

TABLE OF CONTENTS (links)

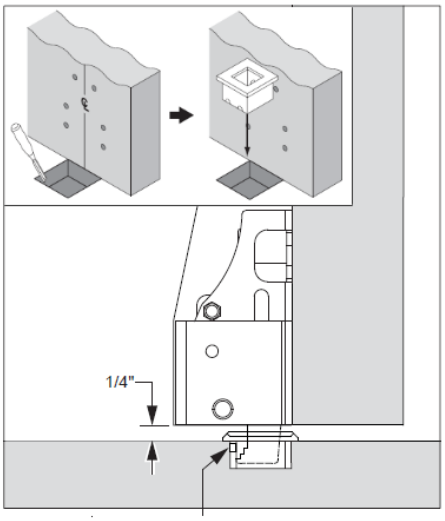
HELPFUL LINKS (webpages and downloads)

- STEELCRAFT.COM Paladin Website links (site right margin)
  - Customer Bulletin – Explains ICC 500-2020 offering
  - TECH DATA (link) see TORNADO SECTION
    - Approved doors/hardware pp212-215
- ALWAYS FOLLOW HARDWARE INSTALLATION INSTRUCTIONS, TEMPLATES, AND DATA SHEETS
  - *Allegion Document Library*
  - ***See last page for Tornado document links***
- SUPPORT
  - email support@allegion.com (subject: Steelcraft) Call (877) 671-7011 #1
  - email STEELCRAFT TECHNICAL PRODUCT SUPPORT Call (877) 671-7011 #2, #5

A. ORDERING PALADIN FRAMES AND DOORS

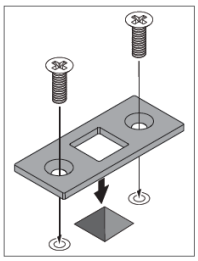
1. For ordering the correct undercut and installing correctly, reference latching hardware installation instructions. The door gap is 1/4" (~1/8" from bottom of door to top of lip on a WS-T-304L cup strike) (see section F.12) (FIG. 1) or 1/8"-1/4" to the top of an LM9300 strike plate (FIG. 2). Manufacture strike must always be used and must be anchored (LM9300) or grouted (WS-T-98/9927/57) into slab as directed by hardware instructions.
2. Installations must follow hardware & accessory manufacturer guidance in data sheets, installation instructions and templates. See helpful links, Steelcraft Paladin webpage right margin, or search the Allegion Document Library for Allegion hardware or accessory catalogs, tech data, and installation instructions. For installation into concrete foundations and shelter walls, follow ICC500 industry code which includes references to other industry codes such as ACI 318 for structural concrete and ACI 530 for masonry structures. Verify any requirements with your local AHJ (Authority Having Jurisdiction), the final authority in issues related to the installation and use of any building products.
3. As with all Tornado Doors and Frames, order frames and doors based on opening size, which is the horizontal dimension from rabbet to

FIG. 1 – WS-T-98/9927/57: BOTTOM GAP about 1/4" to finished floor when strike lip sits on slab (max 0.285" when using max .125 required distance from bottom of latch housing to top of 0.16" thick strike lip).
See Section F.11 – Grouting procedure. Threshold configurations shown affecting door undercut.



Undercut WS-T strike (48047926) shown. Undercut should be oriented as shown.

FIG. 2 - LM9300: BOTTOM GAP 1/8"-1/4" from bottom of door to top of strike. See Section F.11 – grouting procedure shown must be used when using thresholds to ensure connection of strike to slab (no cavity/grout used when attaching strike directly to slab).



rabbet, and vertical dimension from bottom of frame to head rabbet. Targeted door gaps are 3/32” to jambs, and 1/8” to the head. ICC500 limits door undercuts to 3/4".

4. Handing – Correctly understanding handing in ordering and installing tornado products is critical to life safety. See "Handing procedures diagrams" (FIG. 3) also in tech data p11 as well as tornado-specific handing details on p208.
5. Glass kit with frame will be installed from the factory. Care instructions are provided on the glass sticker and in TECH DATA p164 and p207. Stickers should be removed after installation and paint. See FIG. 4 handing chart. (FIG. 4). Call support or email support@allegion.com, subject Steelcraft, for glass replacement options.
   - The Exterior, or Outside, is always the Storm side (the side of the door that faces a storm). Typically, this is the Key Side, but not always (e.g. not typical, but if the shelter is the hallway and a connected classroom is outside of the shelter, the outside of your door would face the classroom since that is the side facing the outside, or storm side, of the shelter).
   - The Interior, or Inside, is always the Safe side (the side on the inside of your shelter or safe room). Typically, this is the non-Key Side, but not always (e.g. not typical, but if the shelter is the hallway and a connected classroom is outside of the shelter, the inside of your door would face the hall since that is the side facing the inside, or safe side, of the shelter).
   - Note that PW doors may be inswing or outswing when using lever trim. But PW doors with panic exit hardware will always be outswing with the panic bar on the safe side and the door opening out towards the Outside, or Storm side.
6. Shutter frames – Handing. Shutters protecting from glass windows would be ordered straight handed/inswing (FIG. 4). Straight handed without

FIG. 3 – HANDING CHART

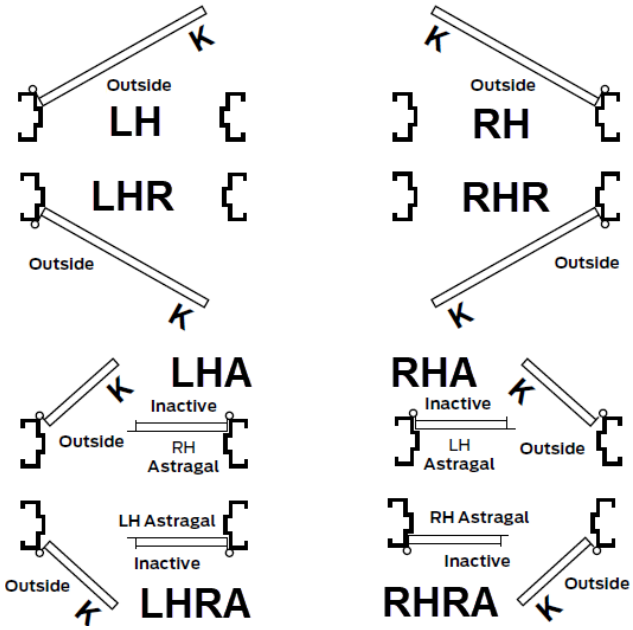


FIG. 4 – HANDING CHART, FACTORY INSTALLED PALADIN LIGHT

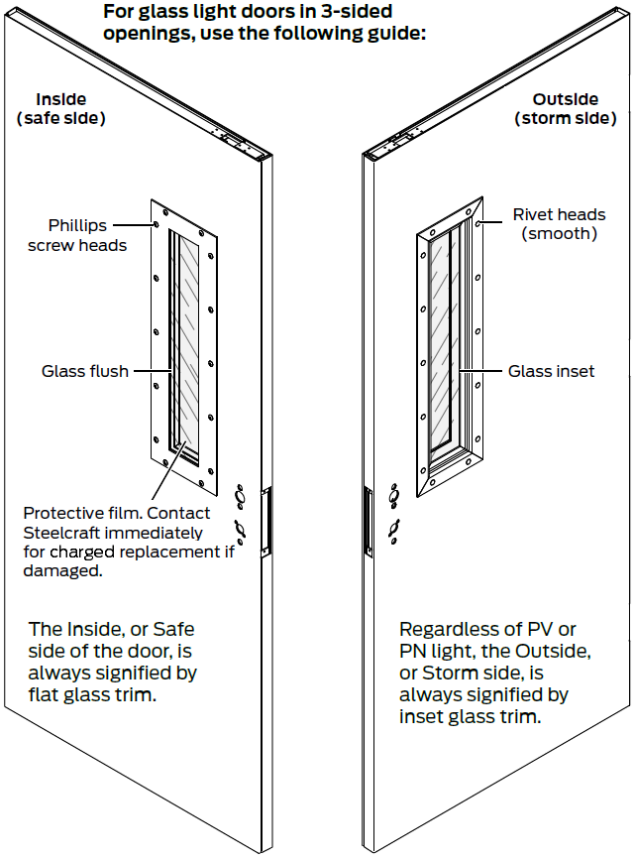
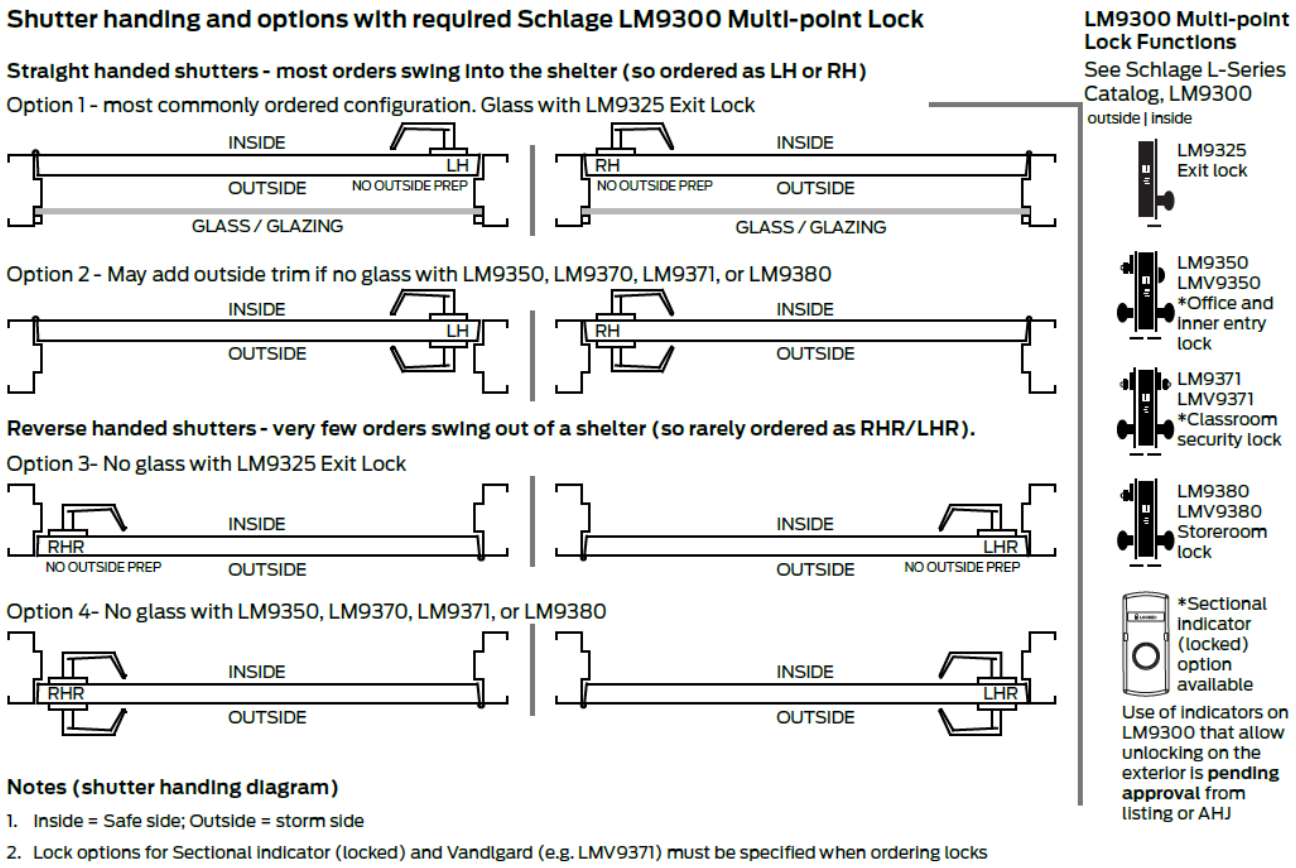


FIG. 5 – STRAIGHT HANDED, OPTION 1 &2 ; FIG. 6 – REVERSE HANDED, OPTION 3 & 4



7. Order Acknowledgement – Sent to the email on file. It is important to review to avoid delays and costly changes within 24 hours. Contact support@allegion.com, subject "Steelcraft – Incorrect Order!" with order number.

B. **FP FRAME INSTALLATION**

1. Follow installation as a guide, noting differences with Paladin Frames in the instructions below. See SDI/Allegion collaborative video under SDI Videos > Steel Door and Frame Installation > How to Install Frames in Masonry Construction *(note videos here are not tornado specific)*
2. **As with any frame installation, take the time to make certain that frames are continually checked for "plumb, level and square" throughout the installation.**
3. Match frame and opening location by opening number or mark number (FIG. 7). Verify ICC500 / FEMA 361 label, as well as fire label if applicable. Confirm handing of frame to drawings/door schedule/hardware schedule.

FIG. 7 – MATCH OPENING LOCATION AND FRAME MARK NUMBER

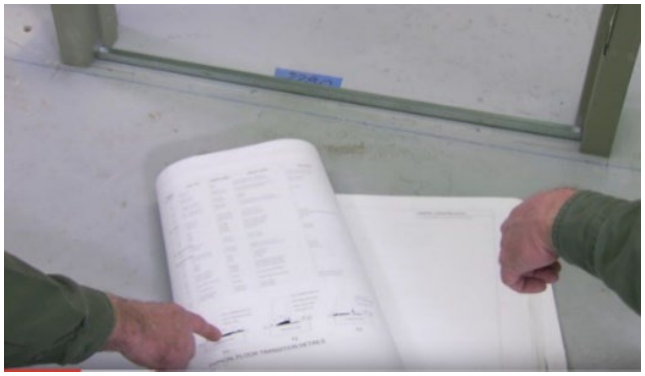


FIG. 8 – PROPERLY GRIND OFF SHIPPING BAR

4. Verify correct reinforcement, hinge size, strike type, closer and other reinforcements for mounting hardware.
5. Determine floor finish (concrete, wood, tile, etc.). Verify correct frame size and undercut. The latch must always engage the strike which must be securely embedded (WS-T-304L, FIG. 26) or anchored (LM strike plate, FIG. 2) into the concrete slab, regardless of threshold or finished floor. See FIG. 29 for a typical Saddle less common rabbeted (bumper) thresholds for WS-T-98/9927/57 latching, with ADA install.
6. You may need to fix uneven floors prior to frame installation to avoid problems in closure, latching and maintaining an even gap/undercut.
7. Frames may be ordered KD or SUA (Welded). Refer to Tech data. An SUA frame will arrive with a shipping bar welded to the base of the frame to prevent collapsing and twisting in transit. Do not use shipping bar to set the frame. Grind off bar prior to setting the frame (FIG. 8, previous page); do not hammer off bar to avoid damage to the frame.
8. KD frames are assembled using the corner tab/slots (see Tech data).
9. **New masonry wall construction install** (e.g. grout filled CMU block walls), set your frame first and then build 3000 psi grout filled CMU block walls up evenly on both jambs.
    - Lay out your frame on the floor per drawings prior to setting the frame.
    - Verify handing, hardware reinforcements, hinge size, strike type and closer mounting
    - Precisely cut square spreader to maintain proper frame spacing setting frame (FIG. 9).
    - Verify the jambs are plumb, head level, and frame is square. Install base anchors into concrete (FIG. 10), adjust with screws to keep head level and to achieve proper floor clearance. Frame may be shimmed with galv metal shim (see B.11 Shimming).
    - Set frame using back braces and spreader bars (FIG. 11).

FIG. 9 – CUT ACCURATE SPREADER BAR TO NOMINAL WIDTH

FIG. 10 – ADJUSTABLE BASE ANCHOR INSTALL WITH DRIVE PIN ANCHOR

FIG. 11 – TEMPORARILY BRACE FRAME

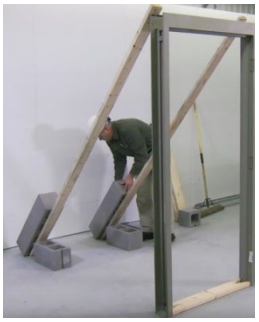


FIG. 12 – INSTALL TIE WIRE FOR INWARD TENSION

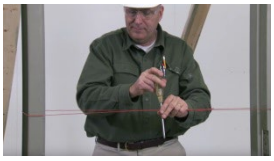


FIG. 13 – ADD MID-HEIGHT SPREADER

FIG. 14 – MASON SHOULD CHECK PLUMB, LEVEL, SQUARE BEFORE BEGINNING

FIG 15. LAY BLOCK, CHECKING FOR PLUMB, LEVEL AND SQUARE EVERY TIME YOU MAKE AN ADJUSTMENT

- For openings with electrical components, now install conduit or flex cable.
- Install a piece of tie wire at about 48” from the floor and twist tight to hold inward tension on the spreader bar (FIG. 12).
- Add a mid-frame temporary spreader to keep frame straight and aligned (FIG. 13).
- Mason should check plumb, level and square before beginning (FIG. 14).
- Lay block and fill with grout evenly on both sides, lightly tapping the frame to settle the grout fill. Mason should check plumb, level and square before starting and throughout the process (FIG. 15).
- **For Paladin frames anchoring, see** Tornado II Drawing – Flush or Tornado II Drawing – Glazed pp.8-14.
  - For jambs in new masonry with CMU block, the order will include approved Masonry T anchors to be placed between top 2 blocks, bottom 2 blocks, and every other block as evenly as possible for nominal 8”x8”x16” CMU blocks (FIG. 16). Masonry T’s are provided in your order and keep jambs in place by holding tight against stops.
  - For heads, use EMA’s or Lintel wedge anchor assembly (FIG. 17).
  - 4-sided shutters come with EMA bolts for heads and sills, but for heads, you may specify the same Lintel wedge specified in 3-sided masonry frames.
- After laying 8-9 courses, the masonry should be allowed to set, typically overnight. Leave spreaders and temporary back bracing in place overnight. Clean out any grout from hinge pockets and strike reinforcements, as well as on the floor. **Continue checking “plumb, level and square” and be sure the frame does not move from your layout lines on the floor (FIG. 18).**
- On day two, carefully remove the back braces and continue laying brick. The head

FIG. 16 – MASONRY T IN JAMBS SHOWN WITH 4” FACE IN LINE WITH BLOCK COURSING

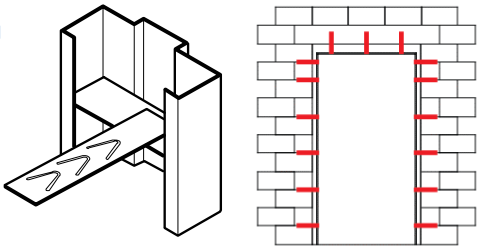


FIG. 17 – LINTEL WEDGE ANCHOR ASSEMBLY IN HEADS FOR NEW MASONRY APPLICATIONS

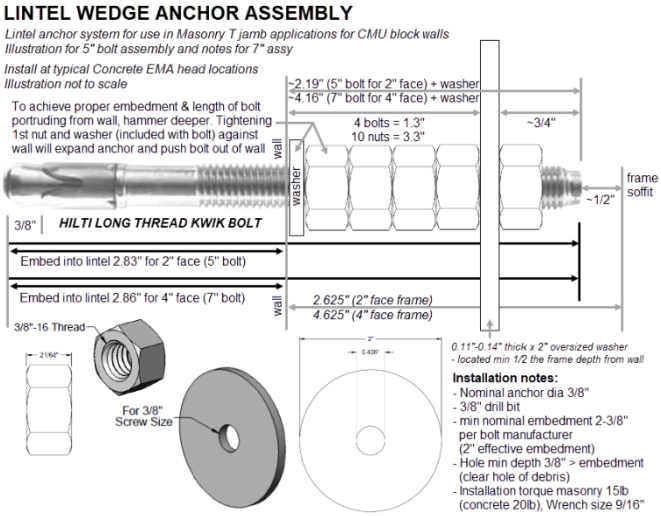
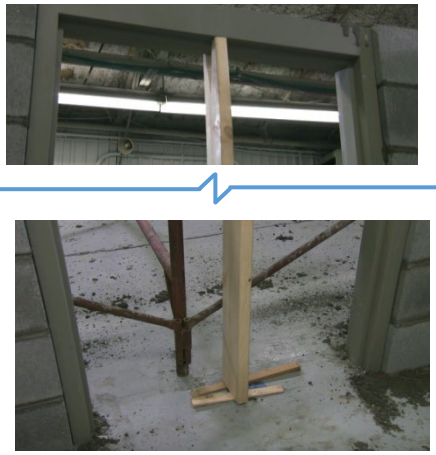


FIG. 18 – MASON CHECKS PLUMB, LEVEL, SQUARE BEFORE LAYING BLOCK AND THROUGH BUILD PROCESS

FIG. 19 – TYP A HIGH PSI PREFAB CONCRETE LINTEL IS USED, ALTHOUH PROPER STEEL LINTELS MAY ALSO BE SPECIFIED. REF NON-TORNADO SDI/ALLEGION MASONRY INSTALL VIDEO min 7:50-8:30. ENSURE NO SAGGING.

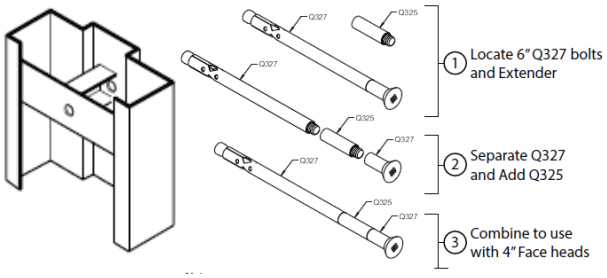
will need grout fill as well, followed by the lintel above the head (FIG. 19). Check again for plumb, level, and square, and be sure no sagging has occurred in the head. Remember that any time you fill a head > 42" length with grout, you need to use a vertical brace from head to floor to prevent sagging in the head (FIG. 20). This completes installation in new construction.

FIG. 20 – SUPPORT HEAD WITH VERTICAL BRACE ON ANY HEAD OVER 42" LONG. SHIM AS NEEDED TO KEEP HEAD LEVEL.



10. **Existing masonry wall construction install** (typically tilt up, pre-fab concrete, or CMU walls installed prior to frame installation), the same rules of plumb, level and square apply.
    - Wall condition must be provided on the order for proper anchor quantities and locations. These specific anchors and locations will be provided automatically from the factory at the time of the order and will appear on the order acknowledgement and invoice.
    - If any anchor interference is possible [with hardware or other], please reference our Anchor Lookup Tool or reference anchor drawing details, see Tornado II Drawing – Flush or Tornado II Drawing – Glazed pp.8-14. Factory may adjust anchor locations +/- 3" to avoid interference.
    - For quantity of EMA anchors, see our Anchor Lookup Tool on our Paladin site, right margin downloads.
    - Min edge distance and other requirements are listed in anchor drawing details, Tornado II Drawing – Flush or Tornado II Drawing – Glazed pp.8-14 for all approved anchoring specifications.
    - You will install the KD or SUA frames using Existing Masonry Anchors. The bottom EMA serves as the base anchor (typ located approximately 2.5" above the bottom of the frame).
    - All EMA's will use welded-in tube and strap anchors in dimpled frames provided from the factory (FIG. 21), along with approved Hilti anchor bolts (FIG. 21-22). 2" face heads will use our 5" bolt and do not require grout filled frames.
    - 4" face heads use our 6" bolt with extender requiring minor assembly (FIG. 21).
    - Unlike 2" face, 4" face heads require full grout using standard industry practices (1" hole max in head, later groove welded & finished smooth).

FIG. 21 – WELD-IN TUBE AND STRAP (TSTRAP) ANCHORS IN DIMPLED FRAME TO ACCEPT TAPERED FLAT HEAD SLEEVE ANCHORS, INCLUDING ASSEMBLY FOR 4" FACE HEAD APPLICATIONS

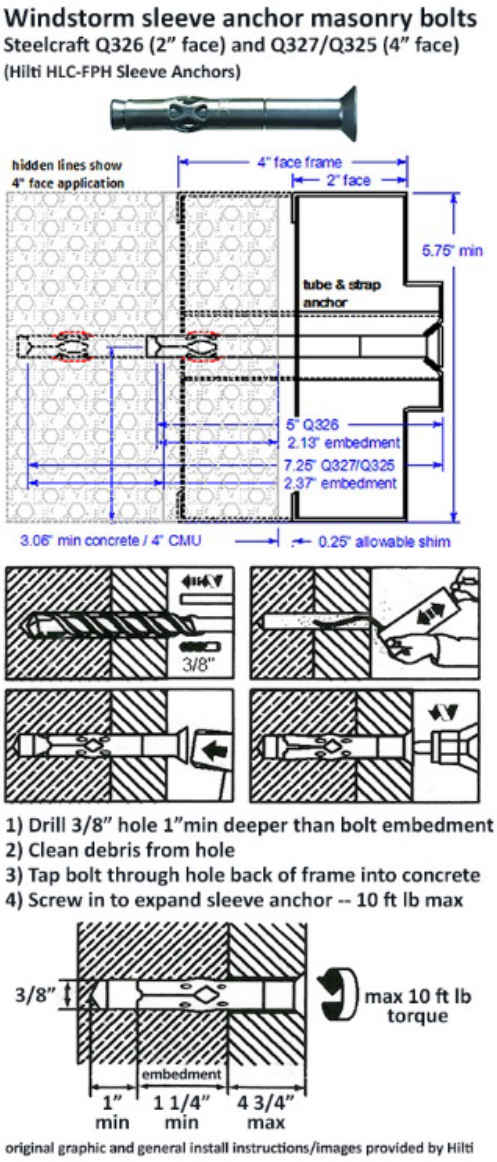


    - Use Steelcraft primer. Use rust preventative frame back coating is recommended but not required.
    - For EMA anchor bolt details, see our price book and Tornado II Drawing – Flush or Tornado II Drawing – Glazed pp.8-14. Contact support for bolt manufacturer tech data.
    - Bolt installation (FIG. 22). Drill a 3/8" hole approx. 3-4" deep, or the manufacturer recommended 1" min deeper than the bolt embedment depth. Bolt manufacturer required embedment is 1-1/4" into Concrete or CMU block, although your typical embedment, using approved bolts and 1/4" shims, will be approx 2-1/8" with 2" face frames, and approx 2-3/8" using 4" face frames. Review wall construction to avoid any steel reinforcement within 1/2" of this wall depth or as recommended by engineer. See ANSI B212.15 for drill bit tolerances. Blow the hole clean. Do not expand the anchor

prior to installation. Drive the anchor through the frame and tube and strap anchor until anchor is firmly seated and to the required embedment depth. Tighten the anchor by turning the head 3 to 5 turns past finger tight, to manufacturers recommendation of 10 ft-lbs. torque (FIG. 22).

- Notes on Lintels and concrete shelter walls. Lintels are typically a high PSI concrete (FIG. 19), bond beams, or a 3/16"-1/4" Steel plate lintel (all are allowed to be used with our product). Structural planning should keep internal concrete wall steel reinforcements away from anchor bolt locations to avoid interference. If wall reinforcements are hit when predrilling EMA bolts, you must drill through these reinforcements to install your anchor. Check with the shelter contractor, architect, structural engineer, or licensed professional engineer, but this typically is allowed (does not affect the integrity of the walls).

FIG. 22 – EMA BOLT INSTALLATION (2" AND 4" FACE HEADS OPTION) WITH BOLT MANUFACTURER'S MIN REQUIREMENTS



11. **Frame installation, gaps and shimming**. ICC 500 defers to the manufacturer's listing and installation instructions. Follow this guide and standard industry protocols.
    See the following including resources and links:
    - ANSI A250.11 -- Frame installation instructions including shimming the frame into the opening, with reference to SDI 122 -- Reviews shimming after door is hung including adjustments at hinges to fix gaps
        - Gaps up to 1/4" may be caulked. Larger/deeper gaps fill with backer rod, metal filler strips or similar as recommended by engineer or architect for aesthetics to resist airflow in windstorms.
        - Material used should be non-combustible as needed so as not to negate fire ratings.
    - **How-to Shim Door Hinges** – Reference SDI 122 with videos. Galvanized steel shim material is recommended to ensure shims will sustain loads designated by testing protocols and to resist corrosion.
    - **Meeting edges of pairs** of beveled edge doors target 3/32, max 3/16" meeting edge (ICC 500/NFPA80). You may shim hinges max 1/16" per hinge leaf to close excess meeting edge or other gaps. Galv steel shims must be used to avoid corrosion or compression during use and over time.
    - **Allowable Gap and Shimming between Wall and Frame** (rough concrete or CMU block wall opening to frame backbend) is 1/4" at head and each jamb.
        - Larger Shim Space allowed if Grouting full. **PER10146 Grout Filled Shim Space** signed/sealed 3rd party licensed PE Report for Tornado Door Systems allows grouting up to 1-1/8" max shim space for 2" face jambs and heads anchored with our 5" bolts, and 1-3/8" max for 4" face heads anchored with our 7-1/4" bolt assemblies. Reference EMA's in Tornado II Drawing – Flush pg10.

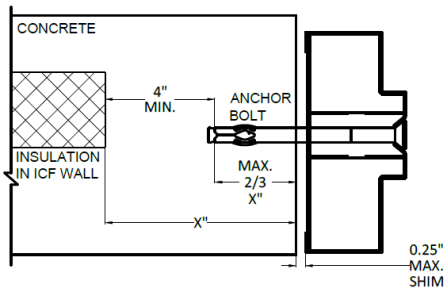
Install using standard industry practices:
1) Hinges and hardware shall be blocked off prior to frame installation to keep grout from interfering with hardware operations.
2) Use Galv Steel shims to set the frame plumb, level, and square using methods provided in Section B FP Frame Installation; install using provided Hilti bolts or approved equivalent at all EMA anchor locations.
3) Block the shim gaps with wooden forms so the concrete will be flush with the frame faces or extend past the faces. Fully grout each frame component or total frame if outside of the typical accepted gaps but within the allowable limits noted above using standard industry practices.
4) The grout used must have a minimum compressive strength of 3000 psi with a 4" maximum slump and must be poured/pumped and vibrated such that mixture has no air bubbles and is fully cured. Cleanly cut 1" maximum diameter holes in the frame to insert the grout. The 1" diameter piece of steel removed from the frame shall be replaced with the same or equivalent galv steel by tack welding back and forth (groove weld) from one side of the hole to the other over the full circumference and pausing (to avoid the frame from becoming too hot and warping) until filled with weld material.
5) Remove forms and touch up as needed. Grind and finish smooth, prime, finish paint. No visible weld marks at grout hole locations.

- **ICC 500 references**
  - ICC 500 306.4.4 Joints, gaps or voids shall not allow a direct debris path into the protected area and must impact at least 2 surfaces first. If not, joints shall be a maximum ½" (gap, void) and shall be sealed with joint material that complies with TMS 602 or masonry and ASTM C920 for concrete.
  - ICC 500 306.4.4 Joints, gaps or voids in a storm shelter envelope that opens into the protected occupant area shall be protected by permanent opening protection as approved by the engineer of record and the authority having jurisdiction.
  - ICC 500 306.5.1 Masonry control and expansion joints. Masonry control and expansion joints shall be a maximum ½" (gap, void) and shall be sealed with joint material that complies with TMS 602 or masonry and ASTM C920 for concrete.

C. **FP FRAME ANCHORING**

1. Anchor drawing details. Tornado II Drawing – Flush or Tornado II Drawing – Glazed pp.8-14.
2. Anchor installation quality. Locations and quality of installation should be checked and verified prior to and during installation to ensure quality of anchoring/installation. Reference this Guide and Steelcraft.com Paladin section, including downloads in the Steelcraft.com right margin.
3. Anchor locations and quantity. Order will provide the correct locations and quantity of anchors based on wall construction and frame size. Reference the following links for approximate anchor locations: Standard Anchor Locations and Anchor Lookup Tool (Excel).
4. Anchor bolts. Quantity and type figured for openings are based on wall construction and frame size. The correct type and quantity of bolts are added to the frame order and ship with ordered product. Replacement bolts can be found in the price book parts section to order as needed if misplaced.
5. Collaborate with other Tornado Shelter Contractors. Plan well in advance of manufacturing and construction to avoid interference that might hinder proper installation and anchoring, causing expensive fixes or replacements later, is imperative. For example, placement of concrete or CMU block reinforcement (rebar) should be clear of the frame's anchor locations and embedment including tolerance per the contractor. If rebar interferes it must be drilled through to achieve bolt engagement.

6. Replacement frames. New frames should avoid old anchor locations and will be located appropriately 2-3” from old locations by Steelcraft upon request. The old anchor bolts can be cut at the wall to avoid interference with the new frame. If bolt is removed from the wall, the cavity must be filled completely with min 3000lb concrete or similar (e.g. CTS RapidSet Cement All non-shrink grout), and wall repaired to original specifications (align with Tornado shelter contractor for wall repairs). Old bolts Repairs and old anchor locations (ref 1:20 if bolts removed) fill with min 3000lb concrete/wall psi or as a good option for repairs up to 4” (must follow manufacturer’s instructions; CTS tech support 800-929-3030). If not possible to avoid old locations, alternate anchoring methods may be used, such as bolting 1/8” steel plates at anchor locations and welding the frame to the plates, p.13 of Tornado II Drawing – Flush and FBC EHPA II Drawing II Flush.
7. Min 3000 PSI recommended for any concrete, concrete filled CMU, lintel, slab, as well as filling bottom strike cavities and thresholds as needed. Verify specific requirements found on Anchor Assy Drawings, pp.8-14, and direction from concrete manufacturer, architect and licensed PE.
8. Allowable gap at wall rough opening and frame is 1/4" at head and each jamb. See Max Gap and Shimming between Wall and Frame in Section B.11 for Larger Shim Space allowed when Grouted. PER 9515 Grout Filled Shim Space.
9. In drilling holes for EMA expansion anchors, drill min 1" deeper than the anchor sleeve final actual embedment, blow out dust, and install expansion anchor bolts tightened to 10 ft lb max.
10. Grouted frame throats. Frames do not require grouting except in 4" face heads and in new masonry jambs, heads or sills, which must be grouted full.
11. Anchors per location – 2 per location for JD’s greater than or equal to 9-1/8".
12. Edge distance is measured from center of bolt to opposite side of CMU block.
13. ICF Walls. For anchoring into ICF walls (insulated concrete forms) bolt embedment cannot exceed 2/3 the thickness (“X”) of the solid concrete, and must have 4” min solid concrete behind embedded bolt. All anchor spacing and edge distance requirement must be maintained. SEE IMAGE RIGHT.



14. Additional information available at Steelcraft.com. Email Steelcraft Product Technical Support / call (877) 671-7011. General video installation reference *(not tornado specific)*, see SDI Videos.

D. **PW DOOR INSTALLATION**

These installation instructions are only guidelines. Applicable building codes, standards and accepted practices apply. Follow typical door installation and ICC500 requirements. The Authority Having Jurisdiction (AHJ) is the final authority in issues related to the installation and use of any building products. Typical installation details are supported by a video collaboration with the Steel Door Institute (SDI). See “Steel Doors and Frame Installation” of SDI Videos – Videos are not tornado-specific.

1. In the SDI video link above, see *(not tornado video)* installation ”How to Install a Steel Door,” and review callouts of this guide. *Take care, noting that Tornado doors weigh considerably more than typical doors.*

FIG. 23 – CHECK PLUMB, LEVEL AND SQUARE PRIOR TO DOOR INSTALLATION

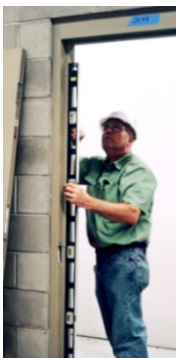


FIG. 24 – VERIFY HINGE LOCATIONS

2. Locate the correct door using the mark number on the doors and verify on the drawing and hardware schedule. Verify ICC500 / FEMA 361 label, as well as fire label if applicable.
3. **Prior to beginning, check the frame for plumb, level and square** (FIG. 23). A good door installation can rarely make up for a poor frame installation, see SDI/Allegion collaborative videos *(not tornado specific)* to reference in this situation. See SDI Videos, Prep and Installation Videos, Troubleshooting Videos.
4. Verify correct hinges and locations on drawings and the hardware schedule. Dimension taken from top of the door to top of the hinge cutout will be 1/8" less than the dimension from the rabbet to top of frame hinge cutout (FIG. 24).
5. Check screw holes and reinforcements to be sure they are clear. Use the correct tap and machine screw provided by Ives, the approved hinge manufacturer (FIG. 25).
6. Check schedule or submittal to verify std or heavyweight hinges. For HW hinges, remove (pull out) existing wire spacers, adjust set screw or break off existing hinge fillers (FIG. 26).
7. Attach Ives hinges to door. Install hinge pins with open end toward the bottom of the door.
8. To begin installing the door, set it up on end and onto a wood wedge or similar spacer to line up door and frame hinges. Align and install top hinge on door to top frame hinge reinf (FIG. 27).
9. Install middle and bottom hinges to the frame.
10. Remove the wedge spacer under the door and test for proper door closure and proper gaps. Reference SDI-122 for Bind or Alignment issues, and SDI/Allegion Troubleshooting Videos.
11. Install the lockset, closer or any other auxiliary hardware. After installing locksets, open and close the door to ensure the latch is engaging properly.

FIG. 25 – CLEAR FOREIGN MATTER

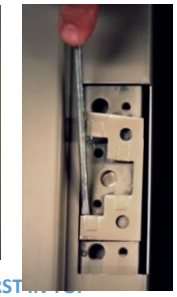


FIG. 26 - REMOVE FILLER PLATE FOR HEAVY WEIGHT HINGES

FIG 27 – INSTALL IVES HINGE FIRST

E. **FIELD MODIFICATIONS**

1. Field modification of ICC 500 approved Steelcraft doors and frames is not acceptable and will void applied labels and warranties with the following exceptions:
   - Limited hardware preparations aligning with NFPA 80, where applicable. Drilling of mounting holes allowed only for approved hardware as detailed in our Schlage Lock Co/Steelcraft Paladin assembly listings.
   - 1" Holes max for grouting frames where required (e.g. 4" face heads).
   - Repair of unused holes not exceeding 1/2" for hardware preps and not exceeding 1" for holes drilled for grouting frames. Repair shall use like material using groove welds to fully close, finish smooth and prime paint with manufacturer recommended primer.
   - Bondo fill non-structural areas of doors and frames, including punch and dimple holes
   - Other alterations are not accepted without prior approval which may require written permission from the labeling agency and may necessitate field inspection and re-labeling. Please be advised, any

modification to internal reinforcements, breakage of welds, and / or latch-strike preparations will nullify label and certification.

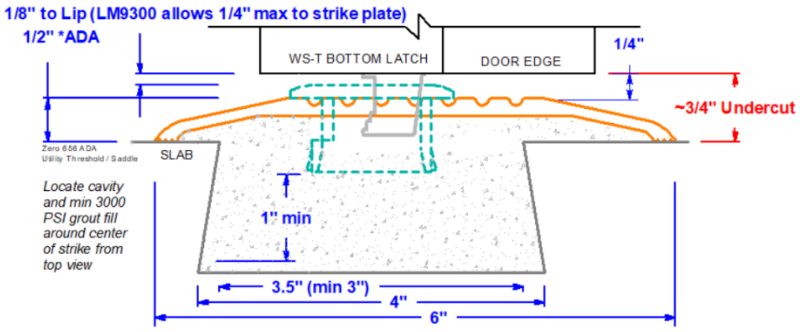
F. **SEALS/GASKETING; THRESHOLDS; BOTTOM LATCHING; SIGNAGE**

See Approved models Steelcraft Tech data, p214-215. All seals, gaskets, and thresholds must be listed.

1. Avoid special gasketing. Maintain proper latching and avoid potential binding or interference.
2. **When using a threshold, refer to hardware installation of strikes (page 1 help links) and items 11-12 below. With or without threshold, the bottom strike must always be anchored into the slab with bolts (LM) or concrete (WS-T) to ensure a direct structural connection of door and frame to slab.**
3. Avoid surface auto door bottoms since they can interfere with the bottom latch.
4. Surface mounted seals work well but may need cut short to fit around the closer mounting and sometimes the WS-T RIM strike mounting.
5. Approved continuous hinges may be used to seal the jamb edge.
6. Do not use a top jamb and strike jamb seal to avoid cutting around latches in the field.
7. Gaskets, seals, or thresholds must not impede or affect the function of the opening or latching hardware.
8. Zero recommends thresholds extend 3/8” past the door thickness if possible.
9. Zero V3 Full body strength option available for thresholds (for heavy duty commercial traffic, schools, etc.)
10. Use 6” wide or greater saddle thresholds when using surface vertical rods; consider Zero 546, 656.
11. Rabbeted / Bumper thresholds consider 566 when ADA is required, or 568 when ADA is not required. Consider Rain Drips for water infiltration.
12. For screw applied meeting edge gasketing, consider Zero 328.
13. For sweeps and door bottoms, consider Zero 139.
14. **Thresholds and WS-T-98/9927/57 bottom strike install notes:**
    - First set threshold in place to mark strike location per hardware install instructions.
    - Cut hole and mark slab under threshold. Remove, mark, and cut 3”x3” min cavity in slab with undercut as shown below, centered around strike. Hole extends 1" min below installed strike location.
    - Clean, re-attach threshold and fill with 3000 psi grout (consider CTS RapidSet) so that min 3” area around strike is fully grouted from slab through the threshold and securely anchoring the strike.
    - Prior to grouting, mask/add foam block to the cavity slot in the sidewall of the 304L-WS cup strike.
    - **Orient WS-T 304L cup strike correctly with the slot on the same side as the stepped latch.**
    - After grouting, insert strike and use a 1”x1” square wood post to push grout down about 3/4”-7/8” so that the engaged latch will rest within 1/4” of the grout but does not touch the grout in the cup strike.
    - Clean area and remove/clean masking/foam block in sidewall of cup strike so the stepped latch bolt will engage strike on impact. Let set.
    - See undercuts section 16 below.

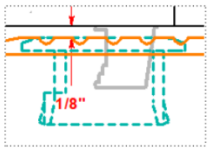
FIG. 29 – WS-T-98/9927 Pair and WS-T-98/9957 Single -- BOTTOM STRIKE INSTALLATION WITH THRESHOLD EXAMPLES

For required Installation Gaps posted in hardware installation instructions, see bottom page 1, FIG 1 for WS-T and FIG 2 for LM9300. Threshold placements may vary to best suit opening. Reference ADA link [2010 ADA Standards for Accessible Design.]

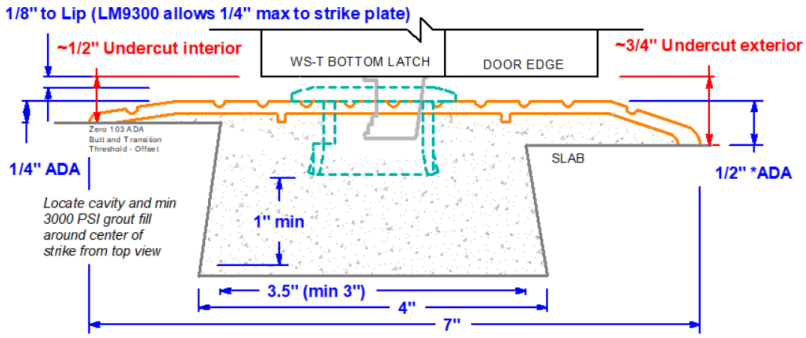


Zero 656 (6" wide version shown)
1/2" ADA Threshold - Ulility / Saddle type
Other 1/2" saddle options: 5" wide=**655** for LM9300 only, 7" wide=**647**, **657**, **6570**, 7.5" wide=**6575**.

*Consult with your AHJ for ADA compliance. Depending on how the AHJ interprets ADA sections 404.2.5, 303.1-3, the strike may need to be embedded into the threshold flush with the top of the 1/2" threshold as shown in image to right.

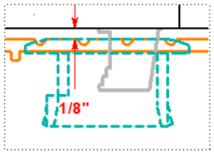


5/8" Undercut option

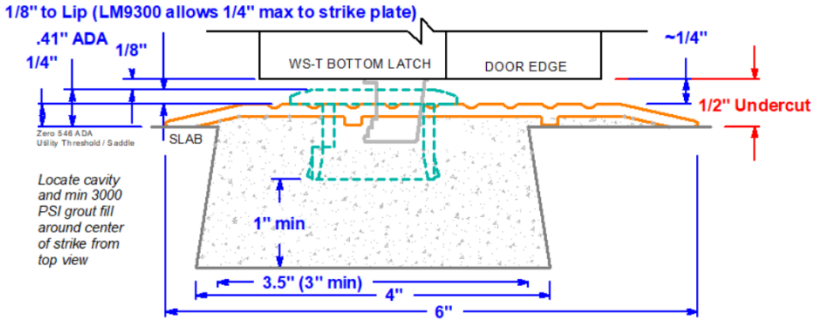


Zero 103 ADA (7" wide version shown)
1/4"/1/2" Butt & Transition Threshold -Offset
7" wide x 0.25" offset step shown
Other offset options: 5.5"x0.25" step=**102**, 6"x0.5"=**104**

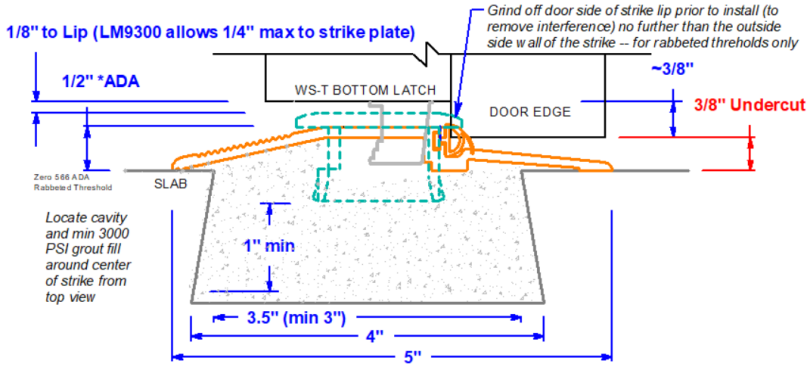
*Consult with your AHJ for ADA compliance. Depending on how the AHJ interprets ADA sections 404.2.5, 303.1-3, the strike may need to be embedded into the threshold flush with the top of the 1/2" threshold as shown in image to right.



5/8" Undercut option

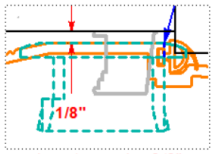


Zero 546 (6" wide version shown)
1/4" ADA Threshold - Ulility / Saddle type
Other 1/4" saddle models:
545=5" wide, **547**=7", **548**=8"



Zero 566 (5" wide, for water infiltration)
1/2" ADA Threshold - Rabbeted type
NOTE: SADDLE TYPE IS RECOMMENDED UNLESS REQUIRED FOR WATER INFILTRATION
Other 1/2" rabbeted option: 6" wide (not ADA)=**568**

*Consult with your AHJ for ADA compliance. Depending on how the AHJ interprets ADA sections 404.2.5, 303.1-3, the strike may need to be embedded into the threshold flush with the top of the 1/2" rabbeted (bumper) threshold as shown in image to right.

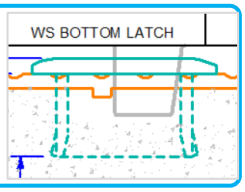


undercut remains 3/8"

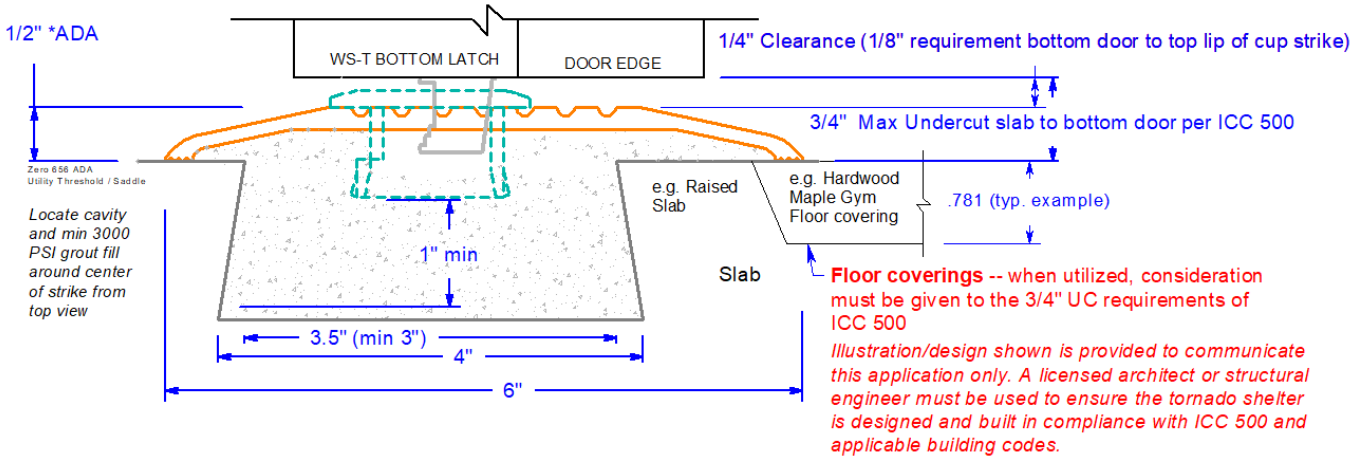
[Link to WS Strike Installation drawing with 566A Rabbeted Threshold] (does not show new WS-T 304L cup strike which **must be oriented so the slot accepts the stepped latch.**)

NOTE: The **WS** 304L Cup Strike used with WS-T-98/9957 Singles uses the same design as 2014, shown to the right.

Other illustrations above show the new **WS-T** 304L strike with slot for WS-T-98/9927 pairs. **With pairs, the Slot MUST orient towards the inside** of the shelter/away from door.



15. **Undercuts.** The door undercut is the distance from the bottom of the door to the bottom of the frame (slab). The Frame should sit on the structural foundation with finished floor cut around the frame, not placed under the frame. The threshold may sit on thinner finished floors but the strike must be grouted into the foundation as shown. Thicker floors should carefully consider the slab and grouted threshold to maintain maximum structural connection between slab and grouted in threshold as shown below as a possible example. *A licensed architect or structural engineer must be used to ensure this connection and the total tornado shelter is designed and built in compliance with ICC 500 and applicable building codes.*
    - 3/4" maximum allowable undercut per ICC 500 is provided as the default in orders to allow for a typical 1/2" ADA saddle threshold if the strike plate (LM) or lip (WS-T) sits on the threshold. Note some AHJ's may require the plate/lip to be embedded into the threshold flush so that the top of the strike is at 1/2" ADA requirement. For any other threshold to fit your opening, you must calculate and specify your undercut when ordering. See the examples above for some common thresholds and dimensions. See approved thresholds in Steelcraft Tech data, Approvals p214-215.
    - ICC 500-2020, 306.4.1.5 **Door undercut**. Door assemblies in the storm shelter envelope shall be limited to a 3/4" max undercut. ICC defines undercut as the bottom of the door to the floor/slab (not the floor covering)
    - NFPA 80, 4.8.4.2 - **Clearance** under the bottom of the door shall be measured vertically from the bottom of the door to the top of the finished floor or threshold.



16. **Signage.** The General Contractor is responsible for posting clear signage on the safe side, supported by lock indicators where available to communicate to occupants when and how to lock during a storm event. If no lock indicator is used, additional information may be required for clear understanding by the occupants. The following is provided as possible examples:

If outside lever trim is able to be left unlocked with inside lockdown feature:

KEEP DOOR CLOSED AND LOCKED
DURING STORMS

Best practice when outside lever is exit only:

OUTSIDE IS **ALWAYS LOCKED**
MUST USE KEY TO ENTER

G. INSTALLATION and MAINTANANCE CHECKLISTS

Qualification Checklist prior to installation (reference Paladin Website Downloads for additional information)

1. ☐ Each installer is an experienced tradesman, skilled in the application of tornado hollow metal doors and frames with a record of successful in-service performance for installing hollow metal doors and frames similar in quantity, type, and quality to that indicated for this project.
2. ☐ ICC 500-2020 and fire labels located on door edge and frame rabbet; or door top/head for continuous hinges. Remove masks
3. ☐ Hardware provided for installation is approved – reference Steelcraft Tech data, Approvals p214-215, and Certified Labeling Body Public Listings found on H. ICC 500 TORNADO DOCUMENTS and RESOURCE MATRIX LINKS
4. ☐ All hollow metal and hardware is in accordance with reviewed shop drawings and manufacturer's printed installation and anchoring instructions per ICC 500-2020. Installation Instructions are provided and understood.

Functional Checklist

5. ☐ Verify anchoring and installation of frames.
   - Frame should be securely anchored to shelter walls, backbends not overlapping nonstructural pieces such as brick veneer.
   - Anchoring quantity and approximate locations can be checked using our anchor lookup tool (file > create copy > download).
   - **Grouting required on 4" face heads** or when using shim spaces above 1/4" up to 1-1/8" at jambs and 1-3/8" at heads.
6. ☐ All hollow metal and hardware securely installed in place without twists, warps, bulges or other unsatisfactory workmanship. All hollow metal components are straight, plumb, level, and square allowing the doors to open and close latch without binding.
7. ☐ Verify acceptable gaps around beveled edge doors and latching hardware (reference ICC500 306.3.6 and NFPA 80)
   - Rough opening to frame gap / shim space 1/4" at head and each jamb. If grouted, max 1-1/8" at jambs and 1-3/8" at head.
   - Between frame and doors, as well as meeting edges of pairs target 3/32, max 3/16". Head to top of door target 1/8".
   - Undercut from finished floor/sill without threshold to bottom of door 3/4" max.
   - Clearance from bottom of door to floor or threshold max 1/4", guided by approximate 1/8" between door and top of strike.
8. ☐ **Test all door, frame and hardware / accessories in the opening assembly for proper installation, latching and functions.**
   - Door opens fully without interference from flooring or frame. Test that all latches fully engage upon closing and retract as required. Strikes are free of debris. Confirm latch function, testing each latch separately by taping over the others to keep them from latching. Adjust rods, closers, and other items per hardware installation instructions as needed.
   - Verify assembly hardware is listed with UL/Intertek (also shown in the Steelcraft Tech Data > Tornado Approvals).
     - Verify location and functional details per install instructions and listing
   - Hardware should avoid interference with other hardware (e.g. mounting magnetic brackets over latch thru bolts).
   - Von Duprin WS-T 304L bottom strike is oriented correctly so the slot lines up with the stepped bottom latch
   - Strike installed correctly and grouted securely into the slab per section F.15. Thresholds (if used) also grouted fully to slab.
   - LM9300 multipoint strike is securely anchored to slab. Surface bolt on inactive is always installed on the safe/shelter side.
   - Trim functions operate as expected, in accordance with ICC 500. Non-egress/storm side operating hardware is locked, disabled, or inactive and not susceptible to unintentional unlatching by debris impact. When no storm is present, if such hardware is active, the egress/safe side provides lockdown functions are capable, accompanied by signage clearly communicating how and when to lock down (in a storm event).
   - Gasketing is properly installed and, while not ICC 500 required, should cover visible gaps to the storm side of the assembly.
9. ☐ Glass is installed with Philips head bolts on safe side, without visible damage to outer layers of glass or film.
10. ☐ Final adjustments to the door and hardware made prior to the final inspection, accepted by Architect and Owner.
    - Adjust doors for proper operation, free from binding or other defects.
    - All surfaces are clean and restored. Prime coat and touch up using compatible primer and paint, sanded, finished smooth.
    - No visible open holes in door or frame (e.g. from incorrectly installed and removed hardware). (See section E, 3rd bullet.)
11. ☐ Damaged or disfigured doors and frames to be replaced by the responsible party. Some repairs may not be allowed in the field in order to maintain the labeled tornado approval. Consult with manufacturer or AHJ.

Maintenance Checklist

12. ☐ Provide a minimum of one complete set of documents to be included in the project construction documents.
13. ☐ Regular field inspection and adjustment is to be conducted by knowledgeable maintenance personnel.
14. ☐ Reference items 8 first bullet and 9 above and check regularly. Perform any adjustments/corrections immediately, referencing door or hardware installation instructions as needed. Contact manufacturer technical support with questions or concerns at support@allegion.com with brand in the subject line, or 877-671-7011, option 2.

H. TORNADO DOCUMENTS and RESOURCE LINKS MATRIX

- Paladin Tornado Website – See right column downloads
- 2024 Customer Bulletin – Explains what's new in the Allegion ICC 500-2020 Offering and how to order
- ICC 500-2020 – FEMA 361 – FEMA 361 Highlights – Steelcraft 2024 Customer Bulletin (general ordering info)
- Paladin Assembly Offering with Latching Hardware – Approved Doors and Hardware
- Certified Public Listings (some required creation of a free account login to access)
  - 2020 UL LISTING for WS-T EXIT PAIRS (ZHLA.79) – 2020 UL LISTING for LM9300 INSWING PAIRS (ZHLA.87)
  - 2020 ITS LISTING FOR Singles and LM9300 outswing pairs (ITS 64895) – 2014 ITS LISTING (ITS 39897)

	HOLLOW METAL	PANIC HARDWARE	LOCKS/LEVERS	HINGES	CLOSERS	HOLDERS/STOPS	SEALS/THRESHOLDS	LIGHTS
Webpages	STEELCRAFT	VON DUPRIN	SCHLAGE	IVES	LCN	GLYNN-JOHNSON	ZERO	TGP
	Paladin Doors (see Downloads)	Severe Weather Exits	Schlage Severe Weather		Surface Mounted Closers	n/a	n/a	Pilkington Pyrostop 60-120 TRSL
	FP Frames	VD Windstorm Solutions	Multi-Point Lock	n/a	Fire & Life Safety	n/a	n/a	
	n/a	98/99 Series	n/a	n/a	9500 Auto Operator	n/a	n/a	
Catalogs, Manuals & Brochures	Steelcraft Catalog	98/99 Series Catalog	L Series Catalog	Ives Catalog	Literature	GJ Catalog	Zero Catalog	
	Steelcraft Tech Data	VD Indicators Brochure	L Series Service Manual	n/a		n/a	Zero E-Brochure	
Sell sheets	OFFERING with Latching Hardware	WS-T Data Sheet (2020)	LM9300 Cut Sheet (remove x9310 x9370)	Electrified Hinges		n/a	n/a	
	Approved Hardware	WS98/9957/9927 Data Sheet (2014)	LM9300 Data Sheet (2014)	n/a		n/a	n/a	
	n/a	ESL Sheet	n/a	n/a		n/a	n/a	
360 Portal	Customer 360 Portal Login to Access: **Price Books** and **Interactive Pricing tool** (to verify approved hardware sets/nomenclature)							
Installation Instructions	Paladin Installation Instructions	WS-T-98/9927 Pairs Install	L Series Door Template Index	n/a	Templates & Install Instructions	Templates & Install Instructions	Templates & Install Instructions	
Templates / Technical References	Tornado II Dwg Flush PWF002	WS-T-98/9957 Single Install	LM9300 lock & rod interactive install	SB360 Surf Bolt Template				
	Tornado II Dwg Glazed PWG002	-2SI Install	LM9300 Rod Install Instructions	Ives Template Index				
	FBC EHPA II Dwg Flush PWF001.pdf	ESL Kit Install	LM9300 Lock Installation Instructions	Ives Template Directory				
	FBC EHPA II Dwg Glazed PWG001.pdf	377T-KC Install	Tornado Shutter Handing Guide					
	Tornado PER10146 Grout Filled Shim Space	377T-KC Template	-					
	Std Anchor Locs	996L-BE Template	n/a					
	Anchor Lookup	996L-DT Template						
	SDI Installation Videos	Grouting WS Strikes (2014)	n/a					

Verify links as some reference older ICC 500-2014 listings; check current ICC 500-2020 listings/offering

END OF DOCUMENT