HEAVY GLASS DOOR

DESIGN MANUAL

NATIONAL GLASS ASSOCIATION with GANA

Introduction

The all-glass entrance has become increasingly popular with architects and interior designers. These entrance systems are technically not all glass but would be better described as heavy glass door and entrance systems. For the purpose of this Design Manual, heavy glass (HG) is defined as fully tempered glass equal to or greater than ⅜ in. (10 mm), or tempered laminated glass constructed with two or more lites of glass equal to or greater than ½ in. (12 mm). Entrance systems incorporate HG, metal rails, small metal patch fittings and sometimes structural silicone. Heavy glass with polished edges provides sleek-looking entrance doors that make an elegant statement for the building or shop owner.

This Heavy Glass Door Design Manual is provided to assist designers in making their decisions by supplying answers to the most commonly asked design questions. A HG entrance can be used as an exterior entrance for a monumental building or a simple interior mall storefront. The attractiveness of a storefront or entrance tends to be the focal point for pedestrians and thus sets the stage for the building or shop.

The purpose of this Design Manual is to provide authoritative technical information to designers and to offer some suggestions as to the proper applications of HG used in doors and entrances. The aim of this Design Manual is to promote good design practice and adherence to appropriate structural standards in fully tempered heavy glass storefront and entrance design. Good design and adherence to standards will serve as a benefit to all parties involved: the architect, the glass fabricator, the installing contractor and, most importantly, the building owner, who is the end user.

This manual hopes to offer assistance during the decision-making stages of a project. The contents of this manual are for the design professional's use in review and final approval.

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Drawings contained herein are not to scale.

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Heavy Glass Door Design Manual
2019 Edition

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About NGA

The National Glass Association (NGA) was founded in 1948. NGA combined with the Glass Association of North America (GANA) on February 1, 2018 to form the largest trade association serving the architectural glass and metals industry supply chain, including glazing contractors, full-service glass companies, glass fabricators, primary glass manufacturers and suppliers to the industry.

It is a technical powerhouse that brings some of the best minds to the table to create technical resources and promote and advocate for glass in buildings through its membership, its Forming, Fabricating and Installing committees and the Glazing Industry Code Committee (GICC).

NGA's education and training programs—both online at MyGlassClass.com and in-person at association-sponsored events—and its official publication Glass Magazine, keep the industry knowledgeable and well-informed.

NGA produces the industry's largest annual trade show in the Americas, GlassBuild America. It hosts the Building Envelope Contractors (BEC) Conference, the Glazing Executives Forum, Glass Processing and Automation Days, as well as Annual and Technical Conferences. These educational and networking events bring together thousands of industry professionals to help them build more profitable businesses.

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I. General Information

When designing storefront or entrance systems, the requirements for accommodation of traffic, plus the effects of wind, rain, and cold or hot weather should be considered. Severely cold climate areas usually require vestibules with both exterior and interior doors. Heavy glass doors are not typically weather-tight, so they are most frequently used as the interior vestibule doors, shop-front entrances in interior shopping malls, and interior office applications. Where ADA or barrier-free access for the physically handicapped is required, design information to assist the architect has been included in this reference manual to the extent that it has been defined by the International Building Code (IBC). Heavy glass doors have some unique characteristics which help accommodate persons in wheelchairs.

The entrances to a building or business give one of the first and last impressions of the building to the pedestrian traffic entering and exiting. The configuration of the entrance doors relative to surrounding conditions is a vital factor. The flow of traffic from the sidewalk, mall corridor or parking area will determine the number of entrances required. Doors must be located so as not to swing into the path of pedestrian traffic. All heavy glass doors, since they are manufactured using fully tempered glass, are intended to meet the safety glazing requirements of ANSI Z97.1 unlimited class and CPSC 16 CFR 1201 Category II. Correct selection of push-pull and operating hardware is an essential element in safe design. Door swing arcs should be limited by the closer hardware or doorstops to prevent one door from swinging into the path of another door. Reference Glass Technical Paper Guidelines for the Production of Heat-Treated Glass for more detail.

Where pairs of doors are required, six-foot-wide openings with a pair of three-foot-wide doors are recommended, as narrower openings tend to impede the flow of pedestrian traffic. Design sidelites so they will not be mistaken for clear openings that invite pedestrian traffic to walk into the glass. Visual patterns, decorative railings or plantings will help prevent this type of problem. If the entrance doors are recessed from the face of the building, it will prevent the door from swinging into pedestrian traffic and also protect exterior doors from cross winds.

Design Considerations
Applications requiring structural analysis should be provided by qualified individuals or companies with engineering capabilities. For glass entrances containing butt-glazed glass panels, the height of the opening (and not the width) will determine the glass thickness required. Butt-joint glazing should not be confused with structural silicone glazing. Both have the same exterior appearance, but structural silicone glazing has interior vertical mullions to which the glass is adhered with structural silicone sealant. Individual glass lites attached to the structure at the top and bottom only (head and sill) are considered typical butt-joint glazing. If, in addition to the top and bottom support, one vertical edge is structurally supported, the glass is supported on three sides. If all four edges are structurally supported, the lite has four-sided support. Butt-jointing one glass panel to another glass panel when both are in the same plane does not structurally support the glass. It is accepted industry standard that structural mullions must be of sufficient strength so as not to deflect when fully loaded more than the span divided by 175, in order for that edge of the glass to be considered fully supported. Typically, the deflection of the glass should be limited as per Table 1 in Appendix I or as otherwise prescribed in local building codes and/or specifications. Tempering does not reduce glass deflection. Glass deflection may also be reduced by using thicker glass construction or adding structural mullions.

Varying levels of security can be achieved using standard rail and patch locks, as well as more sophisticated systems that include electric bolt, shear/magnetic locks and panic devices. Traffic volumes, floor slab thickness, egress requirements and ADA considerations will determine closing device location and selection. Several glass door types can be adapted to automatic and power assisted operators to meet ADA requirements.

Heavy glass doors and entrances can be installed in seismic regions. The design professional must specify the various loads anticipated during a seismic event. Because heavy glass is often butt-glazed, the joint width between panels should be designed to avoid glass-to-glass contact due to the anticipated sway of the building or opening frame. The perimeter glazing channel should also be designed to provide sufficient edge clearance to avoid glass-to-frame contact

due to building sway. See “Glazing Considerations for Systems in Seismic Regions” in the GANA Glazing Manual 50th Anniversary Edition for additional considerations.

Interior Applications

Heavy glass doors are becoming increasingly popular for interior applications. Although wind load is not a consideration, other types of structural loading may limit the size of interior doors. Interior fully tempered glass sidelite panels are not always sealed. See Appendix I of this manual (reprint of Section 9 of the NGA with GANA Engineering Standards Manual, 2019 edition) for additional information regarding height and thickness recommendations for fully tempered interior butt-glazed glass panels. Traffic volume for interior applications needs to be considered the same as with exterior applications. Interior doors are often locked in both the open and closed position, eliminating the need for closers. Structural design of fully tempered all-glass interior entrance systems is discussed in detail in Section XIV.

Door Size Limitations

Door sizes need to be limited due to glass flexibility and hardware limitations. Closers and pivots have weight limitations. Doors that are too wide are difficult to control in windy conditions and may exceed hardware limits. Larger doors may be used when locked open or infrequently used. Full rails, top and bottom, are recommended for larger door sizes. See Section XIV Structural Design of Interior Glass Entrance Systems.

II. Types of Entances

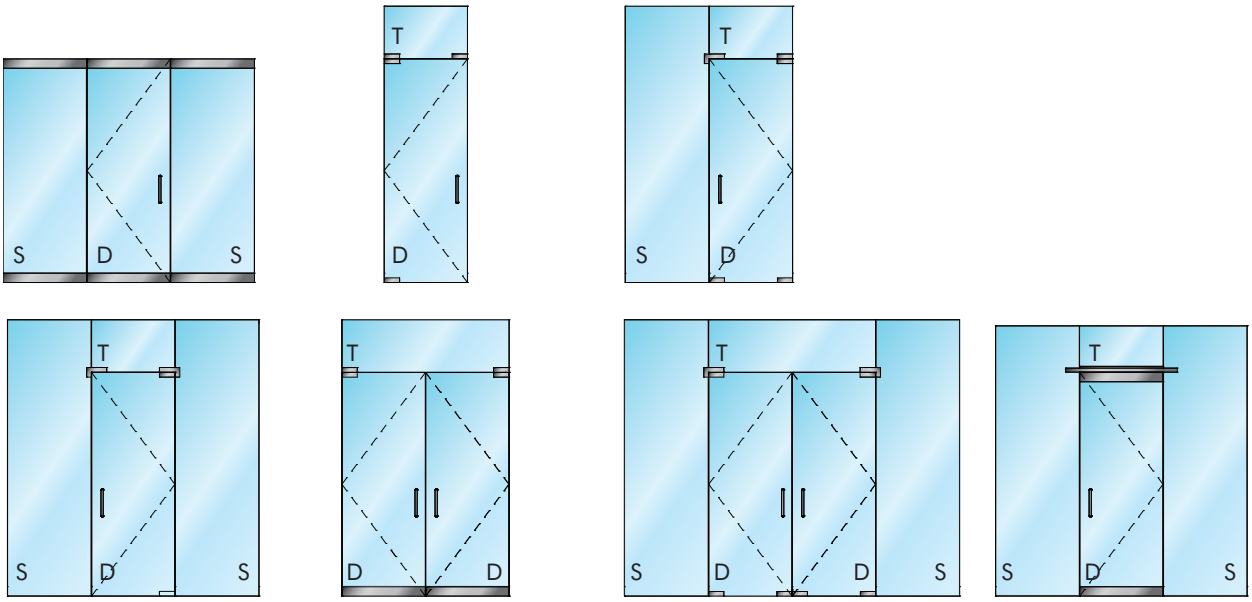


FIGURE 1

Typical Entrance Configurations

Note: S = sidelite

D = door

T = transom

III. Types of Doors

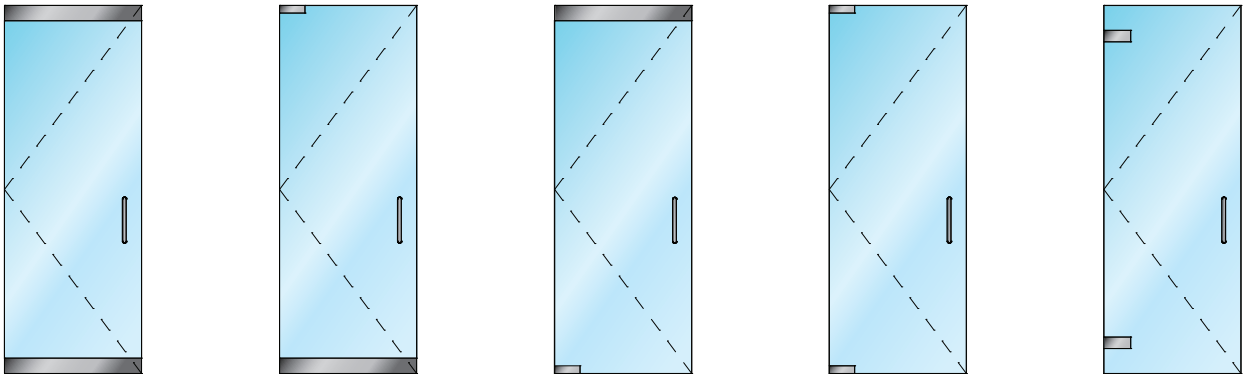
Common styles of fully tempered glass or fully tempered/laminated heavy glass doors are shown below:

R/R (P-Style): Full width top and bottom rails.

P/R (BP-Style): Full width bottom rail with a partial top rail or top patch fitting at the pivot corner.

P/P (A-Style): Partial rails or patch fittings for top and bottom pivot corners. Mid-panel locks or integral locking pulls are required to lock this style of door.

H (Hinge): Self-closing hinge eliminates the need for a separate closer. A patch lock, mid-panel lock or integral locking pulls are required to secure this style of door.



R/R (P-Style) P/R (BP-Style) P/R (BP-Style) P/P (A-Style) H (Hinge)

FIGURE 2

Types of Doors

IV. Types of Glass

Fully tempered glass or fully tempered laminated heavy glass doors and entrances consist of clear and tinted substrates; monolithic fully tempered float glass complies with the standards defined in ASTM C1036 and C1048. Typically, a clear substrate is used and ranges in thickness from ⅜ in. (10 mm); ½ in. (12 mm); ⅝ in. (16 mm); and ¾ in. (19 mm). Low-iron, tinted and obscure heavy float glass products are also available for these same applications.

Fully tempered laminated glass doors must be a minimum of ½ in. (12 mm) thick. See ASTM C1036 and ASTM C1072 for laminated glass fabrication guidelines.

When using mechanically applied hardware in conjunction with glass with irregular surfaces (i.e. cast, etched and patterned glass), you must confirm with the hardware manufacturer that you are not reducing the hardware's ability to perform properly.

All exposed edges of the glass are ground and polished prior to tempering the glass. Holes for handles and patch fittings must be drilled in the glass prior to tempering. The diameter of these holes must be slightly larger than the thickness of the glass. See ASTM C1048 for glass fabrication guidelines.

Based on results from collaborative cyclical testing performed at ambient temperatures on patch fittings with laminated doors, patch fittings can be used with laminated glass in interior applications where temperatures are typically maintained around 75^{0}F. Note that testing was performed on panels with 0.060 in. standard PVB, structural PVB, and ionomer. Interlayers are polymers which respond differently at various temperatures; consult the interlayer manufacturer for details. Prior to specifying other laminate overall thickness or interlayer material for use in these applications, consult the hardware manufacturer for approval.

V. Types of Hardware

RAIL TYPES

Figure 3 shows typical rail profiles. Typical profiles shown may vary by manufacturer. Glass attachment methods include wet (cement) glazing, mechanical and dry gasket glazing. Rails can be full width or partial width (patch) for corner application.

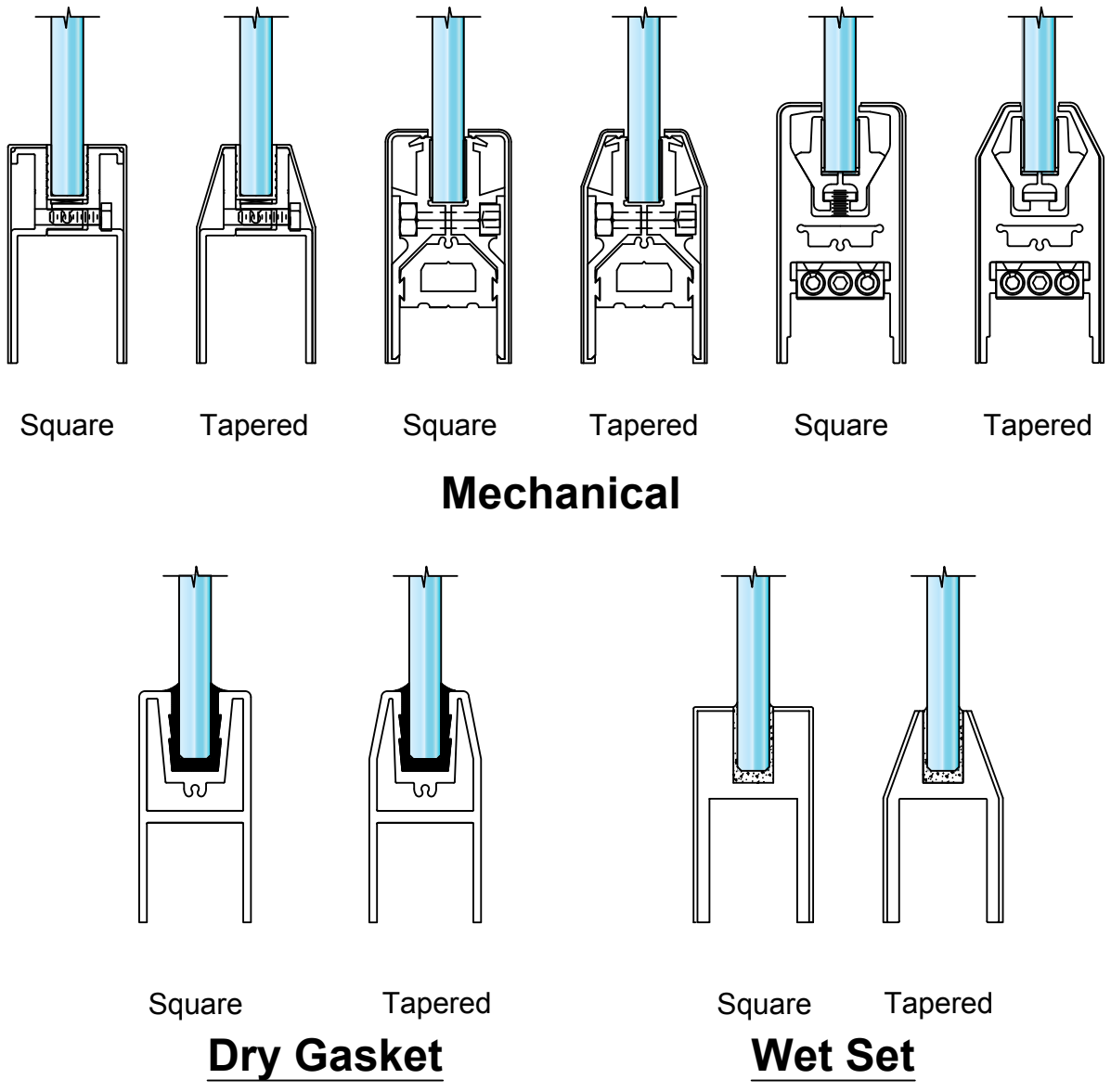
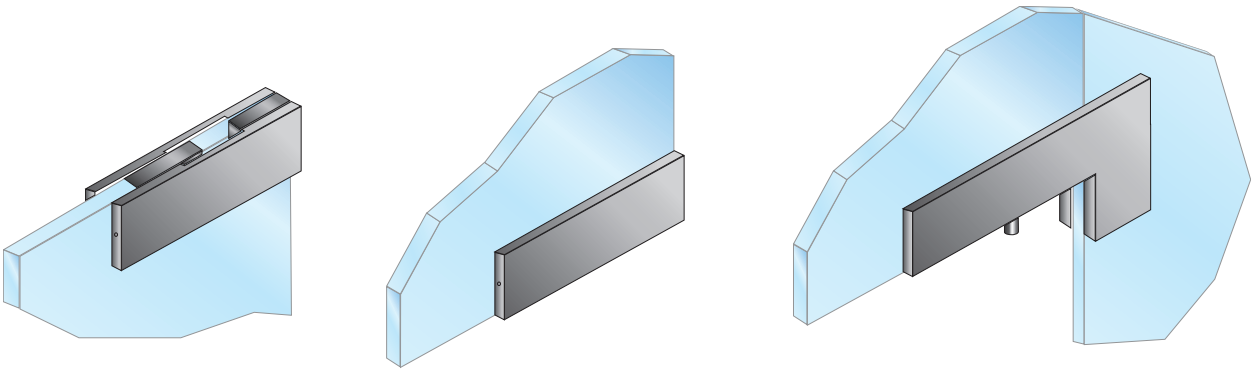


FIGURE 3

Typical Rail Profiles

PATCHES

Figure 4 shows common small profile patch types. Many different entrance configurations can be obtained by using other patch types (not shown). Refer to Figure 1 for examples.



TOP PATCH BOTTOM PATCH TRANSOM SIDELITE PATCH

FIGURE 4

Common Patch Types

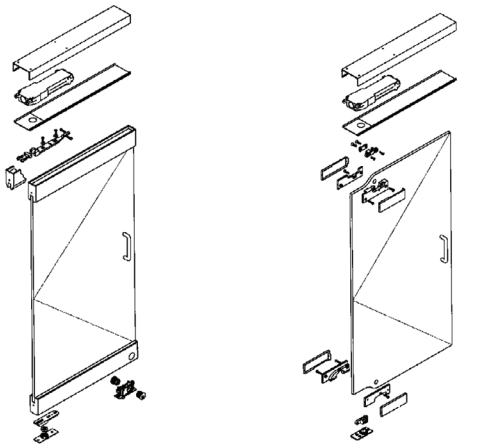
VI. Swinging Door Systems

Heavy glass doors are frequently used as swing doors in singles or pairs with door closers or top and bottom pivots. A free-swinging heavy glass door is attached in the opening, usually at pivot points at both top and bottom of the door. When a swing door is opened it rotates inward or outward on the pivot axis and moves in an arc out of the plane of the door opening, permitting access through the opening.

DOOR CLOSERS

The function of a door closer is to control a door during its opening and closing cycle. The closer may be installed overhead or floor-mounted and is typically concealed, though other options may be available. Varying spring sizes are available to increase or decrease opening and closing forces. Other optional features may control the hold open position, delayed egress, positive stops, or electric integration with fire or security systems. Heavy glass doors can be particularly demanding for closers. It is critical that the closer be properly sized to support the weight of the glass door and interact properly with the specific hardware used on this type of installation. Many companies manufacture closers that comply with ADA closing force requirements for both interior and exterior applications. Consult the manufacturer for proper ADA size compliance and specifics to the application.

Concealed Overhead Closers (C.O.C.s) are typically housed in a header tube above the door. C.O.C.s are used for light to medium size and weight doors and are used with bottom pivots. The bottom pivots may be adjustable to accommodate various floor clearances. Examples of C.O.C.s are shown in Figure 5.



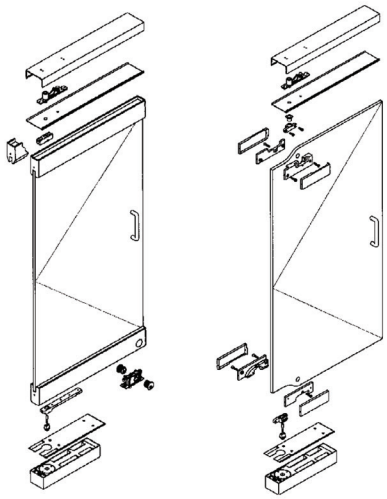
Rail Door Patch Door

FIGURE 5

Concealed Overhead Closers

Floor Closers are housed in a “cement case” that is permanently grouted into or set in the floor prior to a floor being poured. Different sizes can accommodate all types of doors, from high traffic to those seldom used. Floor closers can typically handle heavier and wider doors than can a Concealed Overhead Closer but may not be suitable due to floor condition limitations such as slab thickness. Floor closers are used in conjunction with top pivots, either walking beam or surface-applied top pivots. See Figure 6 on the next page.

Other types of door closers utilized include: 1) automatic; 2) power-assisted; 3) surface-mounted; 4) in-rail concealed; and 5) hinge-mounted.



Rail Door Patch Door

FIGURE 6
Floor Closers

Auxiliary Closing Methods utilized may include rail-mounted or hinge-mounted, where the closing mechanism is part of the actual hardware. Consult suppliers for specific limitations.

FREE-SWINGING PIVOT DOORS

Doors can also be installed without a closer using top and bottom pivots or wall-mount hinges. Due to typical size and weight of heavy glass doors, door control should be addressed. Options may include stops, floor locks, passage locks and control arms. Doors can be hung on offset pivots when they are required to swing open past 105 degrees. Offset pivots allow up to a 180-degree swing. See Figure 8 below. The function of pivots is to support the door and provide swinging action. Pivots fall into two general categories: a) Center hung and b) Offset (see Figures 7 and 8, respectively). Center hung doors may be single or double acting. Offset pivots are single acting and can allow the use of compressible bulb weatherstripping for a glass door.

Note: Pivot locations shown are standard. Other options may be available for specialized applications.

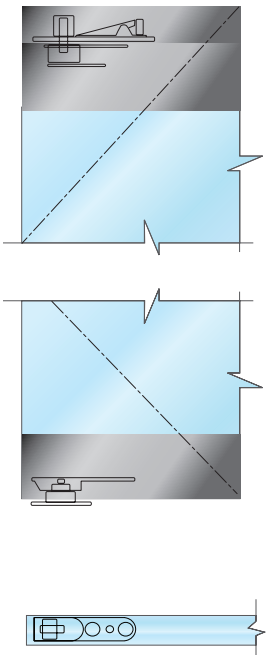


FIGURE 7
Center Pivot

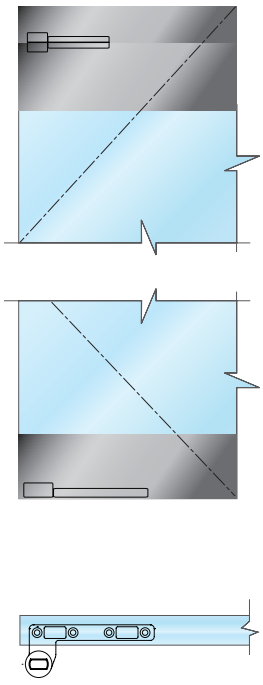


FIGURE 8
Offset Pivot

VII. Sliding Doors, Walls and Fronts

Heavy glass doors can be utilized in sliding door systems using either top rollers or floor loaded rollers. When a sliding door is opened it is moved parallel to and in the same plane as the opening. The weight of the sliding doors can be suspended from rollers in an overhead track or supported by rollers on a floor track. Generally, door panels in sliding door systems may be wider than swing doors. Consult the manufacturer for size limits. Sliding doors can be operated manually or by automated mechanisms.

TOP-HUNG SLIDING SYSTEMS

When the weight of a sliding door is supported by an overhead track it is often referred to as “top-hung.” Top-hung sliding systems are more versatile than floor-mounted systems. Top-hung sliding panels are easier to maintain because the operating hardware is located away from traffic areas. Top-hung track must be level and securely anchored to an adequate overhead structure capable of handling the weight of the system.

Top-Hung Bi-Parting Systems - The configurations available for top-hung bi-parting sliding doors are the same as the floor-mounted systems shown in the next section. A bottom guide may be required to prevent the doors from swinging out of plumb. This guide may be concealed by an adjacent fixed sidelite base or be exposed on the floor. Consult the individual manufacturers for their systems’ capacity for proper design. Refer to Figure 9.

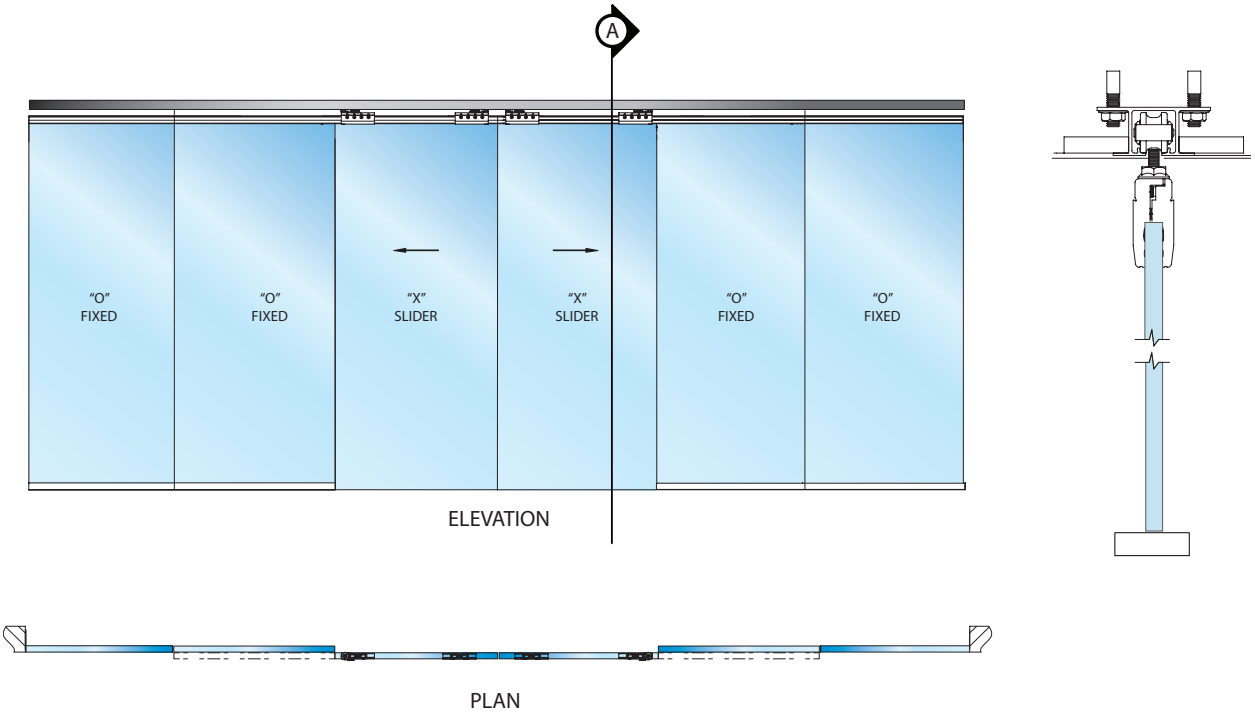


FIGURE 9

Top-Hung Bi-Parting Sliders

Stacking Top-Hung Systems - These systems allow the sliding panels to close in a single plane. The sliding panels can be stacked in a remote "parking" area either parallel or perpendicular to the opening as shown in Figures 10a and 10b below. Special care must be taken to ensure that the structure above the "parking unit" is reinforced to carry the combined weight of the sliding panels when they are stacked. Because the slider and the fixed sidelite are not on the same plane, acoustical and security issues need to be addressed.

An optional fixed swing door may be added to permit egress once the wall is fully extended. Depending on the system specified, one or more of the sliding panels may be converted to a door that can both slide and swing.

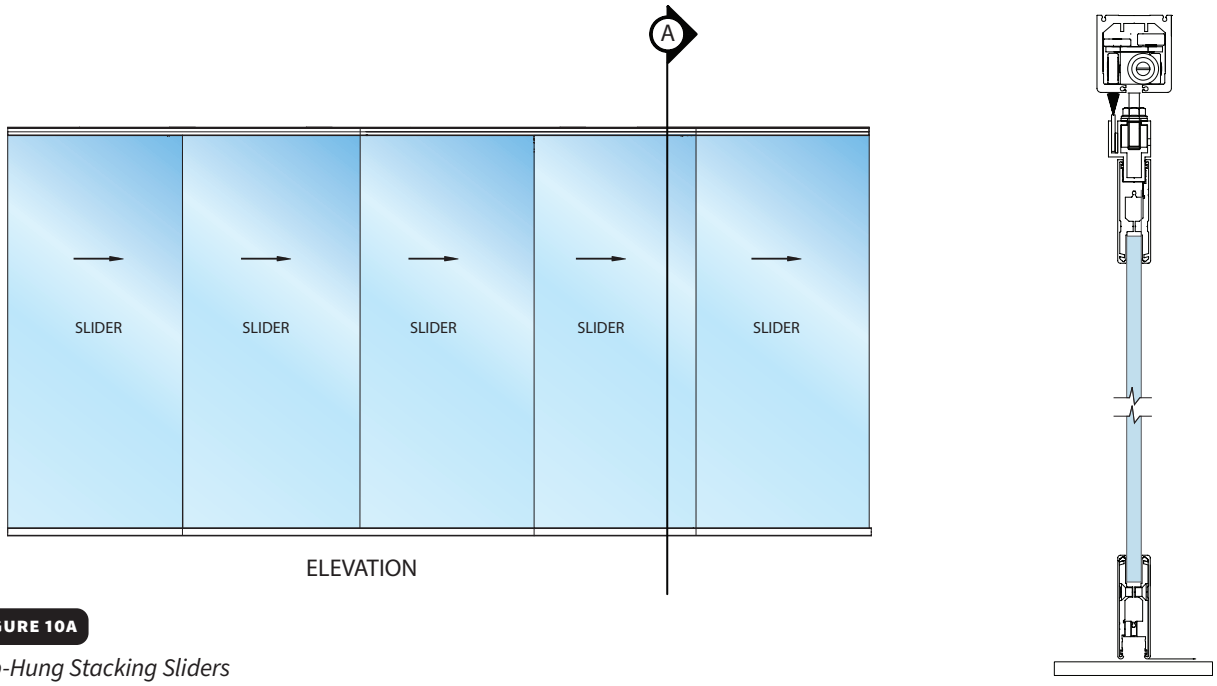


FIGURE 10A

Top-Hung Stacking Sliders

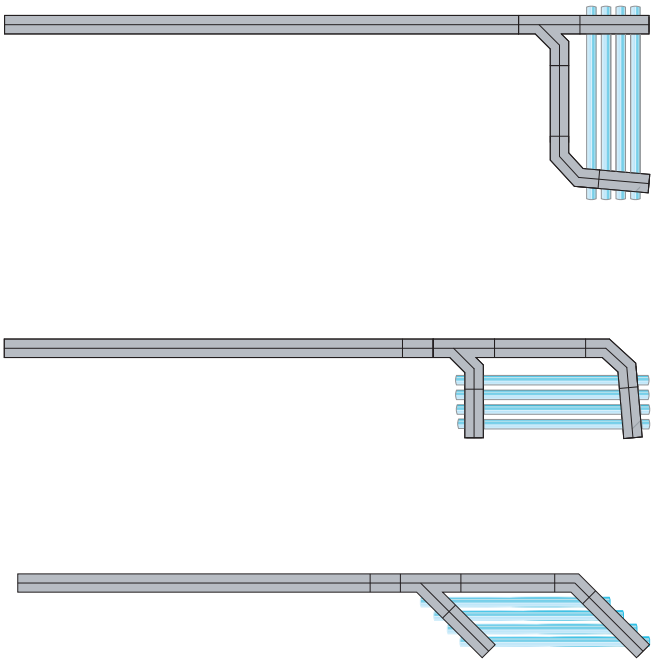


FIGURE 10B

Stacking Options

Top-Hung Bi-Fold systems - These systems use offset-type hinges to attach the panels together to form a perpendicular stack. See Figure 11 below. Roller Hardware for top-hung bi-fold sliding systems may use full rail or patch fitting to secure the glass to the roller mechanism.

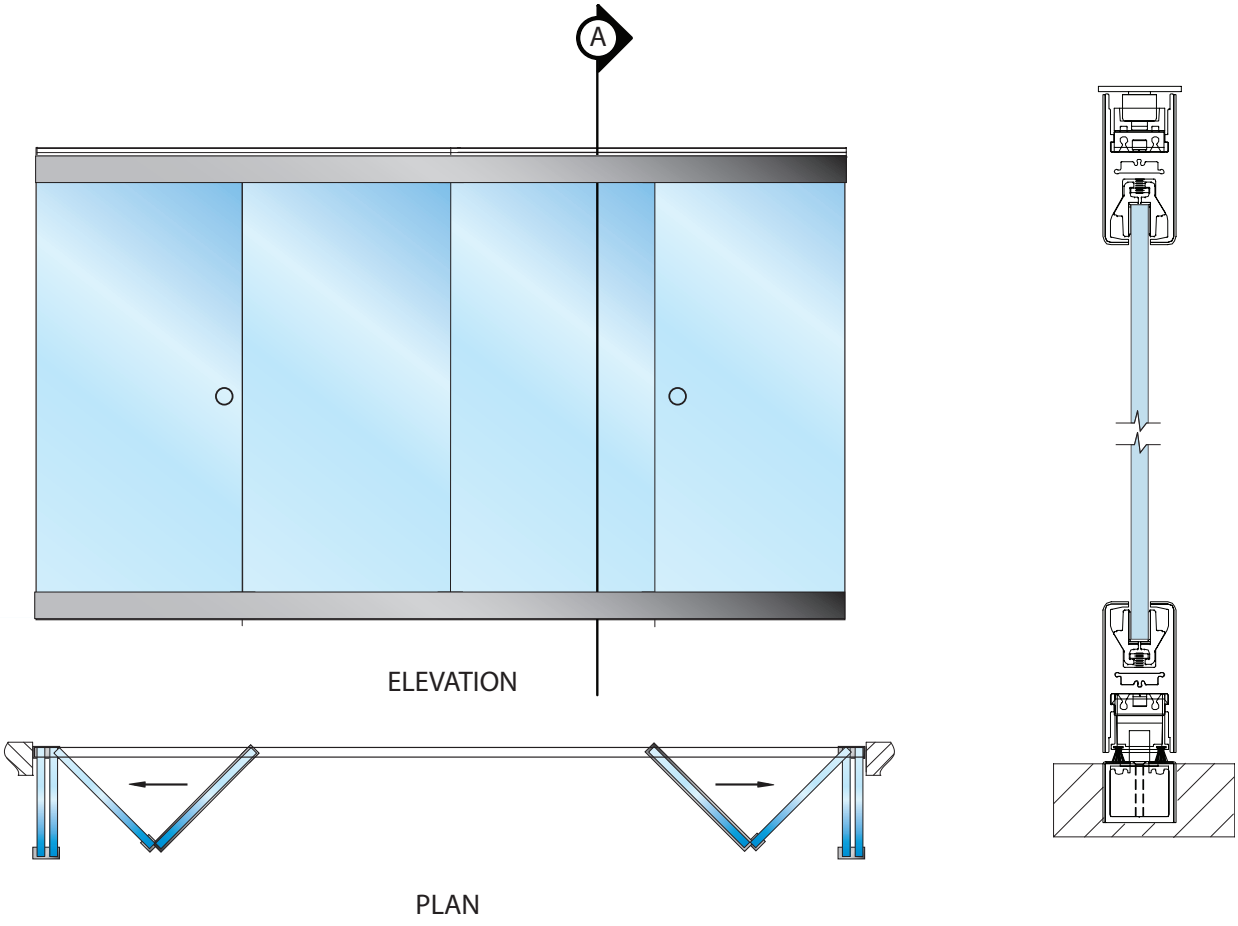


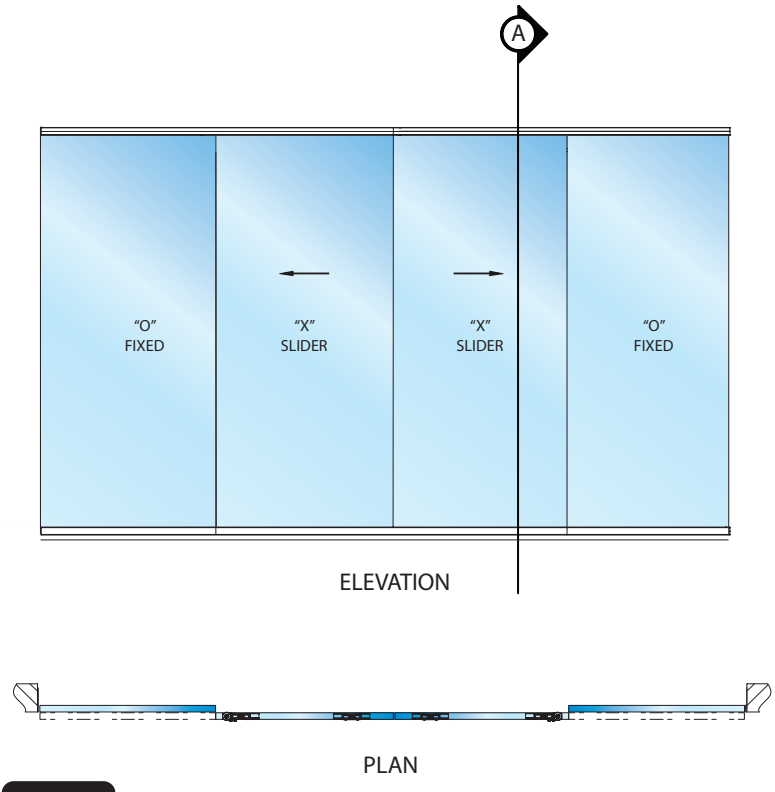
FIGURE 11

Top-Hung Bi-Fold System

FLOOR-MOUNTED SYSTEMS

Floor-mounted systems use rollers mounted into the bottom door rail and roll on a floor track. This type of sliding door operates on single or multiple parallel tracks, commonly used in double track or bi-parting configuration. See Figure 12, next page. Because the slider and the fixed sidelite are not on the same plane, acoustical and security issues need to be addressed.

Multi-slide floor-mounted sliding doors can be used for wide openings by installing several parallel tracks. See Figure 13, next page.



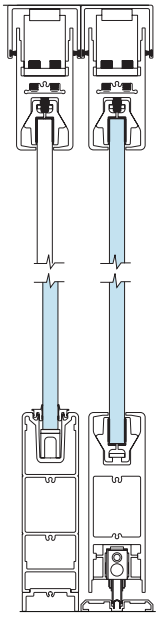
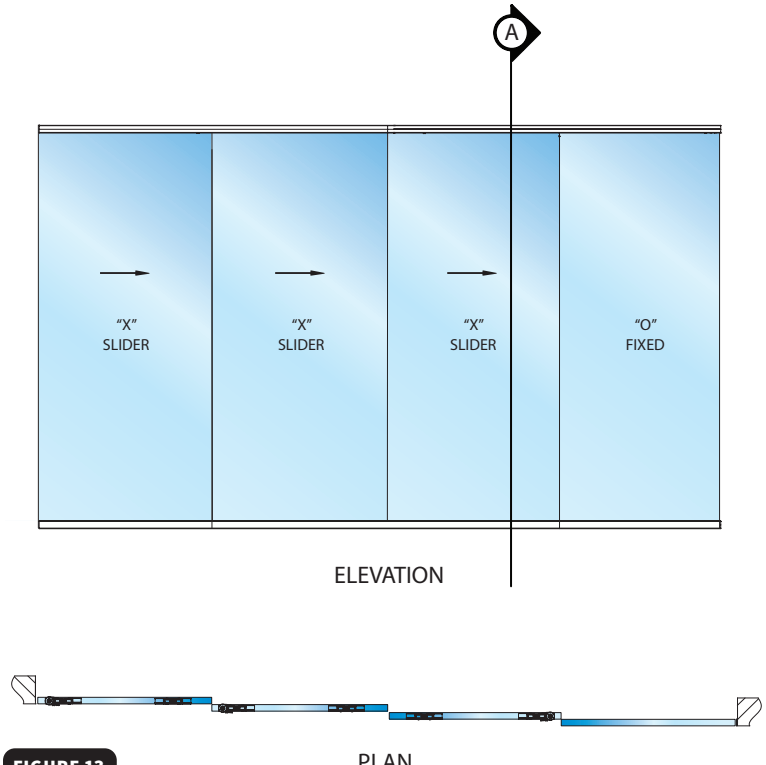


FIGURE 12

Floor-Mounted Sliders



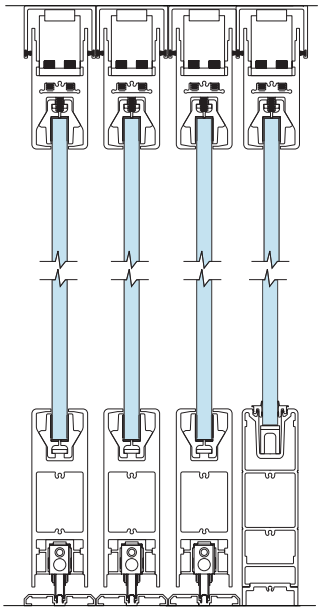


FIGURE 13

Floor-Mounted Multi-Sliding Doors

VIII. Entrance Components

LOCKS

Mechanical Latching

Mechanical latching heavy glass doors can be secured using a floor lock, center lock or head lock with standard keyed cylinders and/or thumbturns. Head and floor locks can be mounted into the door rail or patch lock fitting or incorporated into the handle. Mechanical locks typically engage at the sill into a strike plate or threshold. If a round throw bolt is used, a covered “dust-proof” strike may be used to prevent dirt accumulation in the strike area.

Center locks are used when it is desirable to locate a lock mechanism in proximity to the handle height on the door. This is accomplished by adding a center lock housing which accommodates various lock types. A strike plate is then mounted to the jamb or a strike housing is mounted to the adjacent sidelite to receive the bolt. Center lock housings can have various functions: office style locks, passage style locks, storeroom style locks and classroom style locks.

Electrical Latching

There are a variety of electrical latching options including magnetic locks (exposed surface-mounted locks or concealed shear locks), or electric strikes that work in conjunction with mechanical locks. Any external components that interface with the door locking system should be reviewed for compatibility, such as card readers, transformers, power supply, exit buttons, motion sensors, etc.

Locking Ladder Pulls

Locking pulls or deadbolt handles can also be used to combine the function of the pull handle with a deadbolt locking mechanism. Using the sleek design of a typical ladder-type pull allows the operating function of standard cylinder/thumb turn to be at a convenient height. These locking pulls can be either the full or partial height of the door; locking up into the header to comply with ADA handicap codes or down into a floor strike.

PANIC HANDLES/ELECTRONIC EGRESS HANDLES/PADDLES

Exit devices can be installed on all heavy glass doors engaging in top, bottom and/or jamb conditions. There are three basic types of handles which vary vastly in type and function. Panic handles utilize a positive latching mechanism that mounts into strike housing or engages into an electric strike mechanism. Mechanical/positive latching devices, such as panic handles, create secure entries and allow exit when the power is off. Electronic egress handles (see Electrical Latching above) allow passage by de-energizing and then re-energizing a magnet to create secure entryways. Electronic egress handles do not mechanically latch. A battery backup system is typically implemented to prevent an un-secure application in the event of a power failure. Additional accessories such as card readers, motion detectors, exit buttons, time delays, etc. are often used. Finally, center-lock housing panels with paddle or lever handles can be used to exit a facility but must not be used in areas designated as emergency exits. See below for more detailed definitions of Fail-Secure and Fail-Safe Electric Strikes.

Fail-Secure Electric Strikes

Also known as Non-Fail-Safe or Fail-Locked

On entry - Fail-Secure electric strikes MUST BE energized to allow entry.

Electric current is supplied to the electric strike via a signal from an electronic device. When this device energizes the electric strike it then allows the keeper to move freely; with the keeper released, the latch bolt can be pulled through the keeper, allowing entry. During electrical outages, however, fail-secure electric strikes will remain locked for a more secure application. *Panic hardware using fail-secure electronic controlled devices will require a battery back-up and/or a manual keyed exterior cylinder to allow entry during power outages.*

Note: *Free egress is available at all times via the use of panic hardware.*

Fail-Safe Electric Strikes
Also known as Fail-Open or Fail-Unlocked

On entry - Fail-Safe electric strikes MUST BE de-energized to allow entry.

Electric current is turned off to the electric strike, typically via a signal from a card reader. When this device is de-energized, the electric strike allows the keeper to move freely; with the keeper released the latch bolt can be pulled through the keeper, allowing entry. *During electrical outages the door will remain unlocked unless a battery back-up supply continuously energizes the electric strike.* This type of strike should not be specified for secure applications. Card readers or exterior keyed cylinders are the only means of entry from the exterior while the lock is energized.

Note: *Free egress is available at all times via the use of panic hardware.*

When using any type of panic, electronic egress and/or paddle device, always refer to your local, state and federal building codes to ensure the proper exit device is implemented.

HANDLES
A variety of shapes and styles of handles may be used on heavy glass doors. The most common are 1 in. (25mm) diameter metal pull handles, attached through holes in the glass. These pull handles can be vertical or horizontal, straight or offset. Handles are available to match the metal finish on the door or they can be made of wood, plastic or a contrasting metal finish.

These handles are typically made by “finish hardware” manufacturers and can be supplied either by the glass door manufacturer or by the finish hardware supplier. Holes for the handles must be drilled in the glass prior to tempering. Because of the hole pattern or size, not all handles can be mounted to heavy glass. Designers should consult with the glass door manufacturer or hardware supplier as to the suitability of a particular handle for mounting onto heavy glass. See Figures 14 and 15 below for commonly used heavy glass door pull handle configurations.

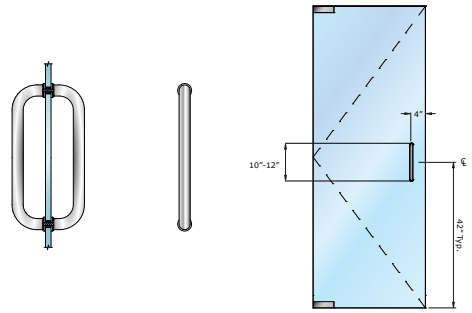


FIGURE 14
Handles (Pull Sets)

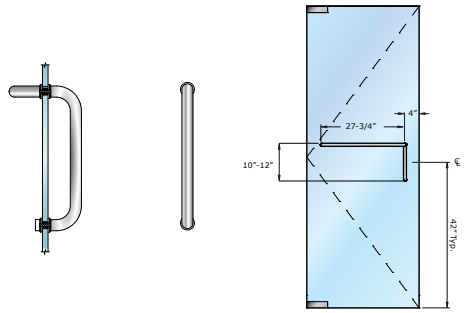


FIGURE 15
Handles (Push/Pull Sets)

IX. Metal Finishes

Metal door rails and patch fittings for heavy glass doors are typically made from extruded or cast aluminum. Door rails are available in anodized finishes. They are also available clad with thin gauge sheet metal adhered to an aluminum extrusion to provide the finishes listed below in Table 1. Small profile patch fittings, shown in Figure 4, usually have applied covers to conceal the patch bolts and to provide the desired metal finish. Metal finish selection may affect the maintenance requirements (see Section XVII – Protection and Cleaning).

Table 1
Typical Metal Finishes

FINISH		DESCRIPTION
U.S. Standard	***B.H.M.A. Standard**	
US-28	628	Clear Anodized
313	710	Dark Bronze Anodized
315	711	Black Anodized
US-3	605	Polished Brass (CDA 260)
US-4	606	Satin Brass (CDA 260)
US-9	611	Polished Bronze (CDA 220)
US-10	612	Satin Bronze (CDA 220)
US-10B	613	Statuary (Oil Rub) Bronze
US-32	629	Polished Stainless Steel
US-32D	630	Satin Stainless Steel

*B.H.M.A. - Builders Hardware Manufacturers Association

In addition to typical metal finishes, other metal and painted finishes may also be available. Some manufacturers offer lacquer coatings on brass and bronze metal finishes. Variations in alloys must be confirmed when matching finishes and hardware. Consult the hardware manufacturer for specific finish information.

X. Sidelites with Rails

Sidelites and other fixed glass may have rails, at the top and bottom, or bottom only, to match the doors. To maintain even alignment with the rail of the adjacent door, a track/saddle of various heights is installed under the sidelite rail, so the top of the door rail and the top of the sidelite rail are the same height. The track/saddle must be anchored to the structure at the ceiling and floor. Additional anchoring of the rail to this track may also be required.

Sidelites with rails are available in two types: Pre-Applied Rails (individual panel only) and Field Glazed Rails (individual or multiple panels). Reference manufacturer's recommendations for anchoring sidelite rails.

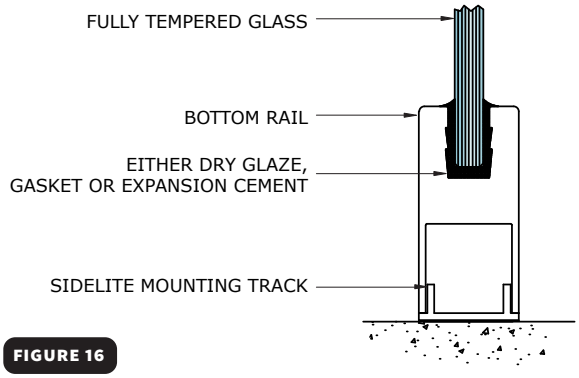


FIGURE 16

Pre-Applied Rails

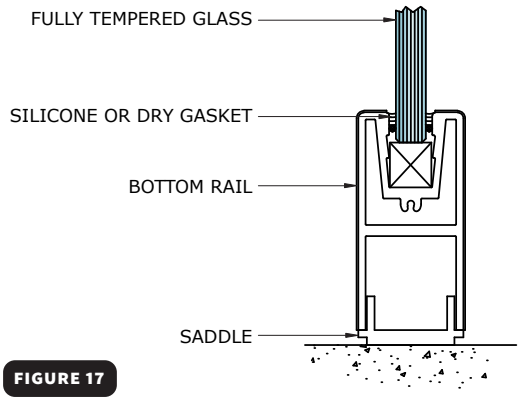


FIGURE 17

Field Glazed Rails

NOTE: See Appendix I (which is a reprint of Section 6 of the NGA with GANA Engineering Standards Manual, 2019 edition) for additional information regarding height and thickness recommendations for fully tempered interior butt-glazed fixed glass panels.

Field glazed rails must provide minimum bite and clearances as shown in Table 2 below.

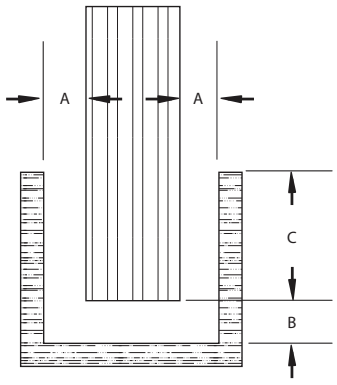


FIGURE 18

Typical Face & Edge Clearance and Bite

Table 2
Typical Face & Edge Clearance & Bite

Thickness		Minimum Clearance					
		A=Face		B=Edge		C=Bite	
Monolithic Glass							
inches	mm	inches	mm	inches	mm	inches	mm
3/8	10	3/16	4.8	5/16	7.9	7/16	11.1
1/2	12	1/4	6.4	3/8	9.5	7/16	11.1
5/8	15	1/4	6.4	3/8	9.5	1/2	12.0
3/4	19	1/4	6.4	1/2	12.0	5/8	15.9

*Figure 18 and Table 2 were taken from the 50th Anniversary Edition of the GANA Glazing Manual.

Notes: 1) Typical clearances above may vary by manufacturer, particularly for some special products or applications.
2) Follow the recommendations of the glass manufacturer, fabricator or sealant supplier for individual instances.

Table 3. Installation Recommendations for All-Glass Laminates			
Glass Thickness	**A = Face Clearance (per side)**	**B = Edge Clearance**	**C = Edge Engagement or Bite**
Bullet-Resistant Laminates (all thicknesses)	⅛ inch (3mm)	⅜ inch (10 mm)	½ inch (12.7 mm)
All Other Laminates			
Up to ¼ inch (6 mm)	⅛ inch (3mm)	¼ inch (6 mm)	⅜ inch (10 mm)
Over ¼ inch (6 mm) to ⅜ inch (10 mm)	3⁄16 inch (5 mm)	5⁄16 inch (8 mm)	7⁄16 inch (11 mm)
Over ⅜ inch (10 mm) to ⅝ inch (16 mm)	¼ inch (6 mm)	⅜ inch (10 mm)	½ inch (12.7 mm)
Over ⅝ inch (16 mm) to ⅞ inch (22 mm)	¼ inch (6 mm)	½ inch (12.7 mm)	¾ inch (19 mm)
⅞ inch (22 mm) or greater	¼ inch (6 mm)	⅝ inch (16 mm)	⅞ inch (22 mm)

Note: Contact the manufacturer for glazing recommendations for zoo, aquarium, security installations, and glass-clad polycarbonates.

* taken from NGA with GANA's Laminated Glazing Reference Manual, 2019 Edition

XI. Guidelines for Interior Swinging Door Sizes

Table 4 provides guidelines for interior swing door sizes using standard glass and hardware options. These sizes consider both the hardware manufacturer's design limitations and glass deflection considerations.

Table 4. Guidelines for Interior Swinging Door Sizes

Entrances utilizing non-structural interlayers and/or exterior door applications are dependent on numerous factors impacting the intended design of the entrance. These types of entrances should be reviewed by qualified individuals or manufacturers with engineering capabilities.[2]

Fully Tempered and Tempered Laminated Glass									
		R/R (Full Rails)				P/P (Patch Fittings) and/or P/R (Rail Combinations)			
Glass Thickness Glass Weight		**10 mm (3/8 in.) [5 lbs/sf]**	**12 mm (1/2 in.) [6.4 lbs/sf]**	**16 mm (5/8 in.) [8.1 lbs/sf]**	**19 mm (3/4 in.) [9.8 lbs/sf]**	**10 mm (3/8 in.) [5 lbs/sf]**	**12 mm (1/2 in.) [6.4 lbs/sf]**	**16 mm (5/8 in.) [8.1 lbs/sf]**	**19 mm (3/4 in.) [9.8 lbs/sf]**
Concealed Overhead Closer (200 lb. max typically)[1]	Width	914 mm (36 in.)	1067 mm (42 in.)	914 mm (36 in.)	914 mm (36 in.)	914 mm (36 in.)	1067 mm (42 in.)	914 mm (36 in.)	914 mm (36 in.)
	Height	2134 mm (84 in.)	2743 mm (108 in.)	2591 mm (102 in.)	2134 mm (84 in.)	2134 mm (84 in.)	2591 mm (102 in.)	2438 mm (96 in.)	2134 mm (84 in.)
	Glass Weight	(105 lbs.)	(202 lbs.)	(207 lbs.)	(206 lbs.)	(105 lbs.)	(191 lbs.)	(195 lbs.)	(206 lbs.)
Floor Closer[1]	Width	914 mm (36 in.)	1219 mm (48 in.)	1219 mm (48 in.)	1219 mm (48 in.)	914 mm (36 in.)	1067 mm (42 in.)	1067 mm (42 in.)	914 mm (36 in.)
	Height	2134 mm (84 in.)	2743 mm (108 in.)	2896 mm (114 in.)	3048 mm (120 in.)	2134 mm (84 in.)	2591 mm (102 in.)	2591 mm (102 in.)	2473 mm (108 in.)
	Glass Weight	(105 lbs.)	(230 lbs.)	(308 lbs.)	(392 lbs.)	(105 lbs.)	(191 lbs.)	(241 lbs.)	(265 lbs.)

[1]Consult specified closer hardware manufacturers for their size and weight capabilities

[2]Based on results from collaborative cyclical testing performed on patch fittings with laminated doors, patch fittings can be used with laminated glass in interior applications with controlled temperatures below 75 degrees F. Note that testing was performed on panels with 0.060 in. standard PVB, and ionomer. Prior to specifying other laminate thickness or material for use in these applications, consult the hardware manufacturer for approval.

XII. Glass Transoms

Fully tempered or tempered laminated glass transoms are those fixed glass panels immediately above the door opening and often span between the top of the doors and the finished ceiling. These transom lites can be incorporated into the glass entrance using patch fittings or other transom support methods. Glass transoms using patch fittings may require mechanical fastening to the ceiling structure, based on weight, size and other design considerations. For example, see Figure 20.

XIII. Glass Stabilizer Fins

With all glass transoms and sidelites, perpendicular fully tempered heavy glass mullions, sometimes called fins, may be mounted from the ceiling to the bottom of the transom to reduce the amount of deflection of the glass entrance. The fin must be mechanically secured and anchored to the overhead load carrying structure. Suspended ceilings do not provide an adequate structure for attachment of stabilizer fins. Typically, these glass fins are made using ½ in. (12 mm), ⅝ in. (15 mm), or ¾ in. (19 mm) thick fully tempered glass. For design criteria for the design and use of glass stabilizer fins, see Section XIV – Structural Design of Interior Glass Entrance Systems.

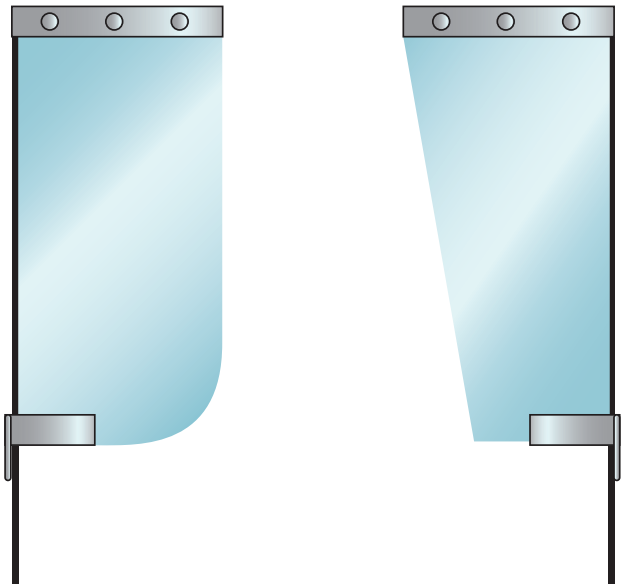


FIGURE 19

Examples of Fully Tempered Glass Stabilizer Fins

XIV. Structural Design of Interior Glass Entrance Systems

One of the primary purposes of this Design Manual is to ensure the designer has considered the structural limitations of the glass and metal fittings, so the fully tempered entrance system will function satisfactorily and safely. Fully tempered all-glass entrance systems using patch fittings were originally designed in Europe and were used in both interior and exterior installations. Interior glass is not subject to uniform wind loading, so other loading criteria had to be developed.

Many interior entrances are designed with the glass panels supported at the head and sill only, without additional mullions or other lateral support. Interior glass entrances and partitions are typically mounted or restrained at the top and bottom. They are more susceptible to deflection than glass supported on three or four sides. Some deflection or vibration in the glass is normal. If the glass system is not designed correctly, fluctuations of interior air pressure or the operation of a door can temporarily cause the glass to move out of plane, affecting the operation of hardware. Persons pushing or leaning on glass can also noticeably deflect the glass. As the unsupported vertical span of the glass panels increases, the glass thickness must be increased, or additional hardware utilized, to limit deflection. In this Design Manual, the design considerations are separated into two-sided and three-sided support. Uniform horizontal pressures or other interior loading criteria are not clearly defined in most building codes. The International Building Code (IBC) limits the differential deflection of two adjacent unsupported sides of the interior glass panels. The recommended minimum thickness of fully tempered glass required to meet the IBC for adjacent panels that are not linked together to prevent differential deflection is shown in Table 12 of Section 9 of the *Engineering Standards Manual*, and Table 1 of Appendix 1 of this manual. By utilizing hardware or applying silicone to the joints of adjacent panels, the thickness limits shown can be used to reduce differential deflection.

INTERIOR TWO-SIDED SUPPORT

The minimum allowable glass thickness for a given height (H) of heavy glass sidelite panels as shown below in Figure 20 can be determined based on the recommendations shown in Table 1 of Appendix 1 of this manual.

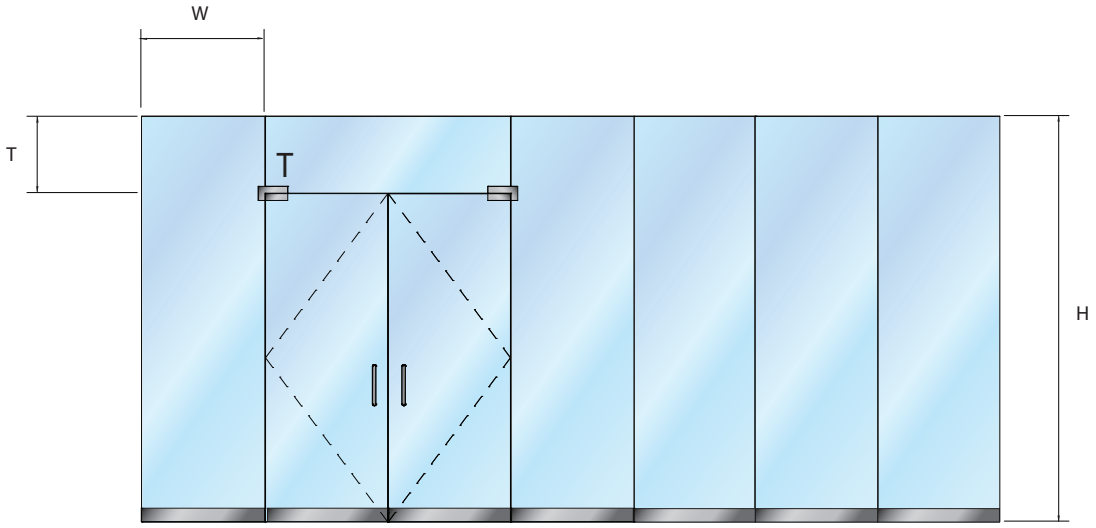


FIGURE 20

Interior Entrance Size when Supported at Head and Sill

Most interior all-glass entrance systems are designed using ½ in. (12 mm) thick fully tempered or tempered laminated glass. The following design examples are for ½ in. (12 mm) thick fully tempered or tempered laminated glass. The structural loading criteria used for two-sided supported panels in this Design Manual was developed using the force developed by the weight of the glass doors opened 90 degrees to the plane of the entrance as the primary design load for these interior applications. This load is often greater than the 5 to 10 PSF (0.25-0.5 kPa) interior design load often stated in building codes.

When a sidelite is located adjacent to a door, this sidelite is often required to support the weight of an operating glass door. According to Section 2403.4 of the Glass and Glazing Chapter of the IBC, the differential deflection of two adjacent unsupported edges shall not be greater than the thickness of the panels when a force of 50 pounds per linear foot is applied horizontally to one panel at any point up to 42 in. (1,067 mm) above the walking surface. Refer to Appendix 1 for a summary of glass wall deflection limits.

If this sidelite (Figure 20) is too narrow, it does not have sufficient strength to support the weight of the door without deflecting to the point where the door clearances will be compromised. The graph in Figure 21 is furnished using common door sizes. This graph is constructed so that if the glass door toe deflects downward more than ¼ in. (6 mm) due to the weight of the door, the sidelite is too flexible. If this occurs, the design must be changed, either by securing the jamb of the sidelite to provide three-sided support or by adding stabilizer fins.

In order to determine if fins are (or are not) required for an interior glass entrance system with two-sided support, the door width and transom height must be known. See “T” (Transom Height) and “W” (Sidelite Width) on Figure 20. The maximum height for ½ in. (12 mm) glass is 120 in. (3 m), as shown in Appendix 1, Table 1 must not be exceeded. As can be seen in the chart, the minimum width for a sidelite that must support the weight of the door is 12 in. (305 mm). Use “T” and “W” in Figure 21 to establish a reference point. If this reference point is below the door width line on the chart, fins are not required. If this point is above the line, fins are required to provide additional lateral stability for the entrance.

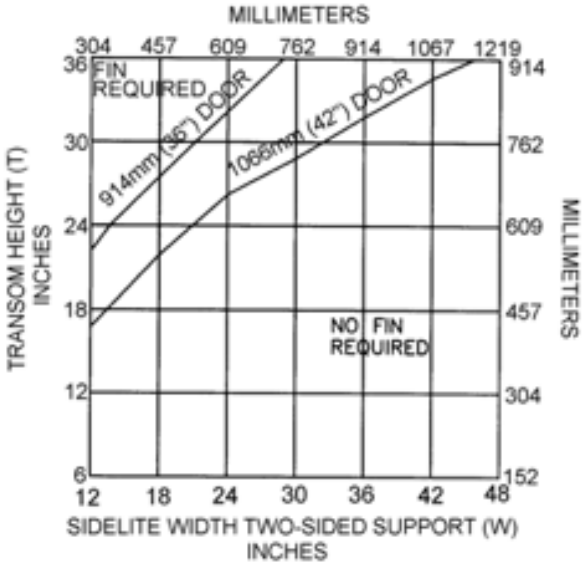


FIGURE 21

Fin Requirement Chart for Doors and Transoms with Two-Sided Support for ½" Interior Glass Entrance Systems

INTERIOR THREE-SIDED SUPPORT

An interior glass entrance can often be supported structurally at the jambs, in addition to the head and sill, as shown in Figure 22. Three-sided support is obtained with the addition of structural members on the vertical edges of the sidelites adjacent to the doors. If the glass sidelite is structurally supported on three sides, it will deflect much less than when it is supported only at the top and bottom. Narrower sidelites are stiffer because they are also supported at the jambs. It is also possible to provide a structurally supported edge for a sidelite by making a 90-degree corner so that the perpendicular sidelite becomes a full-height structural stabilizer for the adjacent sidelite. Structural silicone

is often used to connect the glass corner to provide structural adequacy, but 90-degree patch fittings and clamps can also be used to stabilize the corners.

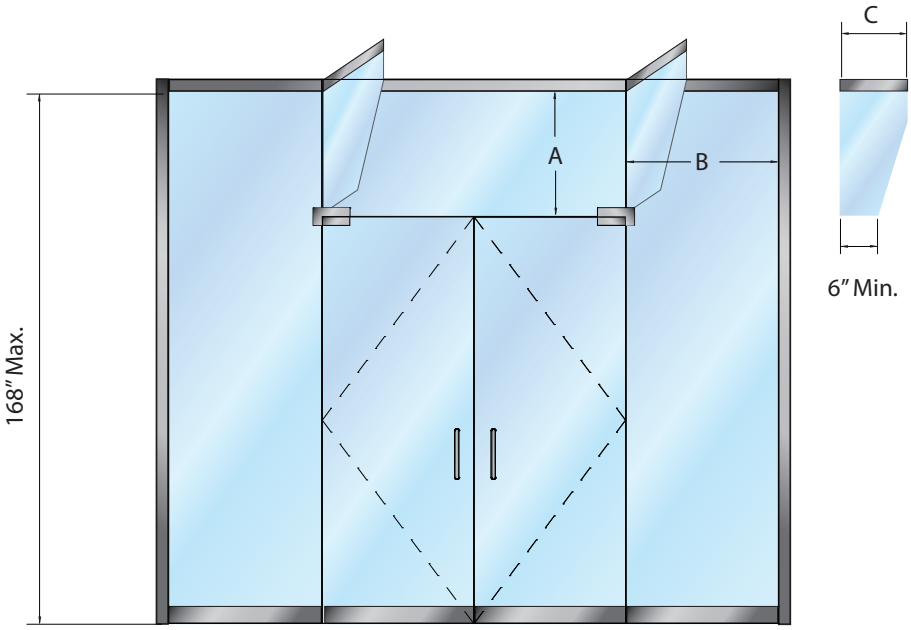


FIGURE 22

Entrance Structurally Supported at the Head, Sill and Jambs Using ½" Glass

FOR INTERIOR APPLICATIONS:

If the sum of the height of the transom "A" plus the width of the sidelite "B" is 72 in. (1,829 mm) or less, the stabilizer fins are not required (A + B < 72 in. [1,829 mm]). The traditional method of analyzing the requirement for structural glass stabilizer fins was developed in Europe more than 20 years ago. Mechanical fastening will be required when transom weight exceeds maximum hardware capabilities; consult the manufacturer for hardware limitations.

If the entrance is to be used heavily or additional stability is desired, a more conservative formula could be used so that fins would be required for smaller openings. Conversely, in applications (such as interior malls) when the doors are locked open all day stabilizers may not be needed because of the limited use of the doors. The design professional must consider glass strength and deflection for both two- and three-sided glass support using this analysis to determine glass fin requirements.

STABILIZER FINS

In most interior applications a 12 in. (305 mm) deep ½ in. (12 mm) glass mullion is adequate for transom/fin heights of up to 24 in. (610 mm). If the transom/fin height is greater than 24 in. (610 mm), the fin width at the top will need to increase as shown in Figure 23. The top of the stabilizer fin must be mechanically fastened to a rigid structure at the top of the assembly to meet the loads imposed by the specific application.

Even with glass stabilizer fins, the recommended maximum height limit for ½ in. (12 mm) fully tempered or tempered laminated glass is 165 in. (4.2 m) for three-side supported interior applications and even less for exterior depending on the wind load. Fully tempered or tempered laminated glass transoms using patch fittings may also require mechanical fastening to the ceiling structure due to the weight of the glass transom.

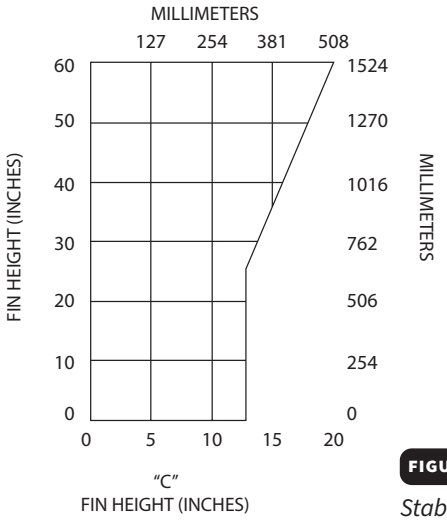


FIGURE 23

Stabilizer Fin Height

XV. Structural Design of Exterior Glass Entrance Systems

EXTERIOR DESIGN

The method of analyzing the glass thickness requirements for a structural glass exterior entrance is essentially the same as for any curtain wall or storefront application. The major design concern for an exterior wall is the wind load pressure. Most exterior glass entrance systems require three- or four-side support for the glass panels using metal or glass mullions. Although tempered glass is very strong, because tempering does not reduce glass deflection, it is usually deflection that determines the glass thickness design, not the glass breaking strength. In most wind load zones the deflection of heavy tempered or tempered laminated glass supported only at the top and bottom is excessive for ½ in. (12 mm) tempered glass if the openings are over 84 in. (2.13 m) high. The major glass manufacturers publish charts showing the amount of deflection for two-side and four-side supported glass when subjected to various wind load conditions. Special calculations are required for three-side supported glass; contact your glass engineer.

Weatherstripping is difficult on center pivoted heavy tempered or tempered laminated glass doors. Weather infiltration around the doors often limits their use in various climatic conditions. Through the use of a double door vestibule airlock arrangement, the amount of air infiltration into the building can be reduced so that the use of heavy tempered or tempered laminated glass makes the entrance more energy efficient.

Full-height and cantilevered glass stabilizer fins must often be used for exterior, heavy glass entrance systems, but the glass system provider or fabricator should provide the design of these stabilizers. The height of the span, the center-to-center spacing of the stabilizer mullions, and the wind load design will determine the stabilizer depth and thickness.

XVI. Application Guidelines for Fully Tempered and Tempered Laminated Glass Entrance Systems

CHANNELS AND FRAMING
Perimeter support applications depend upon job requirements such as size of opening, reinforcement to meet wind load conditions, hardware and design of basic structure.

CHANNELS
⅛ in. (3 mm) thick aluminum channels are often used as perimeter framing. These channels can be clad to match the metal finish of the door hardware.

See Figure 18 and Table 2 for minimum bite and clearance.

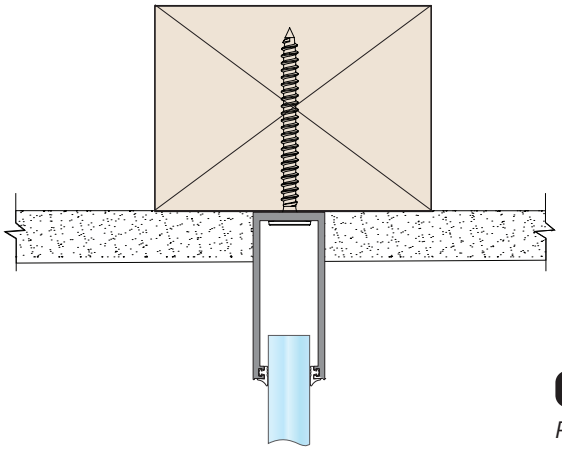


FIGURE 24
Perimeter Channels

FRAMING TUBES
Extruded aluminum tubes or any framing member can be used at the perimeter of the opening. These tubes can be clad with thin-gauge sheet metal to match the metal finish of the door hardware.

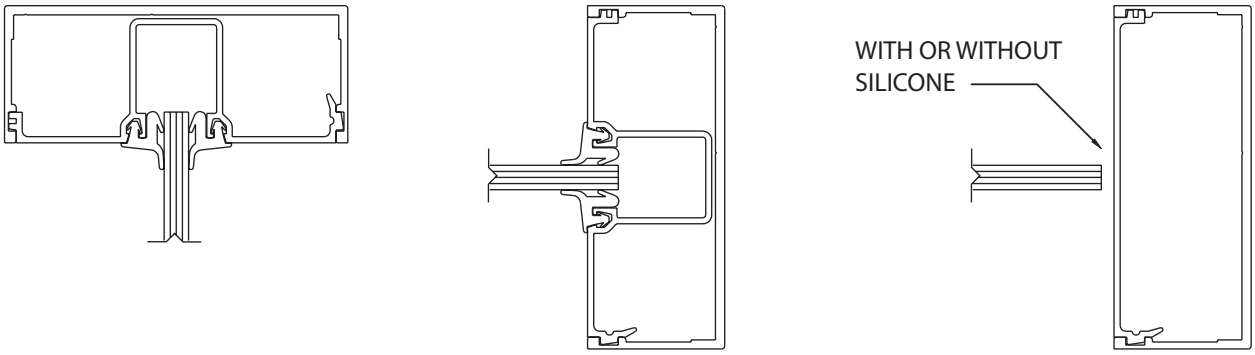


FIGURE 25
Framing Tubes

ACCESSORY HARDWARE

Different types of accessories are available from various manufacturers. When selecting operating hardware (i.e. closers, pivots, etc.), the designer should consult the hardware manufacturer's design limitations, so as not to exceed the maximum recommended sizes and weights for the hardware system selected. For additional information, contact the manufacturer or consult their literature.

Accessory Types

- Center Lock Housing/Strike Housing
- Electric Locks/Strikes
  - Push Button
  - Electrical Access Controls
  - Security/Alarm Systems
  - Magnetic Locks
  - Electric Deadbolts
- Exit Device/Panics
  - Including Rim/Mortise
  - Exposed Vertical Rods
- Lock Indicators
- Balanced Door Hardware
- Door Stops
- Low-energy/Automatic Operators

INSTALLATION

Manufacturers of storefront and entrance systems supply a variety of products that make it possible for the architect to select systems with a broad range of appearance and structural properties. Manufacturer's specifications should be referenced for detailed installation instructions. It is not the purpose of this manual to attempt to point out the detailed procedures to be followed in assembling and installing a particular entrance, but rather to emphasize the importance of proper installation in order to obtain a trouble-free entrance. If a satisfactory installation is to be realized, the installer must become thoroughly familiar with all of these specifications and requirements.

The quality of performance achieved in an entrance depends on three factors: design, manufacture and installation. These three stages of work may be the responsibility of three different parties: the architect, the manufacturer and the installing contractor. The end result, therefore, necessarily depends on intelligent cooperation and teamwork. In any event, the importance of proper installation cannot be overemphasized. No entrance, however perfect in design and manufacture, will function properly **unless it is installed correctly**. The opening must be plumb and square, with the pivots aligned and firmly secured to solid supporting construction with adequate provision for anticipated movements due to seismic or thermal effects.

THE OPENING

The opening in which the entrance is to be installed must be correctly sized, with plumb jambs and level soffit or header. Another consideration is the floor and head condition, not only in the plane of the closed door, but also in front of and through the swing area of operation of the door. Unlevel floors can cause the door to bind in one area and have excess clearance under the door at the locking position so that the lock bolt will not engage. Since the glass in these systems cannot be modified or refabricated, it is important that shop drawing measurements be field verified. If the recommended tolerances are not held, problems are immediately created for the installer of the entrance. If heavy tempered or tempered laminated glass fins are required, they must be properly anchored to structurally adequate supports.

INSTALLATION OF CLOSERS AND PIVOTS

The installation of door closers and pivots requires a high degree of precision. If the door is to operate properly, it is essential that the closer and pivots be installed plumb to each other and level.

Care must be taken to ensure floor reinforcing, electrical conduits or ventilation ductwork does not interfere with the closer installation because floor closers are embedded in the floor. The process may be complicated by the need to place the closer housing or cement case in its exact location before the finished slab is poured. Floor closers are often located near the concrete floor slab edge, so care must be taken to ensure the closer is supported adequately.

Concealed overhead closers are generally installed in an aluminum header that is attached either to vertical or horizontal load-carrying structural supports. The header must be installed level and the closer spindle must be aligned and plumb with the bottom pivot.

When “pivot only” doors are used they should be locked in either the open or closed position. Again, it is essential that the pivots be mounted plumb and level and secured to a load-carrying structural member.

ANCHORAGE

Due to the weight of these systems, frames, sidelites, transoms and structural fins must be properly anchored to the structure. Special consideration may be required when securing these systems in exterior elevations.

HARDWARE INSTALLATION AND ADJUSTMENT

Certain critical door hardware items such as pivots, locks and panic exit devices should be factory installed, reducing the chance that misalignment will interfere with proper operation. One of the most critical installations is that of panic exit hardware because faulty operation may affect emergency egress.

The installation of door closers is also a critical operation and must be done in strict accordance with the manufacturer’s instructions and templates. If the closer is improperly located or mounted, its proper operation will be affected.

Final operational adjustment of all hardware should be made by the installer of the entrance after all glazing is done and the building is completed and ready for occupancy. Some types of swing door hardware, such as pivots, may permit adjustment. Concealed overhead and floor closers can be adjusted to center the door. All closers should be adjusted in the field to obtain proper door closing sweep and latch speeds. All screws should be checked for proper torque according to the manufacturer’s recommendations. Over-torqueing the screws can strip the threads and should be avoided.

XVII. Protection and Cleaning

Specifications typically require protection of the installed entrance system until the building is completed. This must be the responsibility of the general contractor because the installer of the entrance has no control over the scheduling of work in respect to the final completion date of the job. Frequently, the entrance is installed long before the other parts of the building are finished. The movement of materials through it, as well as the adjacent work of other trades, continually subjects it to damage. Adequate protection of the finished entrance components is essential during this period. The entrance contractor should take reasonable precautions to see that work, when completed, is protected from damage, but it is the general contractor who must be responsible for maintaining this protection as long as it is required.

To ensure a long and useful life, a maintenance program should be established for the fully tempered or tempered laminated glass entrance system. This program should include adjusting of the hardware and periodic cleaning of the glass and metal parts. Aluminum and stainless steel parts require periodic washing, but brass and bronze, being copper-based metals, need special care. Copper-based metals are very unstable and are subject to rapid oxidation, thus creating a tarnished appearance. Certain cleaners can damage glass surfaces while others can damage the metal finishes.

The Copper Development Association has defined and numbered the copper-based alloys based upon the percentage of copper, zinc and tin (see Table 1 Metal Finishes). Each of these alloys is a different color, but due to their copper content all of them will tarnish. Light oxidation will occur due to the moisture and other chemicals present in the air. A regular maintenance schedule of cleaning with a non-abrasive brass or metal cleaner will easily return the metal to its natural appearance, help retard oxidation and prevent a heavy buildup of oxidization. Prolonged exposure to water, fingerprints, and glass and floor cleaning chemicals will accelerate the oxidizing process, creating a heavy buildup which may require cleaning by a professional metal restoration company.

Some manufacturers offer a lacquer protective coating for brass and bronze metal cladding. The intent of the lacquer coating is to protect the finish from oxidation during shipping and storage. Lacquer is a soft coating and is susceptible to scratches during use. The lacquer must be considered temporary, as it may last several months, or it could break down within a few weeks depending on field conditions. The lacquer coating must be removed with a strong solvent or paint stripper prior to refinishing. Re-polishing un-lacquered metal with a non-abrasive brass or metal cleaner, and re-lacquering, can best be accomplished by a professional metal restoration company. Do not attempt to polish a lacquered finish with metal polish as this can cause immediate breakdown of the lacquer. Special, longer-lasting clear coatings are available; consult the manufacturer for special maintenance and cleaning procedures for these coatings.

Appendix I. Recommendations for Fully Tempered Interior Butt-Glazed Fixed Glass Panels

RECOMMENDATIONS FOR FULLY TEMPERED MONOLITHIC INTERIOR BUTT-GLAZED FIXED GLASS PANELS
(Reprinted from the Engineering Standards Manual)

The fixed panels of interior glass partitions mounted or restrained on only two sides (top and bottom) require special design considerations:

Glass held only on two sides is much more flexible than glass supported on all four sides. If the glass is too thin, small fluctuations of interior air pressure can cause the glass to tremble or shimmer. People pushing or leaning on glass that is too thin will noticeably deflect the glass. As the unsupported span or height of the glass panels increases, the glass thickness must also increase to maintain a reasonable stiffness. Table 1 below shows recommended minimum thicknesses of FULLY TEMPERED MONOLITHIC glass for various glass heights used in interior butt-glazed fixed glass panels.

Table 1:

Minimum Thickness Guidelines for Fully Tempered Glass

used in two-side simply supported interior panels and mounted or restrained at top and bottom only

	IBC 1607.14[1,2]	IBC 1607.14[1,3]	IBC 2403.4[1,4]	IBC 2403.4[1,3]
	Load - 5 lb/sq.ft.	Load - 5 lb/sq.ft.	Load - 50 lb/ft	Load - 50 lb/ft
Unsupported span from top to bottom of glass	when open joints	when linked with silicone or permanent fastener	when open joints	when linked with silicone or permanent fastener
Up to 5 ft (1.5m)	3/8" (9mm)	3/8" (9mm)	1/2" (12mm)	3/8" (9mm)
Over 5 ft (1.5m) up to 6 ft (1.8m)	3/8" (9mm)	3/8" (9mm)	1/2" (12mm)	3/8" (9mm)
Over 6 ft (1.8m) up to 7 ft (2.1m)	1/2" (12mm)	3/8" (9mm)	5/8" (15mm)	3/8" (9mm)
Over 7 ft (2.1m) up to 8 ft (2.4m)	1/2" (12mm)	1/2" (12mm)	5/8" (15mm)	1/2" (12mm)
Over 8 ft (2.4m) up to 9 ft (2.7m)	5/8" (15mm)	1/2" (12mm)	5/8" (15mm)	1/2" (12mm)
Over 9 ft (2.7m) up to 10 ft (3m)	5/8" (15mm)	1/2" (12mm)	3/4" (19mm)	1/2" (12mm)
Over 10 ft (3m) up to 11 ft (3.4m)	3/4" (19mm)	5/8" (15mm)	3/4" (19mm)	5/8" (15mm)
Over 11 ft (3.4m) up to 12 ft (3.7m)	3/4" (19mm)	5/8" (15mm)	3/4" (19mm)	5/8" (15mm)
Over 12 ft (3.7m) up to 13 ft (4m)	7/8" (22mm)	5/8" (15mm)	7/8" (22mm)	5/8" (15mm)
Over 13 ft (4m) up to 14 ft (4.3m)	7/8" (22mm)	3/4" (19mm)	7/8" (22mm)	3/4" (19mm)
Over 14 ft (4.3m) up to 15 ft (4.6m)	1" (25mm)	3/4" (19mm)	7/8" (22mm)	3/4" (19mm)
Over 15 ft (4.6m) up to 16 ft (4.9m)	1" (25mm)	3/4" (19mm)	7/8" (22mm)	3/4" (19mm)
Over 16 ft (4.9m) up to 17 ft (5.2m)	1" (25mm)	7/8" (22mm)	7/8" (22mm)	7/8" (22mm)
Over 17 ft (5.2m) up to 18 ft (5.5m)	use engineering analysis	7/8" (22mm)	1" (25mm)	7/8" (22mm)
Over 18 ft (5.5m)	use engineering analysis	use engineering analysis	use engineering analysis	use engineering analysis

1. These numbers are based on the assumption that bottom of the glass attachment is at the same height as the walking surface.
2. Guidelines based on IBC 2403.4 deflection limit of the thickness of the glass panel.
3. Guidelines for spans up to 10' are based on a deflection limit of 1.5" (based on pullout of less than 1/16"); guidelines for spans greater than 10' are based on a deflection limit of 2" (based on pullout of 3/32"). Larger deflections should be reviewed by designer.
4. Guidelines based on IBC 2403.4 deflection limit of the thickness of the glass panel and loading from IBC 2403.4.

CAUTIONS:
The following cautions are not addressed in any way by Table 1.

IBC Section 2403.4 states:

> "**Interior Glazed Areas:** Where interior glazing is installed adjacent to a walking surface, the *differential deflection* of two adjacent unsupported sides shall not be greater than the thickness of the panels when a force of 50 pounds per linear foot is applied horizontally to one panel at a point up to 42 inches above the walking surface."

Appendix II. Glossary of Terms

A-Style Door
See P/P Style Door.

Active Door
First operating door of a pair, when opening.

AGT Bracket (all-glass transom)
An L-angle bracket used to support a transom lite and act as the top pivot which attaches to the jamb. Typically used on custom applications where a notch in the transom glass is not permitted. The top patch or door rail must be notched.

All-Glass Door
See Glass Door.

Anodize
Electrochemical method of coloring aluminum. Common colors are clear (natural), dark bronze (313) and black (315).

Arris
The angle or tapered portion of a flat polished edge, approximately 1⁄16 in. (1 mm) wide.

Backset
A reference point on a door referring to pivot or lock location.

Balanced Door
A door equipped with double pivoted hardware so designed as to cause a semi-counterbalanced swing action when opening. This application is used for very large doors, or in areas where high wind pressure could make it difficult to open a normal glass door.

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Bottom Arm
A metal bar that is bolted into the bottom rail and is then mounted on the spindle shaft of the floor closer.

Box Strike
See Strike.

BP Style Door
See P/R Style Door.

C.O.C.
See Concealed Overhead Closer.

Cement Case
Metal casing installed into floor used to encase or mount floor closer.

Center-Hung
A door hung on pivots located in the mid-line of the door.

Center Lock Housing
Lock which is installed into glass door at typical push/pull height in lieu of a top or bottom rail lock. Center lock housing may or may not incorporate the door handle.

Center Pivot
Swing hardware having its pivot axis on the thickness centerline of the door. Standard pivot distance is 2-⅝ in. (68 mm) from edge of door to centerline of pivot (and typically 2-¾ in. (69 mm) from the jamb).

Check
See Door Closer.

Cladding
Thin layer of sheet metal wrapped around an extrusion. Typically attached with two-sided tape, contact cement or mechanical fastener.

Clearance
See Door Clearance.

Closer
See Door Closer.

Concealed Overhead Closer (C.O.C.)
A center-hung door closer that is installed above the door, usually in a header tube.

Cover Plate
A finish plate used to cover the exposed face of a floor closer not covered by the threshold. Also, a plate used to cover the exposed face of a closer mounted in the head of a door frame.

Crash Bar
The cross bar of a panic exit device, serving as a push bar to actuate the panic hardware. Commonly referred to as push bar.

Crash Bar Housing
The housing at either end of a crash bar which is mounted on the surface of a door.

Crush
A lightly pitted area resulting in a dull gray or white appearance over the region.

Cylinder
The cylindrical mechanism that receives the key used to operate a locking mechanism. The cylinders typically used are mortise-type.

Cylinder Cam
Usually refers to the flat metal plate on the end of a mortise-type cylinder, serving to actuate the lock mechanism.

Deadbolt
Straight throw bolt.

Deadlatch
See Lock.

Deadlock
See Lock.

Deflection
The distance a point on the glass is displaced from its original position as a result of loading is called the deflection of the point. Since the glass is normally vertical, this deflection is normally horizontal. Tempering the glass does not reduce glass deflection for a given load.

Digs
Deep, short scratches.

Dirt
A small particle of foreign matter imbedded in the glass surface.

Door Clearance
The margin of clearance around the perimeter of a door, between the door and its frame.

Door Closer
A device or mechanism to control the closing of the door. It can be floor or overhead-mounted, center-hung, or offset and either exposed or concealed.

Door Holder
A hardware device designed to limit the swing of a door and hold it in an open position.

Door Lite
The glass area in a glazed door.

Door Opening
The opening dimension of a doorway measured from jamb to jamb and front floor line to head of frame. The opening size is usually the nominal door size and is equal to the actual door size plus clearances and threshold height.

Door Size (actual)
For swing doors, the actual width and height of the door leaf itself.

Door Size (nominal)
See Door Opening.

Door Stop
(a) A molding or projecting element on a door frame which overlaps the edge of a door, causing it to stop in its closed position.
(b) A bumper mounted on the floor or wall to limit the extension of the door opening.
(c) An accessory feature of a door holder, serving to limit the swing of a door.

Door Sweep
See Sweep Strip.

Door Swing
The designation of direction of the swing of a door. Viewed in plan, a clockwise swing inward is right-hand, and outward is left-hand reverse; a counterclockwise swing inward is left-hand, and outward is right-hand. See figure 26, below.

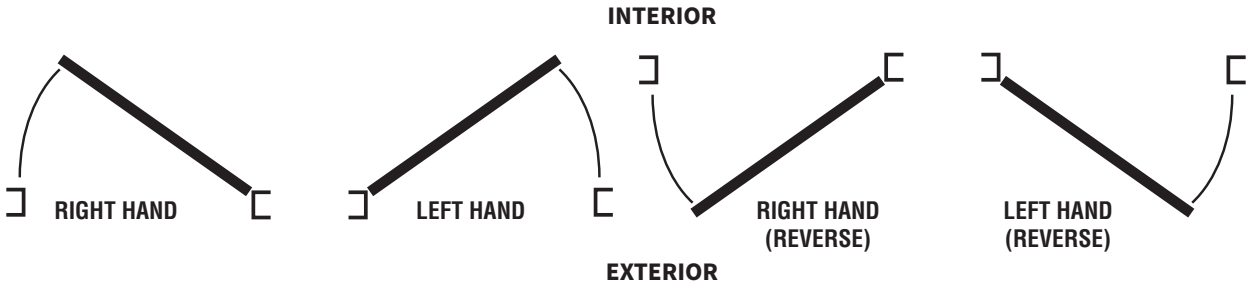

FIGURE 26
Door Swing Diagram

Door Toe
Leading edge of door.

Double Acting Door
A door equipped with hardware which permits it to swing in both directions from the plane of its frame.

Dress Plate
See Cover Plate.

Dry Glazing
A method of securing glass in a frame by use of a dry, performed resilient gasket, without the use of a compound.

Dustproof Strike
See Strike.

Electric Strike
See Strike.

Fail-Safe
When this device is de-energized during electrical outages, the door will remain unlocked and/or free-swinging. See Section VII – Entrance Components.

Fail-Secure
When a device de-energizes during electrical outages, the door will remain locked. See Section VII – Entrance Components.

Fins
Fully tempered heavy glass mullions, typically ½ in. (12 mm) or ¾ in. (19 mm), either partial or full opening height, installed perpendicular to the façade. The fins are attached to the façade glass either by patch fittings, structural silicone or both. See Section XIII – Glass Stabilizer Fins.

Flat Ground
The process by which raw glass edges are ground to a flat, grainy finish.

Flat Polished
The process by which raw glass edges are polished to a smooth finish, usually accompanied by small 45-degree corners on the edges known as arrises.

Floor Check
See Floor Closer.

Floor Closer
A door closing device which is installed in a recess in the floor below the door to regulate the opening and closing swing of a door.

Floor Hinge
See Floor Closer, which is the preferred term.

Floor Pivot
A center or offset pivot which is located at the floor or threshold.

Flush Glazing
The setting of a lite of glass or panel into a four-sided sash or frame opening containing a recessed "U" shaped channel without removable stops on three sides of the sash or frame and one channel with a removable stop along the fourth side.

Frame
An assembly of members surrounding and supporting a door or doors, and perhaps adjacent sidelites and transom lites.

Gaseous Inclusions
Round or elongated bubbles in the glass.

Glass Door
A door manufactured using heavy ⅜ in. (10 mm) or thicker fully tempered or tempered laminated glass.

Glazing Bead
A light member applied to a frame, door stile or rail to hold glass in a fixed position.

Hairline Joint
The line of contact between abutting members, with a maximum joint width of 1⁄64 in. (0.5 mm).

Handle
See Lever Handle. Also refers to any grip-type door pull.

Head (Header)
The horizontal frame member which forms the top of a door opening.

Header Tube
Rectangular aluminum extruded shape mounted at the top of the opening to contain the concealed overhead closer (C.O.C.). It may also have a door stop attached to make a door single acting.

Holder
See Door Holder.

Hold Open
A mechanism within a door closer that holds the door in the open position. It can be at a fixed angle or multi-point adjustable.

Inactive Door (Leaf)
The last door of a pair of doors to be released when opening. Usually the one not equipped with lock cylinders.

Jamb
The vertical frame member forming the side of a door frame or opening. The hinge jamb is one at which the hinges or pivots are mounted. The lock jamb is the jamb at the leading edge of the door, where a lock may be installed.

Keyed-alike Cylinders
Cylinders which are designed to be operated by the same key. (Not to be confused with master-keyed cylinders.)

Keyed-different Cylinders
Cylinders requiring specific, individually designed keys for their operation.

Latch
See Lock.

Leaf
An individual door used either singly or in multiples.

Lever Handle
A bar-like grip which is rotated about an axis at one of its ends to operate a latch.

Lintel
A horizontal structural member spanning an opening at its head to carry construction above the opening.

Lock
(a) Deadlock—a lock in which a bolt is moved by means of a key or thumb turn and is positively stopped in its projected position.
(b) Latch—a mechanism having a spring-activated, beveled latchbolt but no locking device. Retraction of the latchbolt is by lever handle or key.
(c) Deadlatch—a latchbolt having an auxiliary feature which prevents its retraction by end pressure when in projected position.
(d) Deadlock and latch—a hardware item containing both a deadbolt and latchbolt.

Locking Ladder Pulls
A ladder-style pull handle that incorporates a deadbolt locking function with the use of a cylinder and thumb turn or lever.

Masterkey
A key designed to operate a group of cylinders, each of which may be set to a different individual key.

Masterkeying
A system of keying cylinders so that one masterkey will operate all of them, secondary keys will operate only certain groups of them, and other keys will operate only certain individual cylinders. Infinite combinations are available and must be set up by the cylinder manufacturer.

Mullion
A vertical framing member separating fixed lites of glass, operating sash or door openings.

Offset Pivot
Used where doors must be able to swing open more than 105o from closed position. An offset-hung door can be opened 180o from closed position, while a center-hung door can only open about 110o.

Offset Pull Sets
An “L” shaped pair of fixed handles designed to mount toward the lead edge of the door, with the “L” shape causing the actual gripping surface to be further from the edge or located more inboard.

Overhead Closer
(a) Surface type—an exposed door swing control and closer device mounted on the surface of a door and frame at its head.
(b) Semi-concealed type—a door swing control and closer device mortised into the door top rail and/or frame head.
(c) Concealed type (C.O.C.)—a door swing control and closer device enclosed within the door top rail and/or frame head.

P/P Door
Door with partial rail or smaller profile patch fitting for top and bottom pivot corners. Formerly known as A-Style Door.

P/R Door
Door with full bottom rail and top corner patch fitting. Formerly known as BP-Style Door.

P Style Door
See P/P Door.

Panic Bar
See Crash Bar.

Panic Exit Device
A door mechanism designed to control access while always being operable from the interior by pressure on a push bar.

Patch Fitting
Aluminum or steel castings clamped and bolted to the fully tempered or laminated fully tempered glass doors, transoms or sidelites, typically with covers to match desired finish. Patch fittings typically require special glass fabrication. Patch fittings may be fitted with interchangeable inserts for specific door operations or functions. See Section V – Types of Hardware for common patch types.

Pivot
Mechanism(s) consisting of a fixed pin or ball bearing assembly designed to install above and/or below a door used for supporting the door’s weight and allowing the door to swing.

Pivoted Door
A door hung on pivots, as opposed to butt hinges.

Point Support Hardware
Glass hardware that uses through bolt fittings that attach onto the glass panels.

Pull Hardware
A fixed handle or grip used to pull a door open.

Pull Sets
Pair of fixed handles or grips designed to mount on both faces of a double-acting door so that it can be pulled open from either direction.

Push Bar
The operable cross bar of a panic exit device used to actuate the panic hardware. Also referred to as crash bar.

Push/Pull Sets
Fixed handle or grip combined with a fixed bar or plate used to push or pull open a door.

Push Hardware
A fixed, horizontal bar or plate used to push a door.

Rail
A horizontal door frame member, extending the full width of the door. May be at the top or bottom of the door.

Rail Patch
A rail that does not cover the full width of the door.

Removable (Interchangeable) Core Cylinders
A removable core cylinder is a lock cylinder that consists of two main components:

(a) The main cylinder housing that accepts the core and installs in the lockset.
(b) The core which accepts the key and operates the lock. It is removable with the use of the control key to allow for the easy rekeying of the lockset.

Revolving Door
A door consisting of multiple leaves, mounted at equal angles to each other on a common vertical pivot axis, with their outer edges in sweeping contact with the building floor; a flat ceiling; and two opposed curved enclosure walls, each of which extends through slightly more than the 90o arc of a circle.

Roller Latch
A hardware device for holding a door in closed position. It consists of a spring-loaded roller mortised into the edge of the door so as to engage with a grooved strike mortised into the frame jamb.

Saddle
Same as track. Used at the head and sill of sidelites with rails.

Setting Blocks
Small pieces of neoprene or other material which are placed under the lower edge of a lite of glass to support it within a frame.

Sidelite
A fixed lite of glass located in an opening.

Single Acting Door
A door mounted to swing in one direction only. Offset doors are always single action, i.e. either swing in or swing out. Center-hung doors can be made single-acting by means of a door stop.

Sill
Refers to the bottom of a door opening.

Standard Clearance
Typical minimum clearances are ≥¼ in. (6 mm) under door, ⅛ in. (3 mm) above door, ⅛ in. (3 mm) between doors, and ⅛ in. (3 mm) between door and frame. Reference door and hardware manufacturer's guidelines for maximum clearances.

Stiffener (fin)
A lite of glass which serves to limit the deflection of the adjacent sidelites or doors to which it is attached. Used most commonly with glass entrance systems and door openings with large all-glass transoms.

Stile
A narrow, vertical stile may be added to the door to provide weathering for exterior applications.

Stop
See Door Stop and Glass Stop.

Strike
An opening or retaining device provided in the head, jamb or threshold of a door frame, or in the edge of a stile of an inactive door to receive a lock or latch bolt (also referred to as a Keeper or Strike Plate).
(a) Box strike—A strike consisting of a faceplate with rectangular opening and a box-like enclosure attached to the back of the plate and surrounding the opening.
(b) Dust proof strike—A strike which is placed in the floor, sill or threshold of an opening to receive a flush bolt, and is equipped with a spring-loaded follower to cover the recess and prevent its filling with dirt.
(c) Electric strike—A strike for latch bolts, having a roller mounted in the lip to reduce friction.

Strike Plate
See Strike.

Surface Applied Pivot
A door pivot attached directly to the surface of the frame and not recessed within the frame.

Sweep Strip (Door Sweep)
A weather-strip mounted at the top or bottom edge of a swing door.

Swing
The direction of opening of a swing door (same as Hand of Door).

Template (for Hardware)
A precise, detailed layout or pattern for providing the necessary fabrication of door or frame to receive hardware.

Threshold
The lower horizontal member of a door frame, which is set on the floor and extends from jamb to jamb.

Throw
The distance which a lockbolt projects when in the locked position.

Thumbturn
A permanently attached small lever or knob which, when turned, operates the bolt on a lock in the same manner as a key.

Track (Saddle)
Same as saddle. Used at the head and sill of sidelites with rails.

Transom
The lite of glass immediately above a door opening.

Transom Bar
The horizontal frame member which separates the door opening from the transom lite.

Transom Bracket (AGT, all-glass transom)
A bracket used to support an all-glass transom over an all-glass door when the latter has no metal top rail and no transom bar is used.

Walking Beam Pivot
A form of retractable top center-hung pivot.

Weather-strip
Material applied to the edges of a door or sash, or to the inner edges of its frame, to close the clearance opening and prevent the passage of air, moisture or dirt.

Wet Glazing
A method of sealing glass in a frame by use of a glazing compound.

Wind Load
The principle load applied to glass in an exterior wall that is caused by wind. The design wind load is dependent on the wind velocity, importance of the structure, type of exposure, building height, building shape and orientation, location on the building and the size of the glass. See GANA Glazing Manual, 50th Anniversary Edition.

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