NSG GROUP

Technical Information

ATS-192
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General glazing guidelines

Summary

Designing a good glazing system incorporates experience and judgment and considers a number of factors including the glass type, the framing system, in service loads, method of erection and associated tolerances. In addition, the glazing system should be designed to minimize loads on the glass created by building movement. In order to adequately retain glass in the framing system and prevent breakage caused by glass-to-metal contact or by mechanical and thermal stresses, an architect's specifications should include the general glazing guidelines described below.

Thermal stress considerations

Excessive thermally induced stress can result in annealed glass breakage, however good glazing designs can help to prevent this. As heat-strengthened or fully tempered glass will adequately resist solar stress or HVAC-induced thermal stress, heat-treated glass is exempt from the following thermal guidelines.

Solar-induced stresses are caused by uneven absorption of solar radiation situations of where these might occur are listed below

- Deep shadows from mullions or overhangs reducing solar heating in part of the glazing
- Reflections at inside corners or from water / snow increasing heating in certain parts
- Restrictions to natural convection such as tight-fitting closed blinds or suspended ceiling pockets in which rising hot air is trapped
- Large signs fastened to the glass interfering with uniform solar heating

Excessive thermal stress can also be created by misdirected HVAC systems, where ducts blow directly against the glass, causing stress during the heating and cooling cycles of the system.

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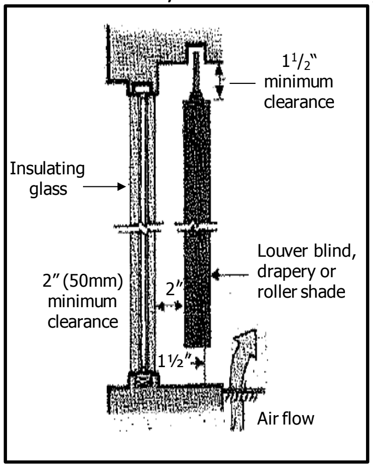
Prevention of excessive thermal stress from louvers or venetian blinds can be achieved by adding lock stops to prevent the blades from being fully closed and typically 30° off full closure is effective. The dimension limits shown below, when followed, will prevent excessive stress.



Dimension limits to prevent excessive thermal stress when using blinds / shades

The type of coating on the glass must also be considered; for example the Pilkington **Eclipse Advantage**™ range of reflective low-e glass products has 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:
http://www.pilkington.com/north-america/usa/english/building+products/tools+and+calculators/

Two examples from this range are Pilkington **Eclipse Advantage**™ Arctic Blue and Pilkington **Eclipse Advantage**™ EverGreen, which have very high performance and will typically need heat treatment when installed in an I.G. unit to prevent thermal stress breakage. For additional information, please refer to Pilkington Technical Bulletin ATS-139: "Thermal Stress for Glazing Combinations".

A final consideration is in the use of cut-size annealed glass, which is supplied with clean-cut edges. It is important that these edges are not allowed to contact any hard objects or be damaged in any way during construction, as the glass strength which resists thermal stress will be reduced.

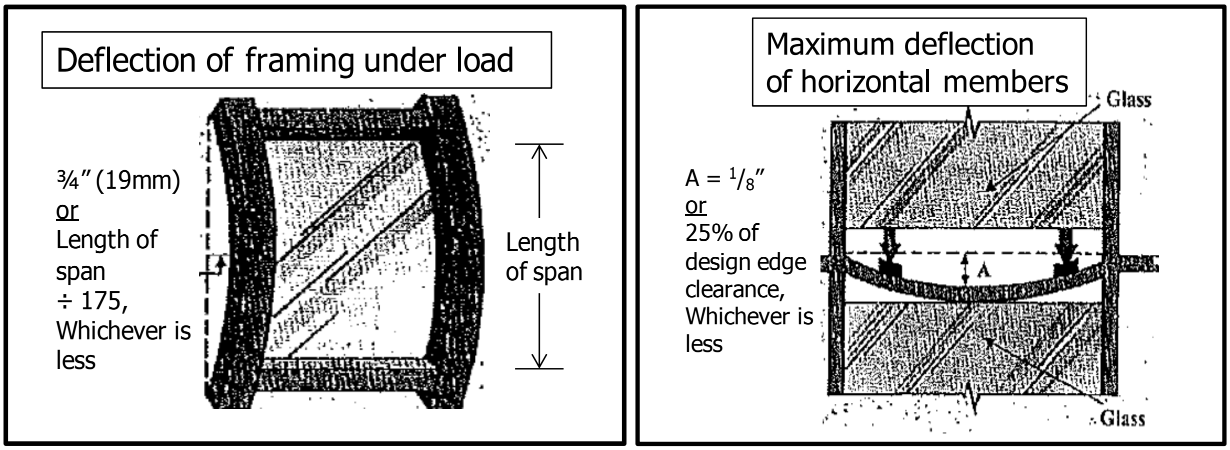
Framing system design

The framing system must structurally support the glass under static and dynamic loads and provide openings within specified limits for squareness and corner offset

- Square: Maximum of $^1/_8$" (3mm) difference in the lengths of the diagonals
- Corner offset: Maximum offset of adjoining members is $^1/_{32}$" (0.8mm) at each corner

There are a number of other design rules that should be followed in construction of the framing system. Firstly, the deflection of glass framing members under design loads must not exceed either ¾" (19 mm) or the length of the span divided by 175.

It is important to limit the deflection of horizontal members due to the weight of the glass, in order to minimize bite variations and thermal stress at the glass edge. For heat-absorbing and reflective glasses, a limit of the lesser of either 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 less than 1° between ends and center to minimize mechanical bending stresses at the glass edge.



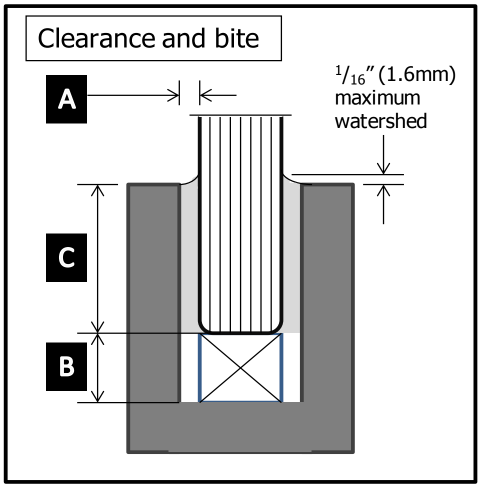
Deflection of glass framing members

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 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.

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 figure and table below.

Proper face clearance should be provided by a continuous cushioning material with Shore A durometer hardness of 65 ± 5, 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, 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.



Face clearance (A), edge clearance (B) and bite (C) in a glazing system

Annealed monolithic glass (clear, tinted and coated)							
Glass thickness		Minimum clearance				Bite	
		A = Face		B = Edge		C	
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				
5/32	4						
3/16	5			3/16	5	5/16	8
1/4	6			1/4	6	3/8	10
5/16	8	3/16	5	5/16	8	7/16	11
3/8	10						
1/2	12	1/4	6	3/8	10		
5/8	16					1/2	13
3/4	19			1/2	13	5/8	16
7/8	22					3/4	19

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

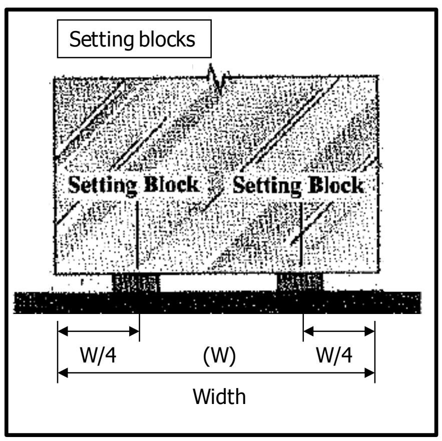
Minimum clearances and bite for annealed monolithic glass

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 ± 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.

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 shows nominal bite recommendations for annealed monolithic glass, which should be carefully adhered to in designing details and glazing systems. Finally, 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.

Setting blocks

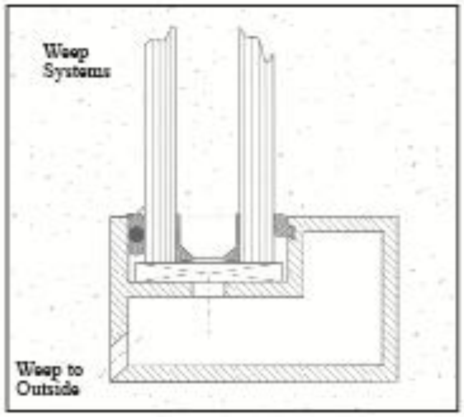
Each lite of glass should be set on two setting blocks centered approximately at the bottom edge quarter points. When this is impractical, the end of the setting block can be moved within either 6″ (152mm) or 1/8 the width of the glass from the vertical edge, whichever distance is greater. Blocks should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



Setting blocks

Weep systems – Monolithic and insulating glass

The glazing system must be designed so that water entering the glazing channel will weep out. To achieve this, 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.

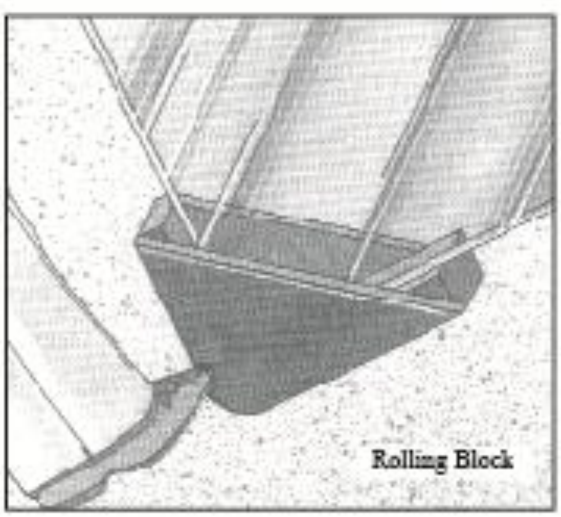


Design of a weep system

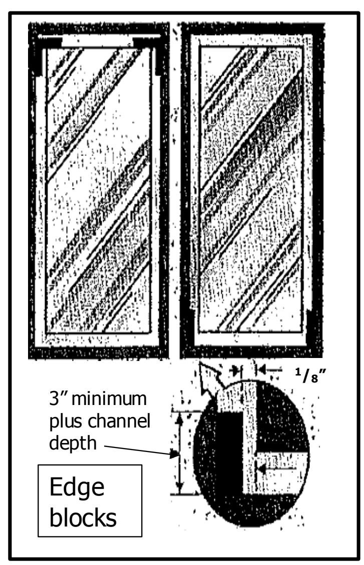
Edge damage

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 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.



Rolling block to prevent edge damage



Edge blocks

Edge blocks

Glass should be centered in the opening of the glazing system vertically and horizontally. For glass in dry glazing systems, edge blocks should be used in each vertical jamb to prevent lateral "walking" as glass movement can lead to glass-to-metal contact and breakage. The preferred edge block material is Shore A 65 ± 5 durometer hardness neoprene. 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

Edge seal pressure

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

Glazing materials

Any materials used within the glazing system must be compatible with all its components and the sealants which they may be in contact with. Glazing materials must be resilient, non-hardening, non-bleeding compounds, tape or elastomeric gaskets and all materials should be approved by the insulating glass manufacturer before they are applied. When a heel or toe bead is necessary, compatibility between this material and the insulating unit sealants are required. Furthermore, glazing compounds must not be thinned with chlorinated solvents (dry cleaning fluids) or benzene-related compounds such as toluene. When selecting blocking materials, it is important that they are compatible with seals and any coatings on the glass. For example, no materials containing sulfur should be used in combination with sensitive sputter coatings and when using a photocatalytic coating such as Pilkington **Activ**™, no silicone oil can be used.

Similar comments apply when designing structural silicone glazing systems, as it is important to 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. Always contact the relevant manufacturer to ensure compatibility of materials. The sealant manufacturer should be consulted for information concerning the compatibility of glass and silicon. 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 their responsibility in ensuring the compatibility of materials used in insulating glass units. Incorrectly designed or applied sealants or use of incompatible materials can lead to premature failure of the insulating glass units.

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. 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 lites 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 recommended to prevent staining.

Another cause of surface damage is sparks from welding and so glass near welding operations should be protected. Also, wind-blown objects and roof gravel can be blown into glass, 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.

For additional information on this topic, 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 glass
ATS 181, Washing Pilkington **Eclipse Advantage**™ reflective low-e glass
ATS 176, Handling, Inspecting, Fabricating & Glazing Pilkington **Eclipse Advantage**™ reflective low-e glass

Damage to coated glass surfaces

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.

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