

Good Glazing Guidelines

The design of a good glazing system incorporates experience and judgment and considers the glass type, in service loads, framing system, method of erection and associated tolerances. The glazing system should be designed to minimize loads on the glass created by building movement.

To adequately retain glass in the framing system and prevent breakage caused by glass-to-metal contact or by mechanical and thermal stresses, architect's specifications should include the following general glazing guidelines.

Thermal Stress Considerations

Glazing designs can help to prevent annealed glass breakage from excessive thermally induced stress. Heat-strengthened or fully tempered glass will adequately resist solar stress or HVAC-induced thermal stress and, therefore, heat-treated glass is exempt from the following thermal guidelines.

Solar-induced stresses are caused by uneven absorption of solar radiation. Deep shadows from mullions or overhangs can reduce the solar heating in part of the glazing, while reflections at inside corners or off water or snow can increase the heating in other parts.

Restrictions to natural convection such as tight-fitting closed blinds, suspended ceiling pockets in which rising hot air is trapped, or large signs fastened to the glass will interfere with uniform solar heating.

Excessive thermal stress from louvers or venetian blinds can be prevented by following the dimension limits shown below or by adding lock stops to prevent the blades from being fully closed. Typically 30° off full closure is effective.

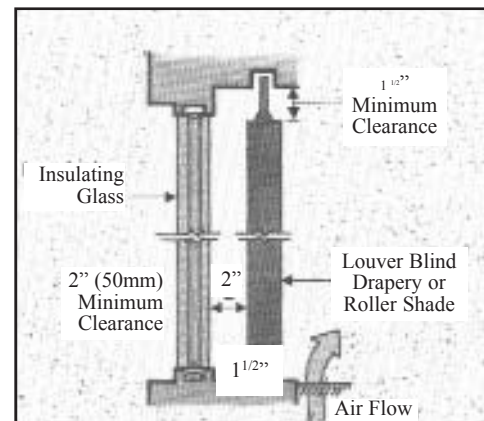
HVAC ducts must not blow directly against the glass. Excessive stress can be created in both heating and cooling cycles by misdirected air vents.

Pilkington **Eclipse Advantage™** Reflective Low-E Glass products have varying amounts of solar absorption. Thermal stress calculations should be made for every project using these glasses with the calculator provided on our website at www.pilkington.com

Pilkington Arctic Blue **Eclipse Advantage™** and Pilkington EverGreen **Eclipse Advantage™** Reflective Low-E Glasses have

very high performance and will typically need heat treatment in most installations to prevent thermal stress breakage when installed in an I.G. unit. For additional information, please refer to Pilkington Technical Bulletin ATS-139: "Thermal Stress for Glazing Combinations".

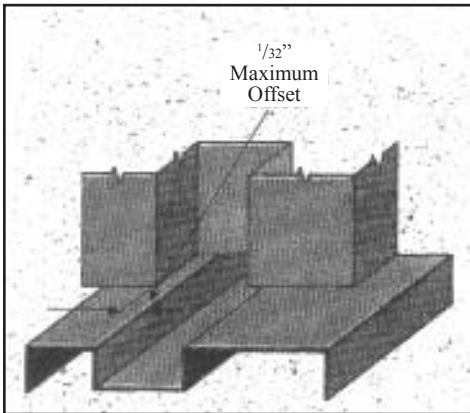
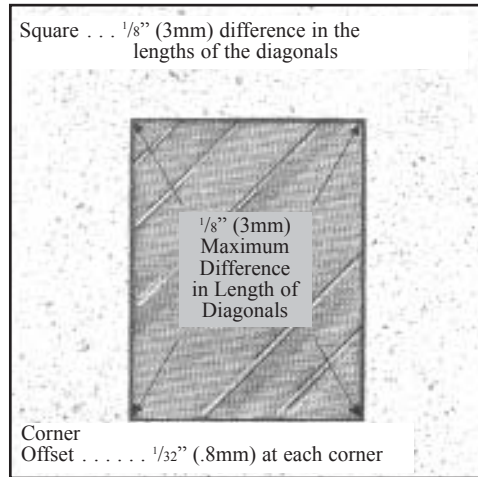
Cut-size annealed glass is supplied with clean-cut edges. These edges must not be allowed to contact any hard objects or be damaged in any way during construction or the glass strength which resists thermal stress will be reduced.



General Glazing Guidelines

Framing System

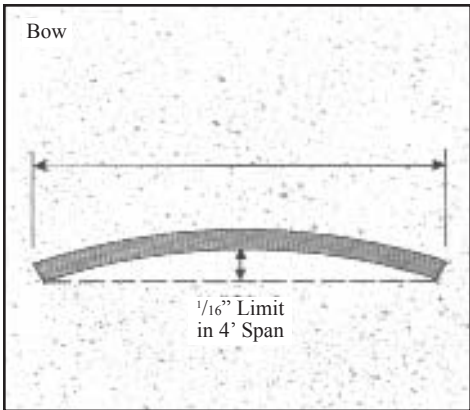
The framing system must structurally support the glass under static and dynamic loads and provide openings within specified limits for squareness, corner offset and bow. These limits are:



Square $1/8''$ (3mm) difference in the lengths of the diagonals

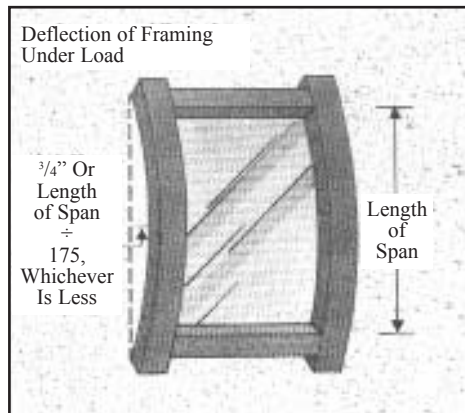
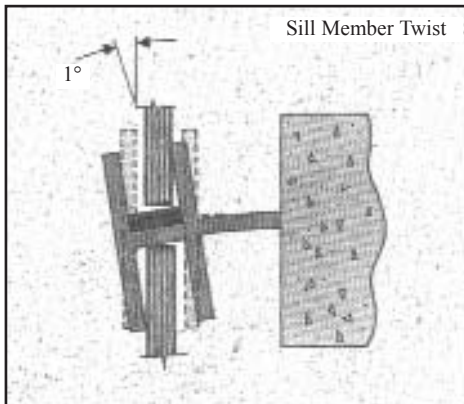
Corner Offset . . $1/32''$ (.8mm) at each corner

Bow $1/16''$ (1.6mm) in any 4' (1.22m) length of framing

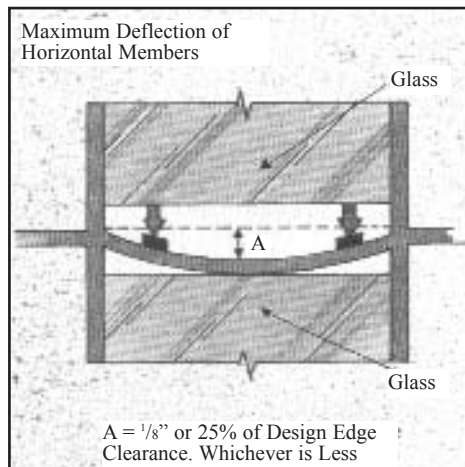


General Glazing Guidelines

The deflection of glass framing members under design loads must not exceed either the length of the span divided by 175 or $\frac{3}{4}$ " (19 mm). The deflection of horizontal members due to the weight of the glass should be limited to minimize bite variations and thermal stress at the glass edge. For heat-absorbing and reflective glasses, a limit of the lesser of either $\frac{1}{8}$ " (3 mm) or 25% of the design edge clearance of the glass or panel below is recommended. Twisting of the sill member due to the dead load of the glass should be limited to 1° between ends and center to minimize mechanical bending stresses at the glass edge.

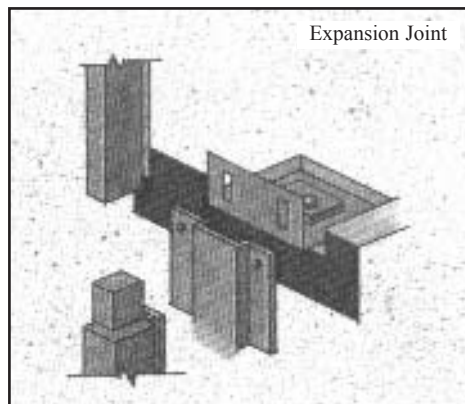


Framing System Continued



Anchors and expansion joints should be designed so that loads are not applied to the glass framing due to the thermal or mechanical movement of the structure. For a stick system, there should be a vertical expansion joint at every floor and preferably at a horizontal support member. Vertical expansion joints should be at glass corners and never placed along an edge of insulating glass.

Horizontal expansion joints should be placed either at each column line or within 30' (9.14 m) of each other, whichever is less.



Anchors and Expansion Joints

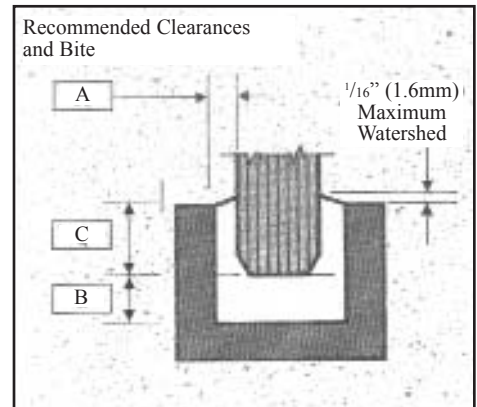
General Glazing Guidelines

Recommended Clearances and Bite

The glazing system should provide for minimum face clearances (A), edge clearances (B) and normal bite or cover (C) at the edge of the glass as shown in the table below. Adequate bite is required to provide a proper seal against infiltration of air and water. Excessive bite can increase thermal stresses at the glass edge, especially for reflective and heat-absorbing products, which could lead to breakage of annealed glass. The table below shows nominal bite recommendations which should be carefully adhered to in designing details and glazing systems

Inadequate edge clearance can result in glass damage by glass-to-metal contact. The chart shows the minimum edge clearance necessary to accommodate glass cutting and normal framing erection tolerances of $\pm 1/16"$ (1.6 mm). When framing members or surrounding material such as steel and concrete are used, construction tolerances may be difficult to control and therefore the edge clearance should be increased appropriately.

Proper face clearance should be provided by a continuous cushioning material with a Shore A 65 ± 5 durometer hardness, such as neoprene or equivalent. Intermittent face shims should not be used. The durometer range of continuous shims may vary depending upon the intended purpose. For example, a high durometer neoprene may be used to apply adequate pressure to a pre-shimmed glazing tape. All glazing



materials must be resilient, nonhardening compounds, tapes or elastomeric gaskets that will retain an adequate face clearance throughout the life of the project. When providing a watershed, the sealant or gasket should be limited to a maximum height of $1/16"$ (1.6 mm) beyond the sightline of the framing members to limit the thermal stress on the edge of the glass throughout the life of the project. When providing a watershed, the sealant or gasket should be limited to a maximum height of $1/16"$ (1.6mm) beyond the sightline of the framing members to limit the thermal stress on the edge of the glass.

Annealed Monolithic Glass (Clear, Tinted and Coated)

Glass Thickness		Minimums									
		A = Face		B = Edge		C = Bite					
in	mm	in	mm	in	mm	in	mm				
$3/32$ - S.S.	2.5	$1/16$	2	$1/8$	3	$1/4$	6				
$1/8$ - D.S.	3	$1/8$	3			$3/16$	5	$5/16$	8		
$5/32$	4					$1/4$	6	$3/8$	10		
$3/16$	5					$3/16$	5	$5/16$	8	$7/16$	11
$1/4$	6	$1/4$	6	$3/8$	10						
$5/16$	8	$3/16$	5	$3/8$	10	$1/2$	13				
$3/8$	10							$1/2$	13	$5/8$	16
$1/2$	12										
$5/8$	16	$1/2$	13	$3/4$	19						
$3/4$	19					$3/4$	19				
$7/8$	22	$3/4$	19								

*Refer to ASTM C1036 for dimensional tolerance for cut-size glass.

General Glazing Guidelines

Glass Thickness		Minimums					
		A = Face		B = Edge		C = Bite	
		in	mm	in	mm	in	mm
3/32 - S.S.	2.5	1/16	2	1/8	3	1/4	6
1/8 - D.S.	3	1/8	3	1/4	6	3/8	10
5/32	4						
3/16	5						
1/4	6	3/16	5	5/16	8	7/16	11
5/16	8						
3/8	10						
1/2	12	1/4	6	3/8	10	1/2	13
5/8	16						
3/4	19			1/2	13	5/8	16
7/8	22						

Heat-Treated Monolithic Glass

Insulating Glass Unit Thickness		Minimums					
		Face A		Edge B		Bite C	
		in	mm	in	mm	in	mm
1/2	13	1/8	3	1/8	3	1/2	13
5/8	16						
3/4	19						
7/8	22	3/16	5	1/4	6		
1	25						

Double Glaze Insulating Glass

Insulating Glass Unit Thickness		Minimums					
		Face A		Edge B		Bite C	
		in	mm	in	mm	in	mm
7/8	22	1/8	3.2	3/16	5	1/2	13
1 1/16	27	3/16	5	1/4	6		
1 1/4	32						
1 3/8	35			5/16	8	5/8	14
1 9/16	40						
1 3/4	44						

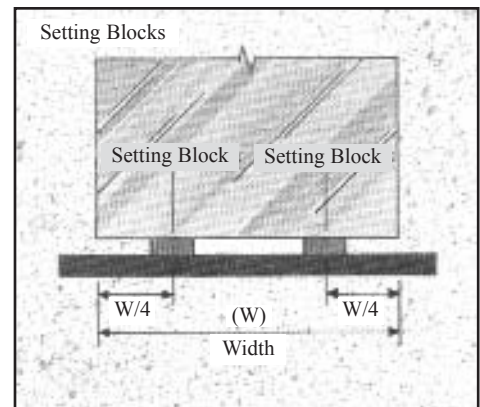
Triple Insulating Glass

Setting Blocks

Each lite of glass should be set on two setting blocks centered approximately at the bottom edge quarter points. When this is impractical, the end of the setting block can be moved within either 6" (152mm) or 1/8 the width of the glass from the vertical edge, whichever distance is greater. Blocks should always be an equal distance from the center of the glass. Neoprene or EPDM setting blocks should have a Shore A durometer hardness of 85 ± 5 .

In a metal glazing system, the length of each setting block should be 0.1" for each square foot (27 mm per square meter) of glass area, but not less than 4" (100 mm).

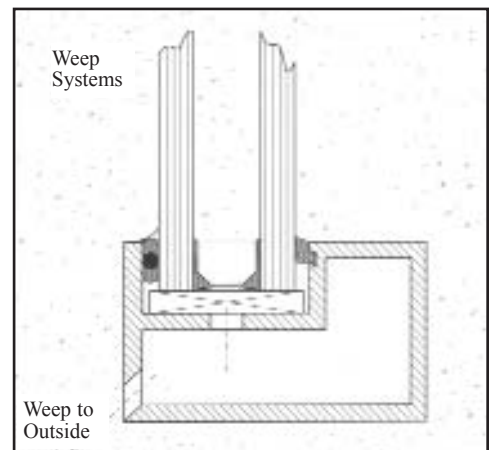
All setting blocks should be of sufficient height to provide the minimum edge clearance for the type of glass being glazed and for the nominal bite recommended. Setting blocks should be 1/16" (2 mm) less than full channel width or positively located in the channel so they cannot be misaligned during



glazing. If setting block shims are required, they must be located under the setting blocks and have a durometer rating equal to or greater than that of the setting blocks. Failure to properly design and locate setting blocks can cause point pressures, bending stress, or glass-to-metal contact resulting in glass breakage or ponding of water, a primary cause of seal failure in insulating glass units.

Weep Systems – Monolithic and Insulating Glass

The glazing system must be designed so that water entering the glazing channel will be weeped out. Each window opening should have a minimum of three weep holes 3/8" (10 mm) in diameter or equivalent. The weep system should not be impaired by improper placement of setting blocks or weep baffles; instead, a void should be left between the edge of the glass and the glazing channel to avoid moisture being trapped. Failure to use a proper weep system or the improper application of sealants can lead to glass breakage, delamination of laminated glass products, or seal failures in insulating glass units.

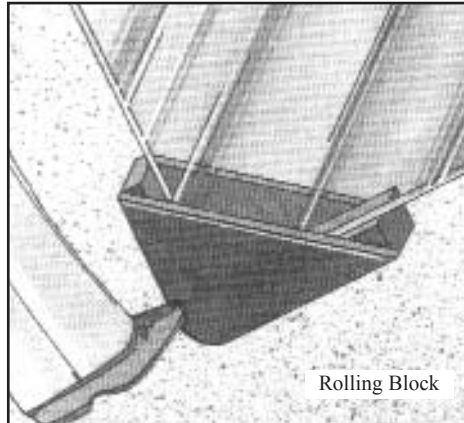


General Glazing Guidelines

Glass should be handled and glazed carefully to prevent edge damage. Care must be taken not to impact the glass edges on metal framing members or surrounding building materials during installation. Chips and impacts at the glass edge can be initially hidden in the glazing channel and later become break origins when the glass is exposed to normal thermal and mechanical stresses. Undamaged, clean-cut, factory edges or factory fabricated edges generally provide the strength needed for annealed glass products to withstand such stresses. Care must be exercised in design to provide a glazing system which will minimize the possibility of edge damage during installation.

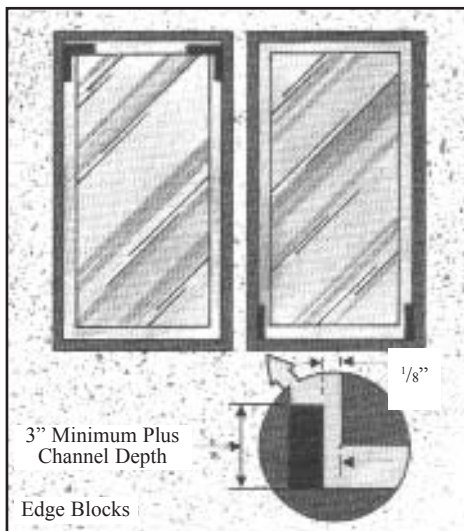
Finished products such as insulating glass, tempered glass, heat-strengthened glass and annealed glass ordered in cut sizes should not be modified by further cutting, seaming

Glass should be centered in the opening vertically and horizontally. For glass in dry glazing systems, edge blocks should be used in each vertical jamb to prevent lateral "walking." Glass movement can lead to glass-to-metal contact and breakage. Shore A 65 ± 5 durometer hardness neoprene is preferred. Each edge block should be at least 3" (76 mm) in length and may be placed anywhere along the jamb. A nominal $1/8$ " (3 mm) clearance should be allowed between the edge of the glass and the block to allow for glass, metal and erection tolerances.



or grinding. Corner edge damage can also occur when glass is rotated on a hard surface prior to glazing. It is recommended that a "rolling block" be used by glaziers to rotate the unit. The rolling block minimizes the chance of damage to the corner of the glass by distributing the glass weight along the edges rather than concentrating it at the corner.

Edge Damage



Edge Blocks

Damage to Glass Surfaces

Glass is a durable product with weathering properties superior to those of most other building materials. The surface of glass may, however, become accidentally damaged during transport and installation. One cause of surface damage is sparks from welding. Glass near welding operations should be protected. Also, wind-blown objects and roof gravel can be blown into glass, thus causing surface damage. This type of damage can lead to surface degradation and possible breakage. Other sources of glass surface damage are alkaline materials and oxidizing steel. Run-down from these materials may be deposited on the glass and stain the surface. Frequent cleaning of glass surfaces during construction and after completion may be necessary.

Glass must be properly stored to avoid wetting and drying cycles. A prolonged wet condition can cause staining or etching of the glass surface. Glass in cases should be stored in dry, well ventilated areas. On a job site, the cases should be stored, elevated off the floor, toward the building interior, and protected from all moisture. Glass stored out of the case should always be stored with interleaving or spacing between the individual lights of glass.

To prevent glass surface staining, the head of all frames should incorporate a small projecting lip or recess to direct rain water away from the glazing below. When rain water washes over upper building levels it picks up dirt and other contaminants. In new construction, this water can become very alkaline from concrete floors or from precast concrete panels. Glass staining can easily occur if run-down water is allowed to dry on the glass and deposits are allowed to remain for an extended period of time.

Frequent washing of glass, especially during construction is recommend to prevent staining.

For additional information, refer to Technical Bulletins:ATS 104, Protecting Flat Glass Surfaces; Technical Bulletin ATS 144, Manual Washing of Clear and Tinted Glass; Technical Bulletin ATS 169 Glazing Guidelines for Pilkington **Activ™** Self-Cleaning GlassATS 181, Washing Pilkington **Eclipse Advantage™** Reflective Low-E GlassATS 176, Handling, Inspecting, Fabricating & Glazing Pilkington **Eclipse Advantage** Reflective Low-E Glass.

Additional Glazing Guidelines for Monolithic Pilkington Eclipse Reflective Glass

When coated or reflective glass surfaces are exposed to high traffic areas care must be taken to avoid contacting the coated surface with abrasive materials or glass-to-metal contact that can damage the coated glass surface.

Additional Glazing Guidelines for Insulating Glass

1. In dry glazing systems, compressive pressure on the glass edge should be a minimum of 4 pounds per linear inch (71.5 g per mm) of edge to assure an adequate seal. The pressure on the glass edge should not exceed 10 pounds per linear inch (180 g per mm). Excessive pressure on the glass can increase mechanical stresses and contribute to glass breakage.

2. Glazing materials must be resilient, non-hardening, nonbleeding compounds, tape or elastomeric gaskets. All materials should be

approved by the insulating glass manufacturer before they are applied.

3. Glazing compounds must not be thinned with chlorinated solvents (dry cleaning fluids) or benzene-related compounds such as toluene.

4. When a heel or toe bead is necessary, compatibility between this material and the insulating unit sealants is required.

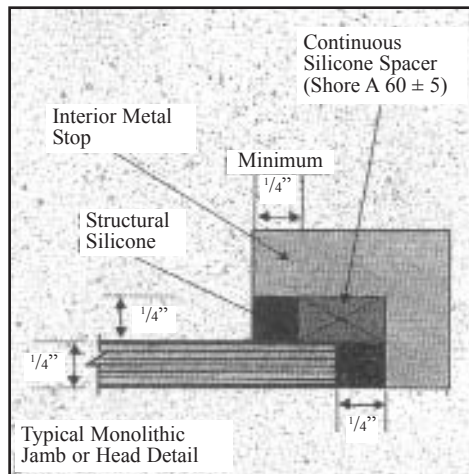
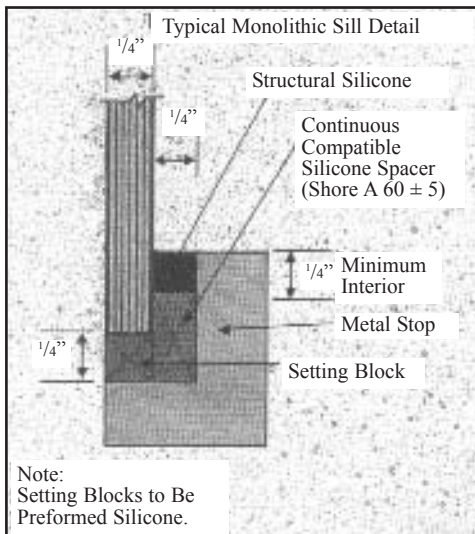
General Glazing Guidelines

The designer of structural silicone glazing systems should be aware that not all glass products can be used in this type of system due to compatibility limitations of silicone sealants with certain insulating glass sealants and some laminated glass interlayer materials. Consult the sealant manufacturer for information concerning the compatibility of glass and silicone for structural silicone glazing. Also, the silicone manufacturer must be contacted for approval of neoprene, EPDM or silicone spacer formulations for optimum joint configurations, for assurances

of silicone strength in the application, and for recommendations for proper adhesion to glass support members. The glazing contractor must design adequate joint dimensions for each application.

The designer must remember that structural silicone sealants may be incompatible with the sealants used to manufacture certain types of insulating glass. Incorrectly designed or applied sealants will lead to premature failure of the insulating glass units and certain glass films.

Additional Glazing Guidelines for Structural Silicone Glazing



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Form No. 974 Printed in U.S.A., 1200/qty/974/Printer