

Recommendations for Measuring Door Gap Dimensions of Swinging Fire Doors with Builders Hardware

By Keith E. Pardoe

Speed, accuracy, and above all consistency are essential when determining the clearance dimensions around and under swinging fire doors are within NFPA 80's specifications.

Tape measures and rulers are not efficient or practical tools for measuring door gap dimensions. The best method for measuring door gap dimensions is to use a tool of the appropriate thickness that can be inserted between the door frame and door, the door and the floor, and between opposing vertical edges (aka, meeting stiles) of paired doors.

Remember, you are confirming door gap dimensions are within NFPA 80's specifications—not measuring them, per se. In addition to using a tool to measure door gaps consistently, you need to follow the same pattern of checking the gaps every time.

Resist the temptation to estimate door gap sizes by sight or only spot-checking them at certain points along the edges. NFPA 80's clearance dimensions apply to the entire perimeter around and under the doors, and between paired doors. In other words, the door gap dimensions must be within NFPA 80's specifications along the full height of the vertical edges and across the full width of the doors at the tops and bottoms. (See Fig. 2.)

Knowing where to check clearance gaps is important to assessing the doors correctly. NFPA 80 requires gaps to be measured on the *pull-side* of doors. Specifically, gaps are measured at the outermost leading edge of the doors and the rabbets of the door frames. (See Fig. 3 and Fig. 4.)

Many doors have beveled vertical edges that create additional operating clearance between door frames and doors. Beveled vertical edges allow doors to have less clearance at the outermost edges and open and close without rubbing against door frames. When measuring door gaps, only the position of the outermost lead-

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Fig. 1 The DoorGap Gauge®

ing edge of the doors in relation to the door rabbet of the frames (or the opposing door edges of pairs) is checked.

The following steps can be applied to any door-gap-tool or material of the appropriate thickness:

Step 1, Identify the Door Frame and Door Construction. Using the door gap dimensions listed in *Table 1: Clearance Dimensions for Swinging Fire Doors*, select a tool with a thickness equal to the maximum or minimum clearance dimension for the type of door you are evaluating (e.g., 3/16-in. max. and 1/16-in. min. for hollow metal door frames and hollow metal doors).

Step 2, Insert Door Gap Tool Between Door Frame and Door. Standing on the pull-side of the door, insert the tool into the gap between the door frame and door; in the following order:

- (a) Latch edge—top to bottom, then
- (b) Hinge edge—top to bottom, then
- (c) Top edge—left to right.

Using a firm grasp, slide the tool all the way along the door edge. Pay close attention to how the tool fits into and slides along the gap. When the gap dimension is at its maximum size, the tool should substantially fill the gap (snuggly, not loosely); no lateral movement should be felt.

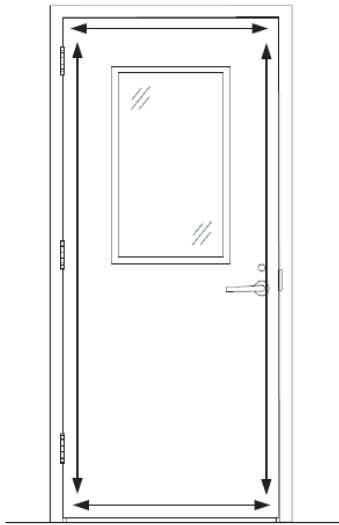


Fig. 2 Measuring Door Gaps Around and Under Doors

Where the tool fits into gaps, check for lateral movement by twisting the tool side-to-side. Any lateral movement—no matter how small—indicates the gap dimension is larger than allowed by NFPA 80, and it should be cited as a deficiency on inspection reports.

For example, the maximum door gap dimension for 3/4-hour (and greater) rated wood fire doors is 1/8-in.—no over-tolerance dimension is permitted. When a 1/8-in.-thick tool fits into the gap, with no lateral movement, the gap is within NFPA 80's specifications. However, when the 1/8-in.-thick tool has any amount of lateral movement, the gap is larger than 1/8-in.; it doesn't matter how much larger.

In the case of fire-rated wood doors (and doors other than hollow metal), the maximum clearance is allowed to be any dimension up to and including 1/8-in. Less than 1/8-in. clearance is acceptable, but it cannot be greater than 1/8-in.

Consider this, an additional 1/32-in. of clearance in this case is twenty-five (25) percent greater than the 1/8-in. maximum dimension—that's significantly larger. More importantly, it is the difference between compliance and non-compliance with NFPA 80's requirements.

When the gap dimension is smaller than the maximum or minimum dimension allowed, the tool will not fit into the gap. In the case of minimum gap dimensions, when the tool cannot fit into the gap the clearance dimension is too small and should be cited as a deficiency.

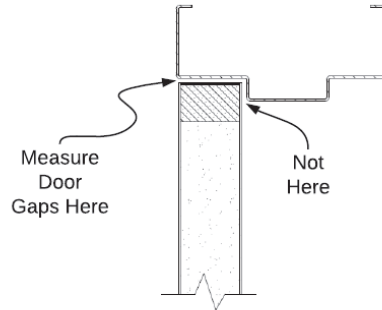


Fig. 3 Measuring Door Gap at Top Edge of Door

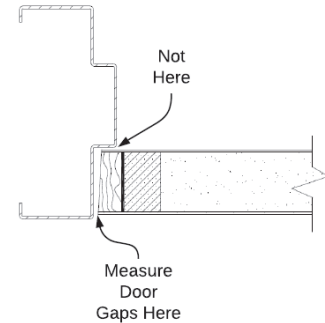


Fig. 4 Measuring Door Gap at Vertical Edge of Door

Step 3, Insert Door Gap Tool Under Bottom of Door.

Regardless of the door frame and door construction, and the level of fire rating of swinging doors, NFPA 80 limits the maximum clearance dimension between the bottom edges the doors and the floor surface to 3/4-in. (see Fig. 5)—no over-tolerance dimension is permitted.

Where bottoms of swinging doors are more than 38 inches above the floor, the maximum clearance dimension is reduced to 3/8-in. (See Fig. 6.)

The measurement is taken between the bottom outermost edge of the doors and the top of the floor surface beneath the doors. (See Fig. 5 and Fig. 7.)

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Door sweeps and shoes (and other types of gasketing products) attached to the bottoms of doors are not included in this measurement—they are not tested or listed

for extending the length of fire-rated doors. Likewise, the height of thresholds under doors is not included in this measurement.

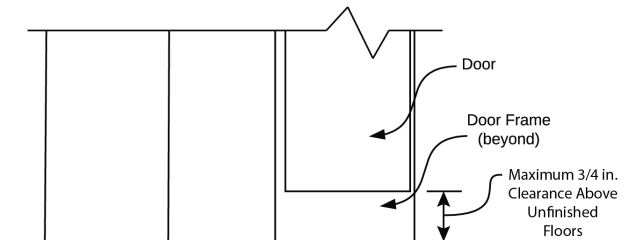


Fig.5 Clearance Between Doors and Unfinished Floors

Clearance dimensions under swinging fire doors are subject to the levelness and flatness of the floor surface directly beneath the doors. Low spots in floor surfaces can create non-compliant conditions that require mitigation. Similarly, unlevel floors can prevent the vertical jambs of door frames from resting on the sub-floor, when the frame heads are level. Thereby,

Door Safety's Recommendations for Measuring Door Gaps

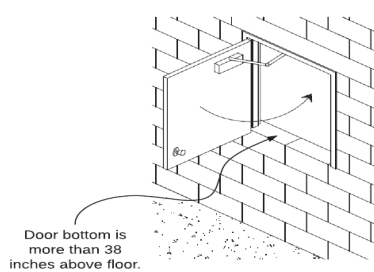


Fig. 6 Door with Raised Sill

creating larger clearance dimensions under doors.

Some hardware components (e.g., concealed vertical rod fire exit hardware and flush bolts) require less than 3/4-in. clearance under doors to operate correct-

ly. For example, certain models of concealed vertical rod fire exit hardware devices require a maximum of 3/8-in. clearance under doors—half of what NFPA 80 allows. In these instances, the installation instructions of the hardware components takes precedence over NFPA 80's requirements. In other words, it is possible for a door to have 3/4-in. (or less) clearance under it and not be in compliance with NFPA 80, due to specific door and/or hardware requirements for less clearance.

The term *clearance* refers to the dimension between the bottom of the door and surface over which it swings...

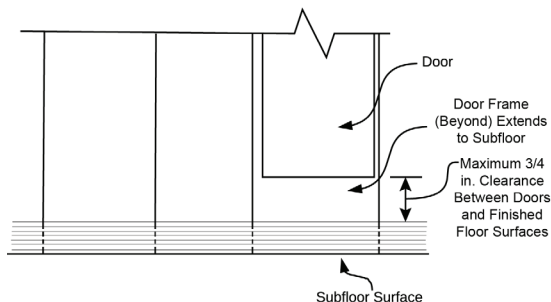


Fig. 7 Clearance Between Doors and Finished Floors

Clearance vs. Undercut

There are two terms that refer to dimensions under swinging doors, *undercut* and *clearance*. The term *undercut* refers to the dimension measured from the bottom of the door frame to the bottom of the door. Most commercial doors are designed with a 3/4-in. undercut, but other dimensions (smaller and larger) are common. In fact, other undercut dimensions are necessary to achieve the desired clearance under a door. The term *clearance* refers to the dimension between the bottom of the door and surface over which it swings.

When the floor surface is sealed or painted concrete there is no substantial thickness to the floor covering, and the clearance dimension is essentially the same as the undercut dimension. (Most fire-rated door frames are required to extend to the sub-floor.)

Once finish flooring materials (e.g., carpet, vinyl tile, ceramic tile, and masonry tiles) are installed in the door opening, clearance under the door is reduced from the undercut dimension. For example, when 1/2-in. thick carpet is installed in door openings, doors with 3/4-in. undercut have 1/4-in. clearance between door bottoms and the surface of the carpet. Using this same example, when 3/4-in. clearance under a fire door is needed (e.g., for air circulation), the undercut dimension of the door would need to be 1-1/4-in. to accommodate the carpet thickness and provide the additional clearance.

Thresholds and Saddles

Like other fire door assembly components, thresholds and saddles need to be installed in accordance with their installation instructions. In many cases, the installation instructions require a maximum of 1/8-in. clearance between the bottom of the door and the portion of the threshold directly under the door (see Fig. 8A and Fig. 8B).

Some thresholds allow up to 1/4-in. clearance under the bottom edges of doors, which are designed to accommodate doors with industry-standard undercuts of 5/8-in. and 3/4-in.

Low profile thresholds (aka, accessible thresholds) require doors to have special (smaller) undercut dimensions of 3/8-in. to 1/2-in. to provide the required clearance between doors and the thresholds. Accessible thresholds can be used on fire door assemblies. Codes limit the overall height of these thresholds to 1/2-in., which reduces the undercut dimension of doors; even though NFPA 80 allows 3/4-in. clearance.

Latching thresholds (aka, latch track) are a type of threshold that have a raised portion opposing the door faces that can be used as bottom strikes for surface-mounted vertical rod fire exit hardware; hence, the term latching threshold. This raised portion also holds gasketing materials (e.g., vinyl, silicone, neoprene, and pile inserts) that contacts the face of the door. Other styles of thresholds have raised portions that hold gasketing materials to seal against the door.

It is worth pointing out that fire-rated thresholds are designed to fit under doors with undercuts up to 3/4-in., which means undercuts of fire doors should not be greater than 3/4-in. unless there are special floor conditions that require larger or smaller undercuts dimensions for specific doors.

Saddles are a type of threshold that are substantially flat; they do not have a raised portion like latching and standard thresholds.

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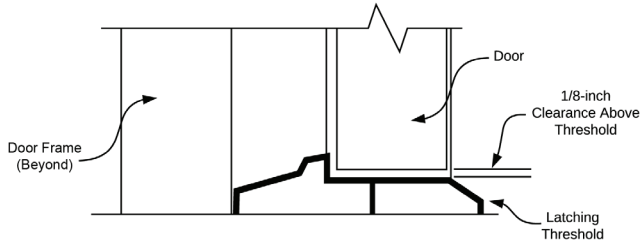


Fig. 8A Clearance Above Latching and Standard Thresholds

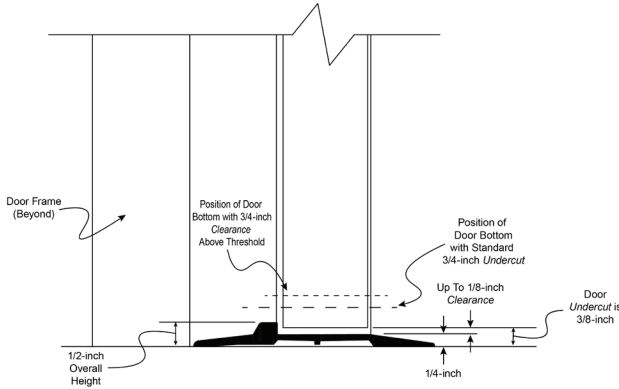


Fig. 8B Clearance Above Low Profile (Accessible) Thresholds

ponents such as thresholds, saddles, and automatic door bottoms. (Most smoke door assemblies do not require gaps under doors to be sealed.)

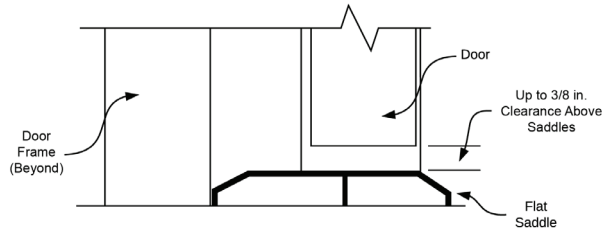


Fig. 9 Clearance Above Saddles

Measuring Gaps Between Paired Doors

Clearance dimensions between meeting vertical edges of paired doors should be measured on the pull side of the doors. Astragals (e.g., overlapping and split) might prevent you from measuring the gap between the doors on the pull side. In these situations, you can check the gaps from the push side, but you need to account for the shape of the door edge.

Many doors have square-edged stiles—meaning the vertical edges are formed at 90 degrees to either face of the doors—in which case the clearance dimensions are the same when measured on the pull and push sides of the doors. Some doors have vertical edges that are beveled; the bevel is 1/8-in. in 2 inches, resulting in an angle of about 93 degrees from the *push-side* face (see Fig. 10).

Knowing this information, the clearance dimension between paired doors with beveled stiles cannot exceed 3/8-in. (1/8-in. ± 1/16-in. plus 3/16-in. allowance for the beveled door edges) on the *push-side* of hollow metal doors and 1/3-hour rated wood doors installed in hollow metal frames.

For all other types of paired doors the clearance dimension between vertical edges cannot exceed 5/16-in. (1/8-in. plus 3/16-in. allowance for beveled edges) when measured on the *push-side* of doors.

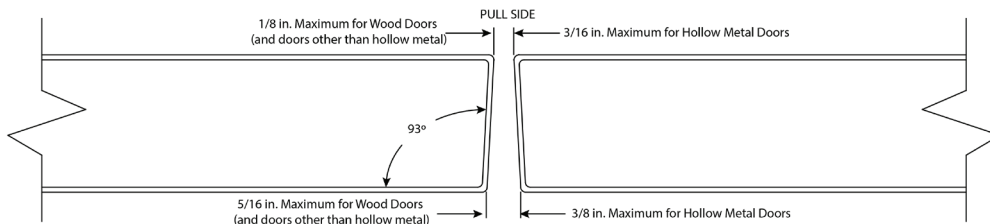


Fig. 10 Maximum Gap Dimensions Between Vertical Edges of Paired Doors

Measuring Gaps on Doors with Continuous Hinges

When fire-rated swinging doors are hung with continuous hinges, geared or pin-and-barrel designs, it is not necessary measure the gap between the vertical hinge-edges of doors and door frames. All types of continuous hinges (e.g., full surface, concealed leaf, and half-concealed leaf) substantially fill or cover gaps between door frames and doors. In these cases, the listings and installation instructions of fire-rated continuous hinges (and doors) are in accordance with the fire door test to which they were subjected.

Other Conditions That Affect Clearances Around Swinging Doors

Frame installation is perhaps the most common factor that affects door gap dimensions. Vertical jambs of door frames should be plumb and true (aligned across the span of the door opening). Head jambs should be level and square to vertical jambs. In other words, door openings within frames should be the same width dimension at the head, the floor, and any point between.

When door opening dimensions between the vertical jambs are wider at the floor than they are at the head of the frame, door gap dimensions might be too large at the bottom of the door.

Poor frame installation practices and techniques contribute to this problem. Swinging fire doors are subject to the skills and competencies of installer personnel.

Damage such as worn-out hinges, loose hinge screws, and broken hinge reinforcements can create conditions that cause doors to sag; making clearance dimensions too large. Dents along the vertical edges create excessive door gaps. (See Fig. 11 and Fig. 12.)

Miscoordination of important details during ordering and fabrication processes can lead to non-compliant door gap dimensions. (See Fig. 13.)

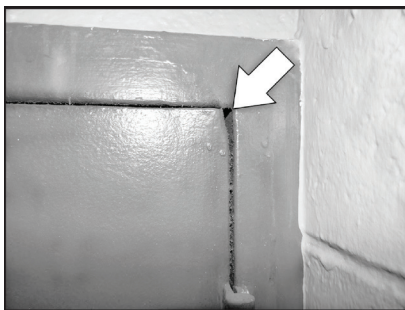


Fig. 11 Dented Top Corner Creates Larger Door Gap

Mitigating Excessive Door Clearance Dimensions

The good news is that there are several tricks-of-the-trade for correcting door clearance issues. Shimming of hinges is the best known, most expedient, and least expensive remedy—provided it is performed correctly.

Replacing standard weight conventional hinges with heavy weight (thicker) hinges effectively reduce excessive clearance gaps at the latch edges of doors.

Changing out full mortise conventional hinges for continuous hinges is another remedy. Continuous hinges eliminate clear-

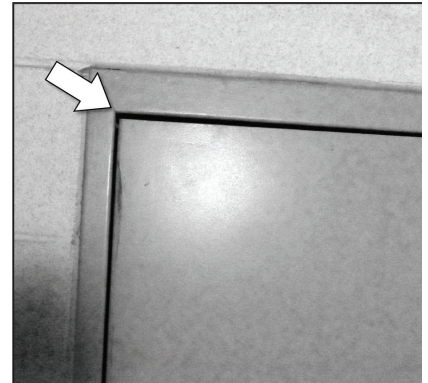


Fig. 12 Sagging Door at Latch Edge

ance gaps at the hinge edges and can be used to reposition doors to correct clearance dimensions at the latch edges—they can be used to raise doors to correct clearance dimensions at the tops of doors.

Correcting door clearances between opposing vertical edges of paired doors is problematic. One potential solution might be to apply wrap-around metal edges (aka, astragals) to one or both doors (see Fig. 14), but this remedy has a couple of issues that need to be addressed.

The metal edges need to be listed and/or labeled for use on fire doors. Cutouts in the metal edges might be required to accommodate edged-mounted hardware (e.g., latch bolts, strike plates, flush bolts, and fire pins).

Excessive clearance dimensions reduce latch bolt engagement and should be handled separately from correcting the gap between doors.

Several new products are available, and more are coming to market, that are designed to mitigate non-compliant door gap dimensions and maintain the fire ratings of doors.



Fig. 13 Excessive Gap at Latch Edge

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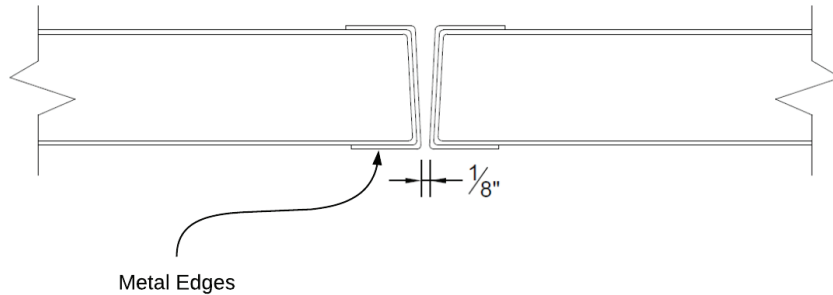


Fig. 14 Opposing Vertical Edges of Paired Doors With Wrap-Around Metal Edges (aka, Astragals)

Table 1: Door Clearance Dimensions for Swinging Fire Doors with Builders Hardware

Door Frame Material	Door Material	Clearance Allowed	Minimum Clearance	Maximum Clearance	Fire Rating
Hollow Metal	Hollow Metal	1/8-in. ± 1/16-in.	1/16-in.	3/16-in.	All fire rating levels
Hollow Metal	Flush Wood, HPDL-faced, Stile and Rail Wood	1/8-in. ± 1/16-in.	No Minimum	3/16-in.	1/3-hour ONLY
Hollow Metal	Flush Wood, HPDL-faced, Stile and Rail Wood	1/8-in.	No Minimum	1/8-in. Maximum	3/4-hour, 1-hour, 1-1/2-hour
Aluminum, Pressed Steel, Wood, Wood Composite	Flush Wood, HPDL-faced, Insulated Steel, Stile and Rail Wood	1/8-in.	No Minimum	1/8-in. Maximum	1/3-hour, 3/4-hour, 1-hour, 1-1/2-hour
*Frame material as required by listing of the doors.	*Door leaves of other construction.	**1/8-in.	No Minimum	1/8-in. Maximum	1/3-hour, 3/4-hour, 1-hour, 1-1/2-hour, 3-hour
<p>Notes: Measure all clearance dimensions on the pull side of the door (see paragraph 6.3.1.7.1 in NFPA 80-2016). Clearance dimensions are measured all along the length of vertical and horizontal edges, between the door frame and door(s) and between meeting stiles (vertical edges) of paired doors.</p> <p>*Other materials include aluminum, fiberglass reinforced polyester (FRP), and other composite materials.</p> <p>**Unless otherwise permitted by the manufacturer's published listings for the door frame, door, and latching hardware.</p>					

SUMMARY

For proper operation, swinging fire doors require at least a minimum amount of clearance between the edges of door leaves and door frames, and above floors. The dimensions of door gaps on swinging fire-rated doors are important for two reasons. First, when the clearance dimensions are within NFPA 80's specifications latching hardware components are able to remain in the latched condition positively. Positively-latched doors stay closed and latched when exposed to fire and the forces exerted on them from water streaming from fire hoses. In other words, NFPA 80's clearance dimensions ensure proper latch bolt engagement under all conditions.

The second reason that door gap clearances are important is that they help fire door assemblies resist the passage of fire, smoke, and gases. Larger gaps are more difficult to seal, even with supplemental gasketing products.

Your best resources for determining how to correct door gap clearances for specific doors might be a local door and hardware supplier, the door manufacturer, or the testing laboratory whose label is on the door.

Bear in mind the following points as you perform NFPA 80's door safety inspections:

- Measure vertical- and top-edge door gaps between the doors and the rabbets of the door frames, at the outermost edge on the *pull-side* of doors, and between opposing vertical edges of paired doors.
- Measure bottom-edge door gaps at the outermost door edge, between the bottoms of doors and the top of floor surfaces directly beneath the doors.
- Follow the same pattern of measuring door gap dimensions every time; consistency is essential.
- Door gap dimensions must be within NFPA 80's or the door and/or hardware manufacturer's specifications along the full height of vertical edges, and across the full width of doors at the top and bottom.
- Manufacturers' listings, installation instructions, and specifications take precedence over NFPA 80's requirements.
- Any dimension, no matter how small, over the maximum clearance dimension permitted by NFPA 80 or the door and/or hardware manufacturer(s) limitations in their listings and installation instructions should be cited as a deficiency on inspection reports and requires corrective action or mitigation.
- Do not estimate door gap dimensions by sight or spot-checking at certain points.
- Use The DoorGap Gauge® equal to the thickness of the maximum (or minimum) clearance dimension permitted for the type of door being inspected.

For more information regarding the The DoorGap Gauge®, please visit their website (<http://www.DoorGap-Gauge.com>). The DoorGapGauge® is a registered trademark of PL2, LLC, Collierville, TN.

Referenced Publication:

- NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2016 edition. (View it online for free at www.NFPA.org/80.)

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